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(54) Title: AMINE-SUBSTITUTED HETEROCYCLIC COMPOUNDS AS EHMT2 INHIBITORS AND DERIVATIVES THEREOF

(57) Abstract: The present disclosure relates to amine-substituted heterocyclic compounds and derivatives thereof. The present disclosure also relates to pharmaceutical compositions containing these compounds and methods of treating a disorder (e.g., cancer) by administering an amine-substituted heterocyclic heterocyclic compound disclosed herein or a pharmaceutical composition thereof to subjects in need thereof. The present disclosure also relates to the use of such compounds for research or other non-therapeutic purposes.

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## AMINE-SUBSTITUTED HETEROCYCLIC COMPOUNDS AS EHMT2 INHIBITORS AND DERIVATIVES THEREOF

### RELATED APPLICATIONS

[001] This application claims benefit of, and priority to, U.S. Application No. 62/573,442, filed on October 17, 2017, U.S. Application No. 62/681,804, filed on June 7, 2018, U.S. Application No. 62/746,252, filed on October 16, 2018, and U.S. Application No. 62/746,495, filed on October 16, 2018, the entire contents of each of which are incorporated herein by reference.

### BACKGROUND

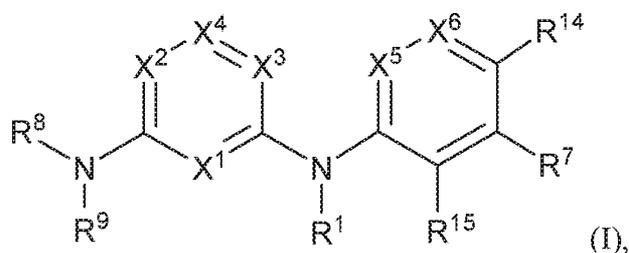
[002] Methylation of protein lysine residues is an important signaling mechanism in eukaryotic cells, and the methylation state of histone lysines encodes signals that are recognized by a multitude of proteins and protein complexes in the context of epigenetic gene regulation.

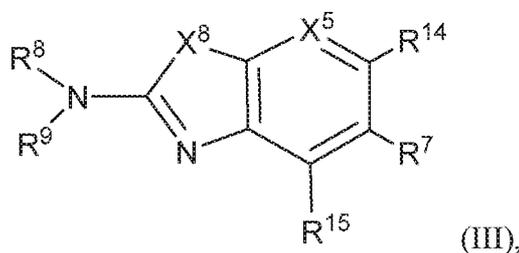
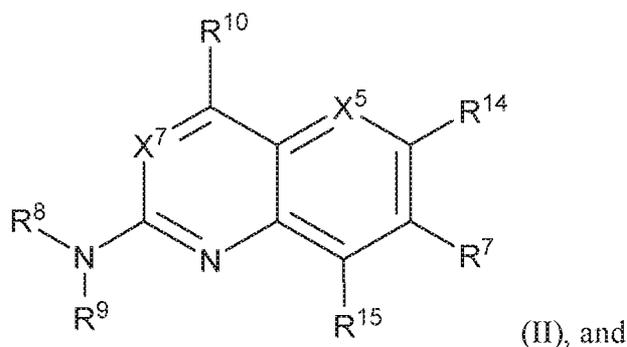
[003] Histone methylation is catalyzed by histone methyltransferases (HMTs), and HMTs have been implicated in various human diseases. HMTs can play a role in either activating or repressing gene expression, and certain HMTs (*e.g.*, euchromatic histone-lysine N-methyltransferase 2 or EHMT2, also called G9a) may methylate many nonhistone proteins, such as tumor suppressor proteins (*see, e.g.*, Liu *et al.*, *Journal of Medicinal Chemistry* 56:8931-8942, 2013 and Krivega *et al.*, *Blood* 126(5):665-672, 2015).

[004] Two related HMTs, EHMT1 and EHMT2, are overexpressed or play a role in diseases and disorders such as sickle cell anemia (*see, e.g.*, Renneville *et al.*, *Blood* 126(16): 1930–1939, 2015) and proliferative disorders (*e.g.*, cancers), and other blood disorders.

### SUMMARY

[005] In one aspect, the present disclosure features, *inter alia*, compounds of any of Formulae (I), (II), and (III) below:





tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers, wherein

$X^1$  is N or  $CR^2$ ;

$X^2$  is N or  $CR^3$ ;

$X^3$  is N or  $CR^4$ ;

$X^4$  is N or  $CR^5$ ;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$X^8$  is  $NR^{13}$  or  $CR^{11}R^{12}$ ;

$R^1$  is H or  $C_1$ - $C_4$  alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano,  $C_1$ - $C_6$  alkoxy,  $C_6$ - $C_{10}$  aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,  $OC(O)NR^aR^b$ ,  $NR^aC(O)OR^b$ ,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, wherein the  $C_6$ - $C_{10}$  aryl,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkoxy,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, are each optionally substituted with one or more of halo,  $OR^a$ , or  $NR^aR^b$ , in which each of  $R^a$  and  $R^b$  independently is H or  $C_1$ - $C_6$  alkyl;

$R^6$  is  $-Q^1-T^1$ , in which  $Q^1$  is a bond, or  $C_1$ - $C_6$  alkylene,  $C_2$ - $C_6$  alkenylene, or  $C_2$ - $C_6$  alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or  $C_1$ - $C_6$  alkoxy, and  $T^1$  is H, halo, cyano, or  $R^{S1}$ , in which  $R^{S1}$  is  $C_3$ - $C_8$  cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6-

membered heteroaryl and  $R^{S1}$  is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, -C(O)R<sup>c</sup>, -C(O)OR<sup>c</sup>, -SO<sub>2</sub>R<sup>c</sup>, -SO<sub>2</sub>N(R<sup>c</sup>)<sub>2</sub>, -NR<sup>c</sup>C(O)R<sup>d</sup>, -C(O)NR<sup>c</sup>R<sup>d</sup>, -NR<sup>c</sup>C(O)OR<sup>d</sup>, -OC(O)NR<sup>c</sup>R<sup>d</sup>, NR<sup>c</sup>R<sup>d</sup>, or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of R<sup>c</sup> and R<sup>d</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>7</sup> is -Q<sup>2</sup>-T<sup>2</sup>, in which Q<sup>2</sup> is a bond, C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more -Q<sup>3</sup>-T<sup>3</sup>, wherein each Q<sup>3</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>3</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, C(O)OR<sup>f</sup>, OC(O)R<sup>f</sup>, S(O)<sub>2</sub>R<sup>f</sup>, NR<sup>f</sup>R<sup>g</sup>, OC(O)NR<sup>f</sup>R<sup>g</sup>, NR<sup>f</sup>C(O)OR<sup>g</sup>, C(O)NR<sup>f</sup>R<sup>g</sup>, and NR<sup>f</sup>C(O)R<sup>g</sup>; or -Q<sup>3</sup>-T<sup>3</sup> is oxo;

each R<sup>e</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of R<sup>f</sup> and R<sup>g</sup>, independently, is -Q<sup>6</sup>-T<sup>6</sup>, in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, halo, OR<sup>m1</sup>, NR<sup>m1</sup>R<sup>m2</sup>, NR<sup>m1</sup>C(O)R<sup>m2</sup>, C(O)NR<sup>m1</sup>R<sup>m2</sup>, C(O)R<sup>m1</sup>, C(O)OR<sup>m1</sup>, NR<sup>m1</sup>C(O)OR<sup>m2</sup>, OC(O)NR<sup>m1</sup>R<sup>m2</sup>, S(O)<sub>2</sub>R<sup>m1</sup>, S(O)<sub>2</sub>NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H, C<sub>1</sub>-C<sub>6</sub> alkyl, or (C<sub>1</sub>-C<sub>6</sub> alkyl)-R<sup>S3</sup>, and R<sup>S3</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>, wherein each Q<sup>7</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>7</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>n1</sup>, C(O)R<sup>n1</sup>, C(O)OR<sup>n1</sup>, OC(O)R<sup>n1</sup>, S(O)<sub>2</sub>R<sup>n1</sup>, NR<sup>n1</sup>R<sup>n2</sup>, OC(O)NR<sup>n1</sup>R<sup>n2</sup>,

$\text{NR}^{\text{n1}}\text{C}(\text{O})\text{OR}^{\text{n2}}$ ,  $\text{C}(\text{O})\text{NR}^{\text{n1}}\text{R}^{\text{n2}}$ , and  $\text{NR}^{\text{n1}}\text{C}(\text{O})\text{R}^{\text{n2}}$ , each of  $\text{R}^{\text{n1}}$  and  $\text{R}^{\text{n2}}$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-\text{Q}^7\text{-T}^7$  is oxo;

$\text{R}^8$  is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$\text{R}^9$  is  $-\text{Q}^4\text{-T}^4$ , in which  $\text{Q}^4$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $\text{T}^4$  is H, halo,  $\text{OR}^{\text{h}}$ ,  $\text{NR}^{\text{h}}\text{R}^{\text{i}}$ ,  $\text{NR}^{\text{h}}\text{C}(\text{O})\text{R}^{\text{i}}$ ,  $\text{C}(\text{O})\text{NR}^{\text{h}}\text{R}^{\text{i}}$ ,  $\text{C}(\text{O})\text{R}^{\text{h}}$ ,  $\text{C}(\text{O})\text{OR}^{\text{h}}$ ,  $\text{NR}^{\text{h}}\text{C}(\text{O})\text{OR}^{\text{i}}$ ,  $\text{OC}(\text{O})\text{NR}^{\text{h}}\text{R}^{\text{i}}$ ,  $\text{S}(\text{O})_2\text{R}^{\text{h}}$ ,  $\text{S}(\text{O})_2\text{NR}^{\text{h}}\text{R}^{\text{i}}$ , or  $\text{R}^{\text{S2}}$ , in which each of  $\text{R}^{\text{h}}$  and  $\text{R}^{\text{i}}$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and  $\text{R}^{\text{S2}}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $\text{R}^{\text{S2}}$  is optionally substituted with one or more  $-\text{Q}^5\text{-T}^5$ , wherein each  $\text{Q}^5$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $\text{T}^5$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $\text{OR}^{\text{j}}$ ,  $\text{C}(\text{O})\text{R}^{\text{j}}$ ,  $\text{C}(\text{O})\text{OR}^{\text{j}}$ ,  $\text{OC}(\text{O})\text{R}^{\text{j}}$ ,  $\text{S}(\text{O})_2\text{R}^{\text{j}}$ ,  $\text{NR}^{\text{j}}\text{R}^{\text{k}}$ ,  $\text{OC}(\text{O})\text{NR}^{\text{j}}\text{R}^{\text{k}}$ ,  $\text{NR}^{\text{j}}\text{C}(\text{O})\text{OR}^{\text{k}}$ ,  $\text{C}(\text{O})\text{NR}^{\text{j}}\text{R}^{\text{k}}$ , and  $\text{NR}^{\text{j}}\text{C}(\text{O})\text{R}^{\text{k}}$ , each of  $\text{R}^{\text{j}}$  and  $\text{R}^{\text{k}}$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-\text{Q}^5\text{-T}^5$  is oxo;

$\text{R}^{10}$  is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di-alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy,  $\text{C}(\text{O})\text{NR}^{\text{j}}\text{R}^{\text{k}}$ , or  $\text{NR}^{\text{j}}\text{C}(\text{O})\text{R}^{\text{k}}$ ;

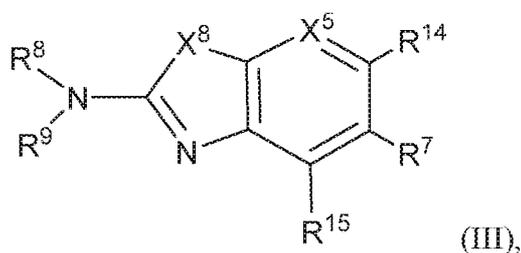
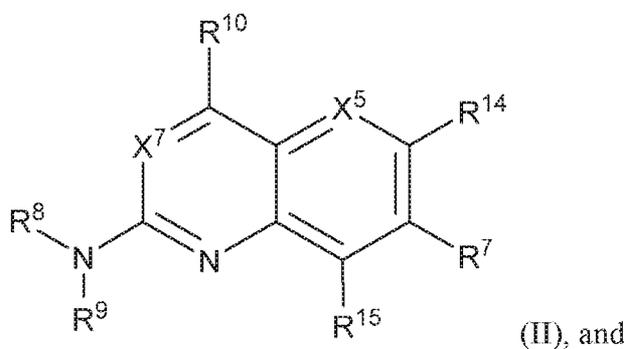
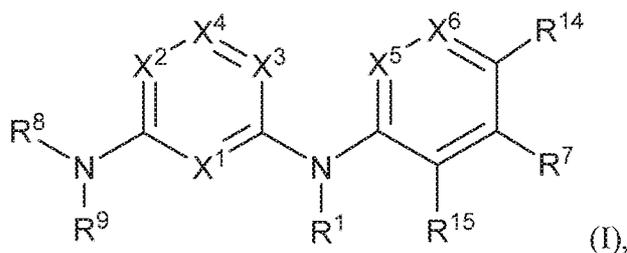
$\text{R}^{11}$  and  $\text{R}^{12}$  together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

$\text{R}^{13}$  is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S; and

each of  $\text{R}^{14}$  and  $\text{R}^{15}$ , independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo

or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

[006] In one aspect, the present disclosure features, *inter alia*, compounds of any of Formulae (I), (II), and (III) below:



tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers, wherein

X<sup>1</sup> is N or CR<sup>2</sup>;

X<sup>2</sup> is N or CR<sup>3</sup>;

X<sup>3</sup> is N or CR<sup>4</sup>;

X<sup>4</sup> is N or CR<sup>5</sup>;

each of X<sup>5</sup>, X<sup>6</sup> and X<sup>7</sup> is independently N or CH;

X<sup>8</sup> is NR<sup>13</sup> or CR<sup>11</sup>R<sup>12</sup>;

R<sup>1</sup> is H or C<sub>1</sub>-C<sub>4</sub> alkyl;

each of R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, and R<sup>5</sup>, independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>6</sub>-C<sub>10</sub> aryl, OH, NR<sup>a</sup>R<sup>b</sup>, C(O)NR<sup>a</sup>R<sup>b</sup>, NR<sup>a</sup>C(O)R<sup>b</sup>, C(O)OR<sup>a</sup>, OC(O)R<sup>a</sup>,

OC(O)NR<sup>a</sup>R<sup>b</sup>, NR<sup>a</sup>C(O)OR<sup>b</sup>, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, wherein the C<sub>6</sub>-C<sub>10</sub> aryl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, are each optionally substituted with one or more of halo, OR<sup>a</sup>, or NR<sup>a</sup>R<sup>b</sup>, in which each of R<sup>a</sup> and R<sup>b</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>6</sup> is -Q<sup>1</sup>-T<sup>1</sup>, in which Q<sup>1</sup> is a bond, or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>1</sup> is H, halo, cyano, or R<sup>S1</sup>, in which R<sup>S1</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and R<sup>S1</sup> is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, -C(O)R<sup>c</sup>, -C(O)OR<sup>c</sup>, -SO<sub>2</sub>R<sup>c</sup>, -SO<sub>2</sub>N(R<sup>c</sup>)<sub>2</sub>, -NR<sup>c</sup>C(O)R<sup>d</sup>, -C(O)NR<sup>c</sup>R<sup>d</sup>, -NR<sup>c</sup>C(O)OR<sup>d</sup>, -OC(O)NR<sup>c</sup>R<sup>d</sup>, NR<sup>c</sup>R<sup>d</sup>, or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of R<sup>c</sup> and R<sup>d</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>7</sup> is -Q<sup>2</sup>-T<sup>2</sup>, in which Q<sup>2</sup> is a bond, C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl is optionally substituted with one or more -Q<sup>3</sup>-T<sup>3</sup>, wherein each Q<sup>3</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>3</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6- membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, C(O)OR<sup>f</sup>, OC(O)R<sup>f</sup>, S(O)<sub>2</sub>R<sup>f</sup>, NR<sup>f</sup>R<sup>g</sup>, OC(O)NR<sup>f</sup>R<sup>g</sup>, NR<sup>f</sup>C(O)OR<sup>g</sup>, C(O)NR<sup>f</sup>R<sup>g</sup>, and NR<sup>f</sup>C(O)R<sup>g</sup>; or -Q<sup>3</sup>-T<sup>3</sup> is oxo;

each R<sup>e</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of R<sup>f</sup> and R<sup>g</sup>, independently, is -Q<sup>6</sup>-T<sup>6</sup>, in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, halo, OR<sup>m1</sup>, NR<sup>m1</sup>R<sup>m2</sup>, NR<sup>m1</sup>C(O)R<sup>m2</sup>, C(O)NR<sup>m1</sup>R<sup>m2</sup>, C(O)R<sup>m1</sup>, C(O)OR<sup>m1</sup>, NR<sup>m1</sup>C(O)OR<sup>m2</sup>, OC(O)NR<sup>m1</sup>R<sup>m2</sup>, S(O)<sub>2</sub>R<sup>m1</sup>, S(O)<sub>2</sub>NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S3</sup> is

C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>, wherein each Q<sup>7</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>7</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>n1</sup>, C(O)R<sup>n1</sup>, C(O)OR<sup>n1</sup>, OC(O)R<sup>n1</sup>, S(O)<sub>2</sub>R<sup>n1</sup>, NR<sup>n1</sup>R<sup>n2</sup>, OC(O)NR<sup>n1</sup>R<sup>n2</sup>, NR<sup>n1</sup>C(O)OR<sup>n2</sup>, C(O)NR<sup>n1</sup>R<sup>n2</sup>, and NR<sup>n1</sup>C(O)R<sup>n2</sup>, each of R<sup>n1</sup> and R<sup>n2</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or -Q<sup>7</sup>-T<sup>7</sup> is oxo;

R<sup>8</sup> is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>9</sup> is -Q<sup>4</sup>-T<sup>4</sup>, in which Q<sup>4</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>4</sup> is H, halo, OR<sup>h</sup>, NR<sup>h</sup>R<sup>i</sup>, NR<sup>h</sup>C(O)R<sup>i</sup>, C(O)NR<sup>h</sup>R<sup>i</sup>, C(O)R<sup>h</sup>, C(O)OR<sup>h</sup>, NR<sup>h</sup>C(O)OR<sup>i</sup>, OC(O)NR<sup>h</sup>R<sup>i</sup>, S(O)<sub>2</sub>R<sup>h</sup>, S(O)<sub>2</sub>NR<sup>h</sup>R<sup>i</sup>, or R<sup>S2</sup>, in which each of R<sup>h</sup> and R<sup>i</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S2</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S2</sup> is optionally substituted with one or more -Q<sup>5</sup>-T<sup>5</sup>, wherein each Q<sup>5</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>5</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>j</sup>, C(O)R<sup>j</sup>, C(O)OR<sup>j</sup>, OC(O)R<sup>j</sup>, S(O)<sub>2</sub>R<sup>j</sup>, NR<sup>j</sup>R<sup>k</sup>, OC(O)NR<sup>j</sup>R<sup>k</sup>, NR<sup>j</sup>C(O)OR<sup>k</sup>, C(O)NR<sup>j</sup>R<sup>k</sup>, and NR<sup>j</sup>C(O)R<sup>k</sup>, each of R<sup>j</sup> and R<sup>k</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or -Q<sup>5</sup>-T<sup>5</sup> is oxo;

R<sup>10</sup> is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di- alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C(O)NR<sup>j</sup>R<sup>k</sup>, or NR<sup>j</sup>C(O)R<sup>k</sup>;

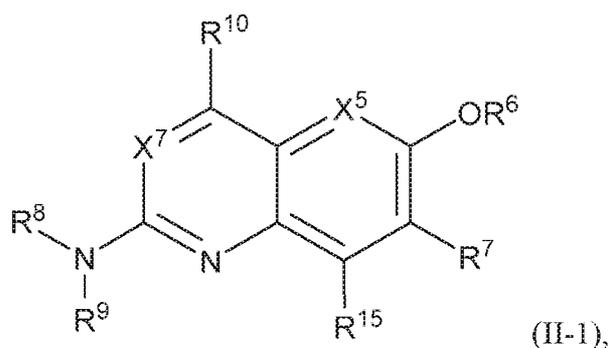
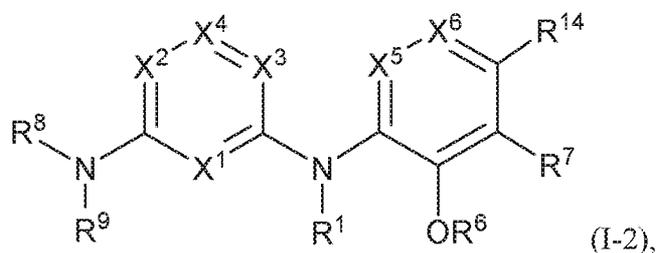
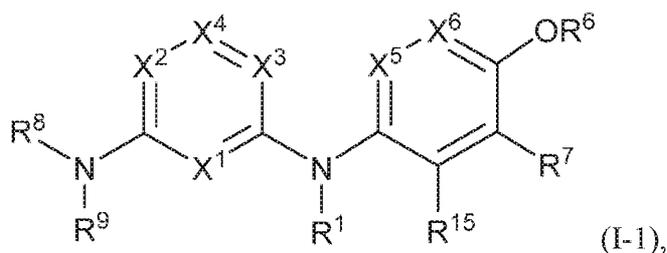
R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N,

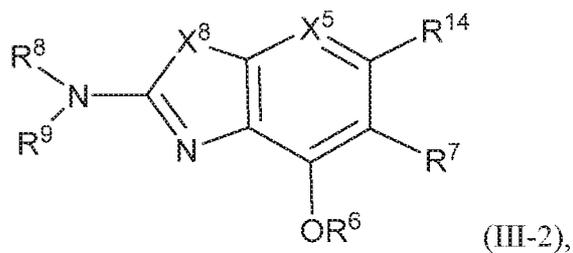
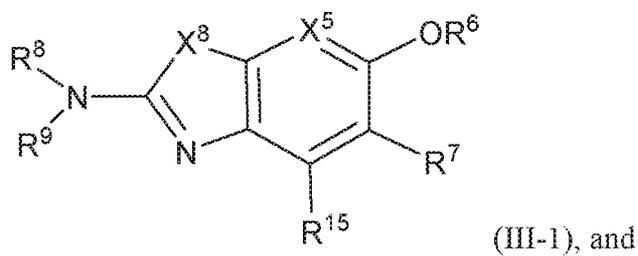
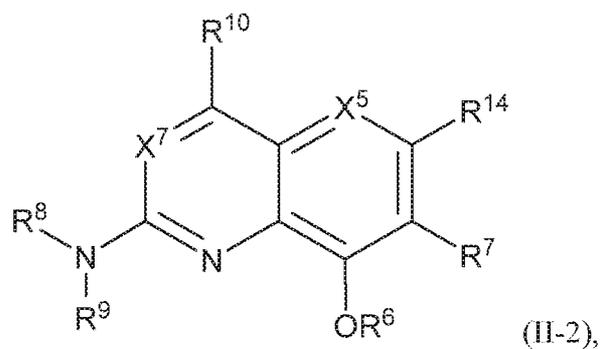
O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

R<sup>13</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S; and

each of R<sup>14</sup> and R<sup>15</sup>, independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

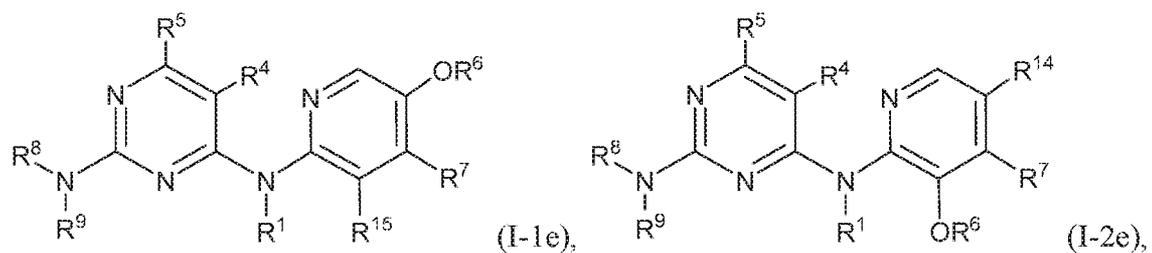
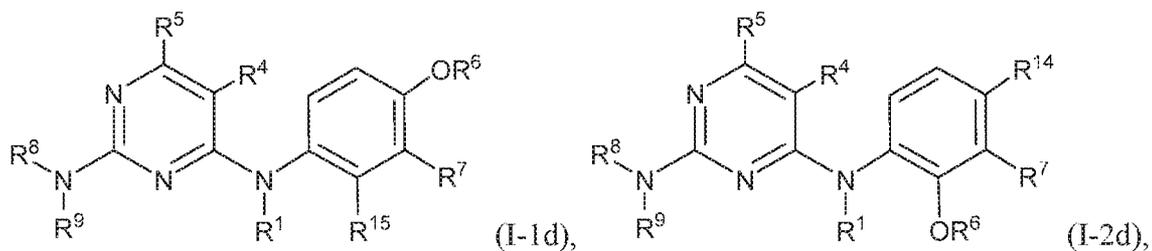
[007] Subsets of the compounds of Formulae (I)-(III) include those of Formulae (I-1), (I-2), (II-1), (II-2), (III-1), and (III-2):

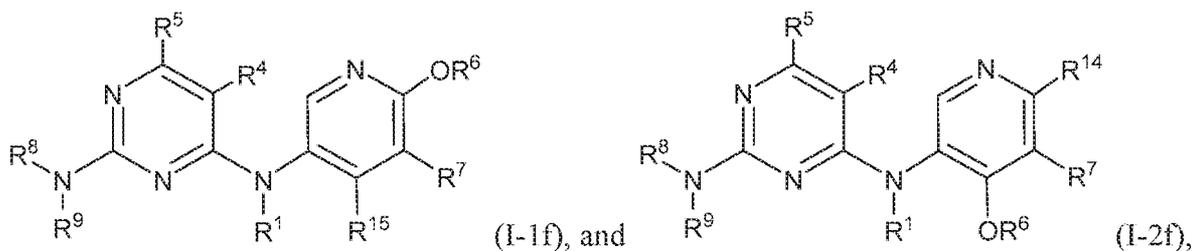




tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

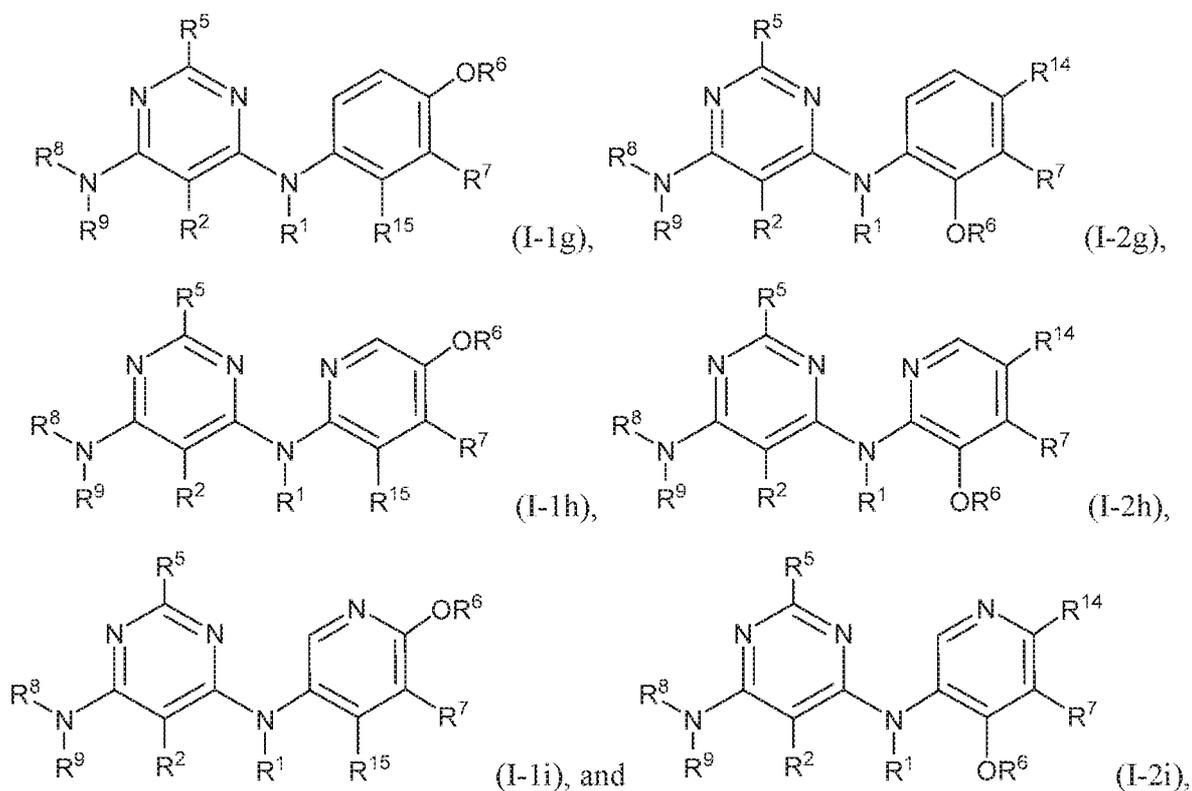
[008] Subsets of the compounds of Formulae (I-1) and (I-2) include those of Formulae (I-1d), (I-2d), (I-1e), (I-2e), (I-1f), and (I-2f):





tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[009] Subsets of the compounds of Formulae (I-1) and (I-2) include those of Formulae (I-1g), (I-2g), (I-1h), (I-2h), (I-1i), and (I-2i):



tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[010] In some embodiments, one or more of the compounds of the present disclosure are inhibitors of one or more HMTs (*e.g.*, EHMT1 and/or EHMT2). In some embodiments, one or more of the compounds are inhibitors of one or more HMTs (*e.g.*, EHMT1 and/or EHMT2) with an enzyme inhibition  $IC_{50}$  value of about 1  $\mu$ M or less, about 500 nM or less, about 200 nM or less, about 100 nM or less, or about 50 nM or less.

[011] In some embodiments, one or more of the compounds of the present disclosure inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of about 100 nM or greater, 1  $\mu$ M or greater, 10  $\mu$ M or greater, 100  $\mu$ M or greater, or 1000  $\mu$ M or greater.

[012] In some embodiments, one or more of the compounds of the present disclosure inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of about 1 mM or greater.

[013] In some embodiments, one or more of the compounds of the present disclosure inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of 1  $\mu$ M or greater, 2  $\mu$ M or greater, 5  $\mu$ M or greater, or 10  $\mu$ M or greater, wherein the kinase is one or more of the following: Abl, AurA, CHK1, MAP4K, IRAK4, JAK3, EphA2, FGFR3, KDR, Lck, MARK1, MNK2, PKC $\beta$ 2, SIK, and Src.

[014] Also provided herein are pharmaceutical compositions comprising one or more pharmaceutically acceptable carriers and one or more of the compounds of the present disclosure.

[015] Another aspect of the present disclosure features a method of inhibiting one or more HMTs (e.g., EHMT1 and/or EHMT2). The method includes administering to a subject in need thereof a therapeutically effective amount of a compound of the present disclosure, or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer. In some embodiments, the subject has one or more disorders associated with the activity of one or more HMTs (e.g., EHMT1 and/or EHMT2), thereby benefiting from the inhibition of one or more HMTs (e.g., EHMT1 and/or EHMT2). In some embodiments, the subject has an EHMT-mediated disorder. In some embodiments, the subject has a disease, disorder, or condition that is mediated at least in part by the activity of one or both of EHMT1 and EHMT2.

[016] Another aspect of the present disclosure features a method of preventing or treating an EHMT-mediated disorder. The method includes administering to a subject in need thereof a therapeutically effective amount of a compound of the present disclosure, or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer. The EHMT-mediated disorder is a disease, disorder, or condition that is mediated at least in part by the activity of EHMT1 or EHMT2 or both. In some embodiments, the EHMT-mediated disorder is a blood disease or disorder. In some embodiments, the EHMT-mediated disorder is selected from proliferative disorders (e.g., cancers such as leukemia, hepatocellular carcinoma, prostate carcinoma, and lung cancer), addiction (e.g., cocaine addiction), and mental retardation.

[017] Unless otherwise stated, any description of a method of treatment includes use of the compounds to provide such treatment or prophylaxis as is described herein, as well as use of the compounds to prepare a medicament to treat or prevent such condition. The treatment includes treatment of human or non-human animals including rodents and other disease models. Methods described herein may be used to identify suitable candidates for treating or preventing EHMT-

mediated disorders. For example, the disclosure also provides methods of identifying an inhibitor of EHMT1 or EHMT2 or both.

[018] In some embodiments, the EHMT-mediated disease or disorder comprises a disorder that is associated with gene silencing by one or more HMTs (e.g., EHMT1 and/or EHMT2). In some embodiments, EHMT-mediated disease or disorder is a blood disease or disorder associated with gene silencing by EHMT2.

[019] In some embodiments, the method comprises the step of administering to a subject having a disease or disorder associated with gene silencing by one or more HMTs (e.g., EHMT1 and/or EHMT2) a therapeutically effective amount of one or more compounds of the present disclosure, wherein the compound(s) inhibits histone methyltransferase activity of one or more HMTs (e.g., EHMT1 and/or EHMT2), thereby treating the disease or disorder.

[020] In some embodiments, the blood disease or disorder is selected from the group consisting of sickle cell anemia and beta-thalassemia.

[021] In some embodiments, the blood disease or disorder is hematological cancer.

[022] In some embodiments, the hematological cancer is acute myeloid leukemia (AML) or chronic lymphocytic leukemia (CLL).

[023] In some embodiments, the method further comprises the steps of performing an assay to detect the degree of histone methylation by one or more HMTs (e.g., EHMT1 and/or EHMT2) in a sample comprising blood cells from a subject in need thereof.

[024] In some embodiments, performing the assay to detect methylation of H3-K9 in the histone substrate comprises measuring incorporation of labeled methyl groups.

[025] In some embodiments, the labeled methyl groups are isotopically labeled methyl groups.

[026] In some embodiments, performing the assay to detect methylation of H3-K9 in the histone substrate comprises contacting the histone substrate with an antibody that binds specifically to dimethylated H3-K9.

[027] Still another aspect of the present disclosure features a method of inhibiting conversion of H3-K9 to dimethylated H3-K9. The method comprises the step of contacting a mutant EHMT, the wild-type EHMT, or both, with a histone substrate comprising H3-K9 and an effective amount of a compound of the present disclosure, wherein the compound inhibits histone methyltransferase activity of EHMT, thereby inhibiting conversion of H3-K9 to dimethylated H3-K9.

[028] In yet another aspect, the present disclosure features compounds disclosed herein for use in inhibiting one or both of EHMT1 and EHMT2 in a subject in need thereof.

[029] In yet another aspect, the present disclosure features compounds disclosed herein for use in preventing or treating an EHMT-mediated disorder in a subject in need thereof.

[030] In yet another aspect, the present disclosure features compounds disclosed herein for use in preventing or treating a blood disorder in a subject in need thereof.

[031] In yet another aspect, the present disclosure features compounds disclosed herein for use in preventing or treating a cancer in a subject in need thereof.

[032] In yet another aspect, the present disclosure features use of a compound of the present disclosure in the manufacture of a medicament for inhibiting one or both of EHMT1 and EHMT2 in a subject in need thereof.

[033] In yet another aspect, the present disclosure features use of a compound of the present disclosure in the manufacture of a medicament for preventing or treating an EHMT-mediated disorder in a subject in need thereof.

[034] In yet another aspect, the present disclosure features use of a compound of the present disclosure in the manufacture of a medicament for preventing or treating a blood disorder in a subject in need thereof.

[035] In yet another aspect, the present disclosure features use of a compound of the present disclosure in the manufacture of a medicament for preventing or treating a cancer in a subject in need thereof.

[036] Further, the compounds or methods described herein can be used for research (e.g., studying epigenetic enzymes) and other non-therapeutic purposes.

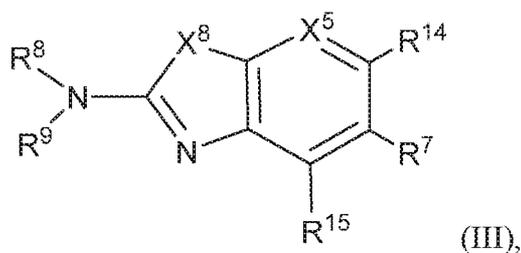
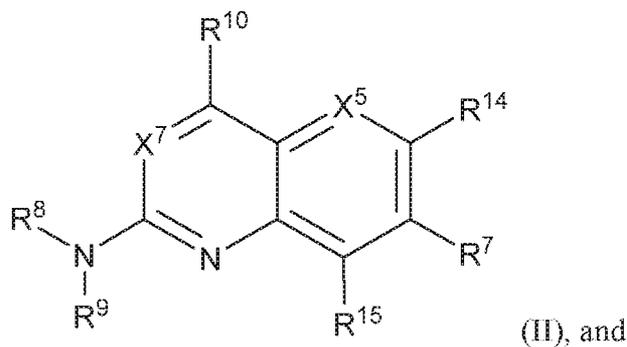
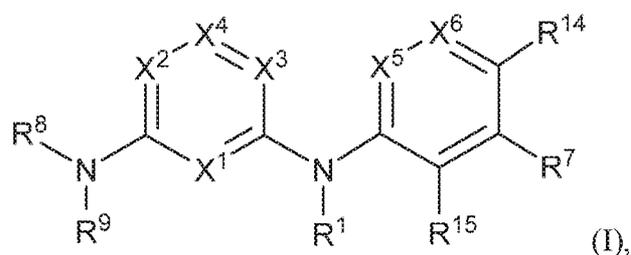
[037] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. In the specification, the singular forms also include the plural unless the context clearly dictates otherwise. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present disclosure, suitable methods and materials are described below. All publications, patent applications, patents and other references mentioned herein are incorporated by reference. The references cited herein are not admitted to be prior art to the claimed invention. In the case of conflict, the present specification, including definitions, will control. In addition, the materials, methods and examples are illustrative only and are not intended to be limiting. In the case of conflict between the chemical structures and names of the compounds disclosed herein, the chemical structures will control.

[038] Other features and advantages of the disclosure will be apparent from the following detailed description and claims.

#### DETAILED DESCRIPTION

[039] The present disclosure provides novel amine-substituted heterocyclic compounds, synthetic methods for making the compounds, pharmaceutical compositions containing them and various uses of the compounds.

[040] In one aspect, the present disclosure features, *inter alia*, compounds of any of Formulae (I), (II), and (III) below:



tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers, wherein

$X^1$  is N or CR<sup>2</sup>;

$X^2$  is N or CR<sup>3</sup>;

$X^3$  is N or CR<sup>4</sup>;

$X^4$  is N or CR<sup>5</sup>;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$X^8$  is  $NR^{13}$  or  $CR^{11}R^{12}$ ;

$R^1$  is H or C<sub>1</sub>-C<sub>4</sub> alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>6</sub>-C<sub>10</sub> aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,  $OC(O)NR^aR^b$ ,  $NR^aC(O)OR^b$ , C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, wherein the C<sub>6</sub>-C<sub>10</sub> aryl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, are each optionally substituted with one or more of halo,  $OR^a$ , or  $NR^aR^b$ , in which each of  $R^a$  and  $R^b$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^6$  is  $-Q^1-T^1$ , in which  $Q^1$  is a bond, or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^1$  is H, halo, cyano, or  $R^{S1}$ , in which  $R^{S1}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and  $R^{S1}$  is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo,  $-C(O)R^c$ ,  $-C(O)OR^c$ ,  $-SO_2R^c$ ,  $-SO_2N(R^c)_2$ ,  $-NR^cC(O)R^d$ ,  $-C(O)NR^cR^d$ ,  $-NR^cC(O)OR^d$ ,  $-OC(O)NR^cR^d$ ,  $NR^cR^d$ , or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of  $R^c$  and  $R^d$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^7$  is  $-Q^2-T^2$ , in which  $Q^2$  is a bond, C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and  $T^2$  is H, halo, cyano,  $OR^e$ ,  $OR^f$ ,  $C(O)R^f$ ,  $NR^eR^f$ ,  $C(O)NR^eR^f$ ,  $NR^eC(O)R^f$ , C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl is optionally substituted with one or more  $-Q^3-T^3$ , wherein each  $Q^3$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^3$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^e$ ,  $OR^f$ ,  $C(O)R^f$ ,  $C(O)OR^f$ ,  $OC(O)R^f$ ,  $S(O)_2R^f$ ,  $NR^fR^g$ ,  $OC(O)NR^fR^g$ ,  $NR^fC(O)OR^g$ ,  $C(O)NR^fR^g$ , and  $NR^fC(O)R^g$ ; or  $-Q^3-T^3$  is oxo;

each  $R^e$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of  $R^f$  and  $R^g$ , independently, is  $-Q^6-T^6$ , in which  $Q^6$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^6$  is H, halo,  $OR^{m1}$ ,  $NR^{m1}R^{m2}$ ,  $NR^{m1}C(O)R^{m2}$ ,  $C(O)NR^{m1}R^{m2}$ ,  $C(O)R^{m1}$ ,  $C(O)OR^{m1}$ ,  $NR^{m1}C(O)OR^{m2}$ ,  $OC(O)NR^{m1}R^{m2}$ ,  $S(O)_2R^{m1}$ ,  $S(O)_2NR^{m1}R^{m2}$ , or  $R^{S3}$ , in which each of  $R^{m1}$  and  $R^{m2}$  independently is H, C<sub>1</sub>-C<sub>6</sub> alkyl, or (C<sub>1</sub>-C<sub>6</sub> alkyl)- $R^{S3}$ , and  $R^{S3}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $R^{S3}$  is optionally substituted with one or more  $-Q^7-T^7$ , wherein each  $Q^7$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^7$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^{n1}$ ,  $C(O)R^{n1}$ ,  $C(O)OR^{n1}$ ,  $OC(O)R^{n1}$ ,  $S(O)_2R^{n1}$ ,  $NR^{n1}R^{n2}$ ,  $OC(O)NR^{n1}R^{n2}$ ,  $NR^{n1}C(O)OR^{n2}$ ,  $C(O)NR^{n1}R^{n2}$ , and  $NR^{n1}C(O)R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^7-T^7$  is oxo;

$R^8$  is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^9$  is  $-Q^4-T^4$ , in which  $Q^4$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^4$  is H, halo,  $OR^h$ ,  $NR^hR^i$ ,  $NR^hC(O)R^i$ ,  $C(O)NR^hR^i$ ,  $C(O)R^h$ ,  $C(O)OR^h$ ,  $NR^hC(O)OR^i$ ,  $OC(O)NR^hR^i$ ,  $S(O)_2R^h$ ,  $S(O)_2NR^hR^i$ , or  $R^{S2}$ , in which each of  $R^h$  and  $R^i$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and  $R^{S2}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $R^{S2}$  is optionally substituted with one or more  $-Q^5-T^5$ , wherein each  $Q^5$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^5$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^j$ ,  $C(O)R^j$ ,  $C(O)OR^j$ ,  $OC(O)R^j$ ,  $S(O)_2R^j$ ,  $NR^jR^k$ ,  $OC(O)NR^jR^k$ ,  $NR^jC(O)OR^k$ ,  $C(O)NR^jR^k$ , and  $NR^jC(O)R^k$ , each of  $R^j$  and  $R^k$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^5-T^5$  is oxo;

$R^{10}$  is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each

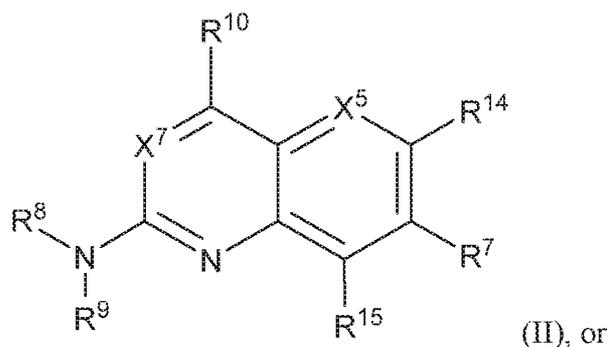
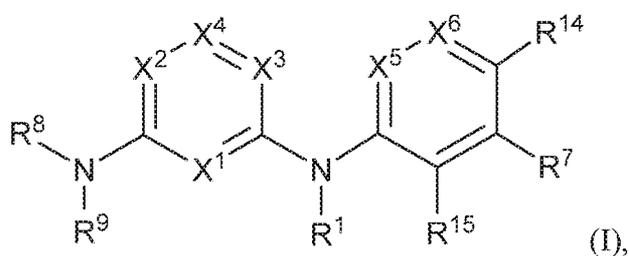
of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di- alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C(O)NR<sup>j</sup>R<sup>k</sup>, or NR<sup>j</sup>C(O)R<sup>k</sup>;

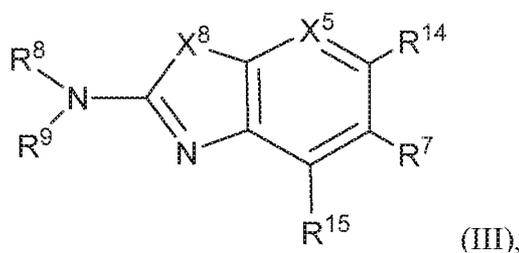
R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

R<sup>13</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S; and

each of R<sup>14</sup> and R<sup>15</sup>, independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

[041] In one aspect, the present disclosure provides compounds of any of Formulae (I), (II), and (III):





tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers, wherein

$X^1$  is N or  $CR^2$ ;

$X^2$  is N or  $CR^3$ ;

$X^3$  is N or  $CR^4$ ;

$X^4$  is N or  $CR^5$ ;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$X^8$  is  $NR^{13}$  or  $CR^{11}R^{12}$ ;

$R^1$  is H or  $C_1$ - $C_4$  alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano,  $C_1$ - $C_6$  alkoxy,  $C_6$ - $C_{10}$  aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,  $OC(O)NR^aR^b$ ,  $NR^aC(O)OR^b$ ,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, wherein the  $C_6$ - $C_{10}$  aryl,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkoxy,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, are each optionally substituted with one or more of halo,  $OR^a$ , or  $NR^aR^b$ , in which each of  $R^a$  and  $R^b$  independently is H or  $C_1$ - $C_6$  alkyl;

$R^6$  is  $-Q^1-T^1$ , in which  $Q^1$  is a bond, or  $C_1$ - $C_6$  alkylene,  $C_2$ - $C_6$  alkenylene, or  $C_2$ - $C_6$  alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or  $C_1$ - $C_6$  alkoxy, and  $T^1$  is H, halo, cyano, or  $R^{S1}$ , in which  $R^{S1}$  is  $C_3$ - $C_8$  cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and  $R^{S1}$  is optionally substituted with one or more of halo,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl,  $C_2$ - $C_6$  alkynyl, hydroxyl, oxo,  $-C(O)R^c$ ,  $-C(O)OR^c$ ,  $-SO_2R^c$ ,  $-SO_2N(R^c)_2$ ,  $-NR^cC(O)R^d$ ,  $-C(O)NR^cR^d$ ,  $-NR^cC(O)OR^d$ ,  $-OC(O)NR^cR^d$ ,  $NR^cR^d$ , or  $C_1$ - $C_6$  alkoxy, in which each of  $R^c$  and  $R^d$  independently is H or  $C_1$ - $C_6$  alkyl;

$R^7$  is  $-Q^2-T^2$ , in which  $Q^2$  is a bond,  $C_1$ - $C_6$  alkylene,  $C_2$ - $C_6$  alkenylene, or  $C_2$ - $C_6$  alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and  $T^2$  is H, halo, cyano,  $OR^e$ ,  $OR^f$ ,  $C(O)R^f$ ,  $NR^eR^f$ ,  $C(O)NR^eR^f$ ,  $NR^eC(O)R^f$ ,  $C_6$ - $C_{10}$

aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more  $-Q^3-T^3$ , wherein each Q<sup>3</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>3</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, C(O)OR<sup>f</sup>, OC(O)R<sup>f</sup>, S(O)<sub>2</sub>R<sup>f</sup>, NR<sup>f</sup>R<sup>g</sup>, OC(O)NR<sup>f</sup>R<sup>g</sup>, NR<sup>f</sup>C(O)OR<sup>g</sup>, C(O)NR<sup>f</sup>R<sup>g</sup>, and NR<sup>f</sup>C(O)R<sup>g</sup>; or  $-Q^3-T^3$  is oxo;

each R<sup>e</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of R<sup>f</sup> and R<sup>g</sup>, independently, is  $-Q^6-T^6$ , in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, halo, OR<sup>m1</sup>, NR<sup>m1</sup>R<sup>m2</sup>, NR<sup>m1</sup>C(O)R<sup>m2</sup>, C(O)NR<sup>m1</sup>R<sup>m2</sup>, C(O)R<sup>m1</sup>, C(O)OR<sup>m1</sup>, NR<sup>m1</sup>C(O)OR<sup>m2</sup>, OC(O)NR<sup>m1</sup>R<sup>m2</sup>, S(O)<sub>2</sub>R<sup>m1</sup>, S(O)<sub>2</sub>NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S3</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more  $-Q^7-T^7$ , wherein each Q<sup>7</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>7</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>n1</sup>, C(O)R<sup>n1</sup>, C(O)OR<sup>n1</sup>, OC(O)R<sup>n1</sup>, S(O)<sub>2</sub>R<sup>n1</sup>, NR<sup>n1</sup>R<sup>n2</sup>, OC(O)NR<sup>n1</sup>R<sup>n2</sup>, NR<sup>n1</sup>C(O)OR<sup>n2</sup>, C(O)NR<sup>n1</sup>R<sup>n2</sup>, and NR<sup>n1</sup>C(O)R<sup>n2</sup>, each of R<sup>n1</sup> and R<sup>n2</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^7-T^7$  is oxo;

R<sup>8</sup> is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>9</sup> is  $-Q^4-T^4$ , in which Q<sup>4</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>4</sup> is H, halo, OR<sup>h</sup>, NR<sup>h</sup>R<sup>i</sup>, NR<sup>h</sup>C(O)R<sup>i</sup>, C(O)NR<sup>h</sup>R<sup>i</sup>, C(O)R<sup>h</sup>, C(O)OR<sup>h</sup>, NR<sup>h</sup>C(O)OR<sup>i</sup>, OC(O)NR<sup>h</sup>R<sup>i</sup>, S(O)<sub>2</sub>R<sup>h</sup>, S(O)<sub>2</sub>NR<sup>h</sup>R<sup>i</sup>, or R<sup>S2</sup>, in which each of R<sup>h</sup> and R<sup>i</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S2</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered

heteroaryl, and  $R^{S2}$  is optionally substituted with one or more  $-Q^5-T^5$ , wherein each  $Q^5$  independently is a bond or  $C_1-C_3$  alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and each  $T^5$  independently is selected from the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_8$  cycloalkyl,  $C_6-C_{10}$  aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^j$ ,  $C(O)R^j$ ,  $C(O)OR^j$ ,  $OC(O)R^j$ ,  $S(O)_2R^j$ ,  $NR^jR^k$ ,  $OC(O)NR^jR^k$ ,  $NR^jC(O)OR^k$ ,  $C(O)NR^jR^k$ , and  $NR^jC(O)R^k$ , each of  $R^j$  and  $R^k$  independently being H or  $C_1-C_6$  alkyl; or  $-Q^5-T^5$  is oxo;

$R^{10}$  is halo,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_8$  cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each of the  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_8$  cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di-alkylamino,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_1-C_6$  alkoxy,  $C(O)NR^jR^k$ , or  $NR^jC(O)R^k$ ;

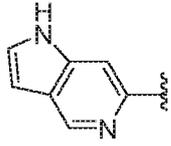
$R^{11}$  and  $R^{12}$  together with the carbon atom to which they are attached form a  $C_3-C_{12}$  cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the  $C_3-C_{12}$  cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl, hydroxyl, oxo, amino, mono- or di-alkylamino, or  $C_1-C_6$  alkoxy;

$R^{13}$  is H,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_{12}$  cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S; and

each of  $R^{14}$  and  $R^{15}$ , independently, is H, halo, cyano,  $C_1-C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2-C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2-C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3-C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

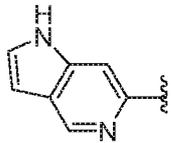
[042] In some embodiments, the compounds are of Formula (I) and tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[043] In some embodiments, when  $X^1$  is N,  $X^2$  is CH,  $X^3$  is N,  $X^4$  is  $CCH_3$ ,  $X^5$  is CH,  $X^6$  is CH,

$R^1$  is H,  $R^7$  is , one of  $R^8$  and  $R^9$  is H and the other one is  $CH_3$ , and  $R^{14}$  is  $OCH_3$ , then

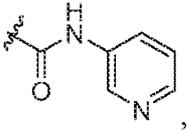
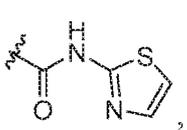
$R^{15}$  is H, halo, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

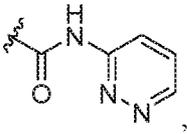
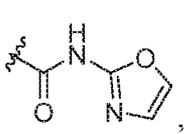
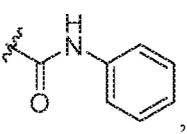
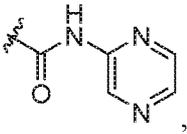
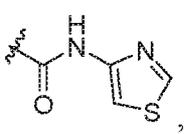
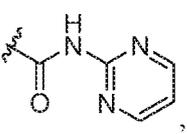
[044] In some embodiments, when  $X^1$  is N,  $X^2$  is CH,  $X^3$  is N,  $X^4$  is  $CCH_3$ ,  $X^5$  is CH,  $X^6$  is CH,

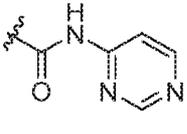
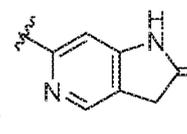
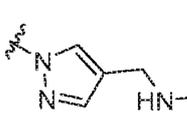
$R^1$  is H,  $R^7$  is , one of  $R^8$  and  $R^9$  is H and the other one is  $CH_3$ , and  $R^{14}$  is  $OCH_3$ , then

$R^{15}$  is H, Cl, Br, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

[045] In some embodiments, wherein when  $X^1$  is N,  $X^2$  is CH,  $X^3$  is N,  $X^4$  is  $CCH_3$ ,  $X^5$  is CH,

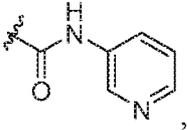
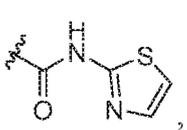
$X^6$  is CH,  $R^1$  is H,  $R^7$  is selected from the group consisting of , ,

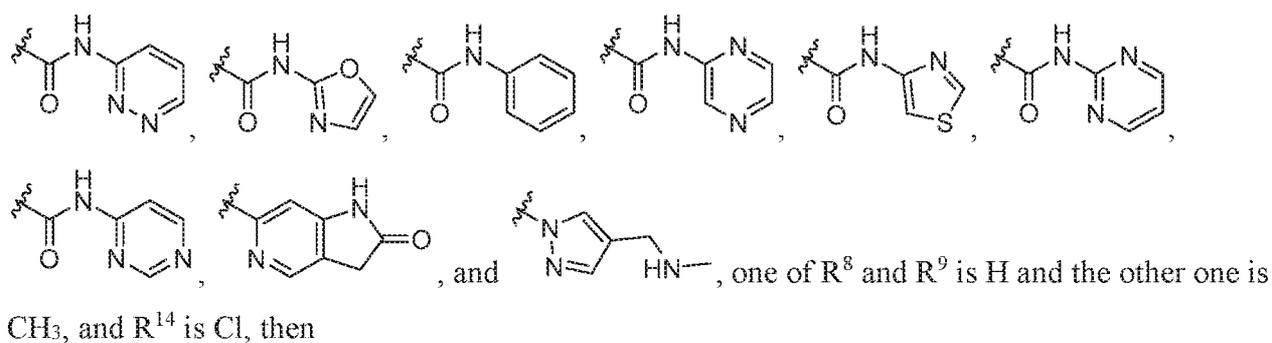
, , , , , ,

, , and , one of  $R^8$  and  $R^9$  is H and the other one is  $CH_3$ , and  $R^{14}$  is Cl, then

$R^{15}$  is H, halo, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

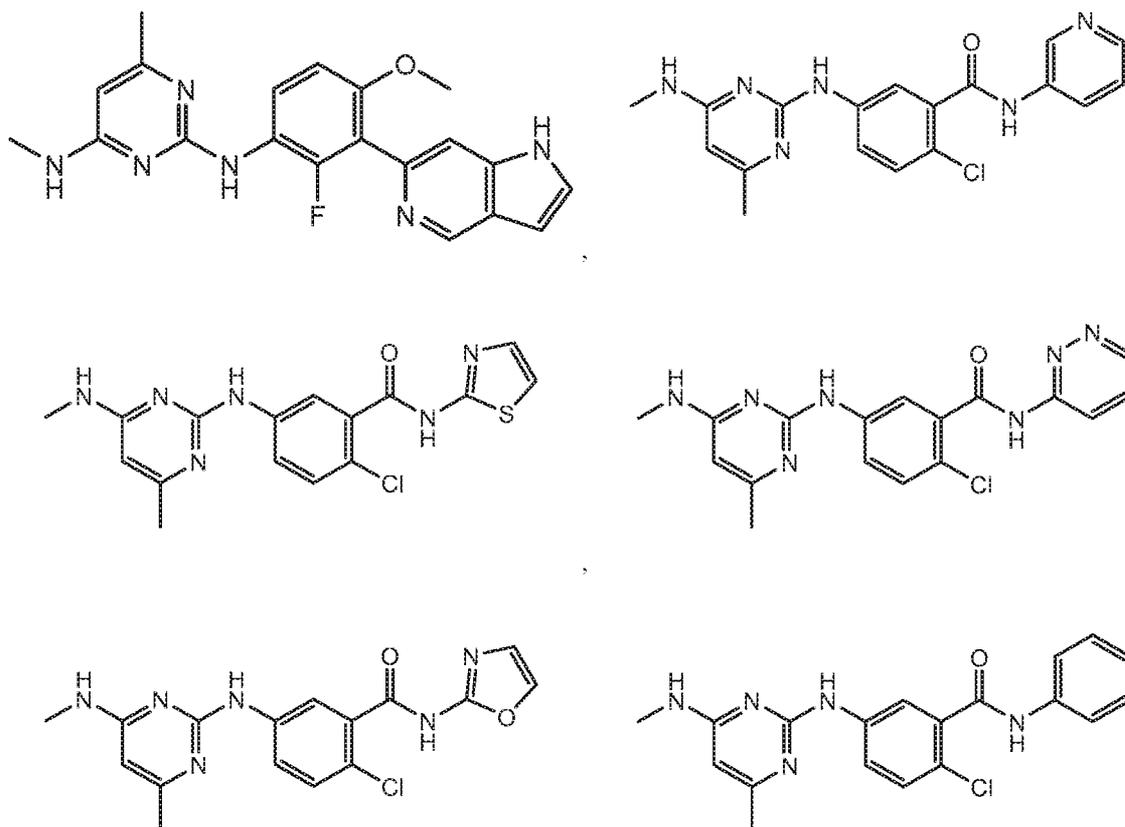
[046] In some embodiments, wherein when  $X^1$  is N,  $X^2$  is CH,  $X^3$  is N,  $X^4$  is  $CCH_3$ ,  $X^5$  is CH,

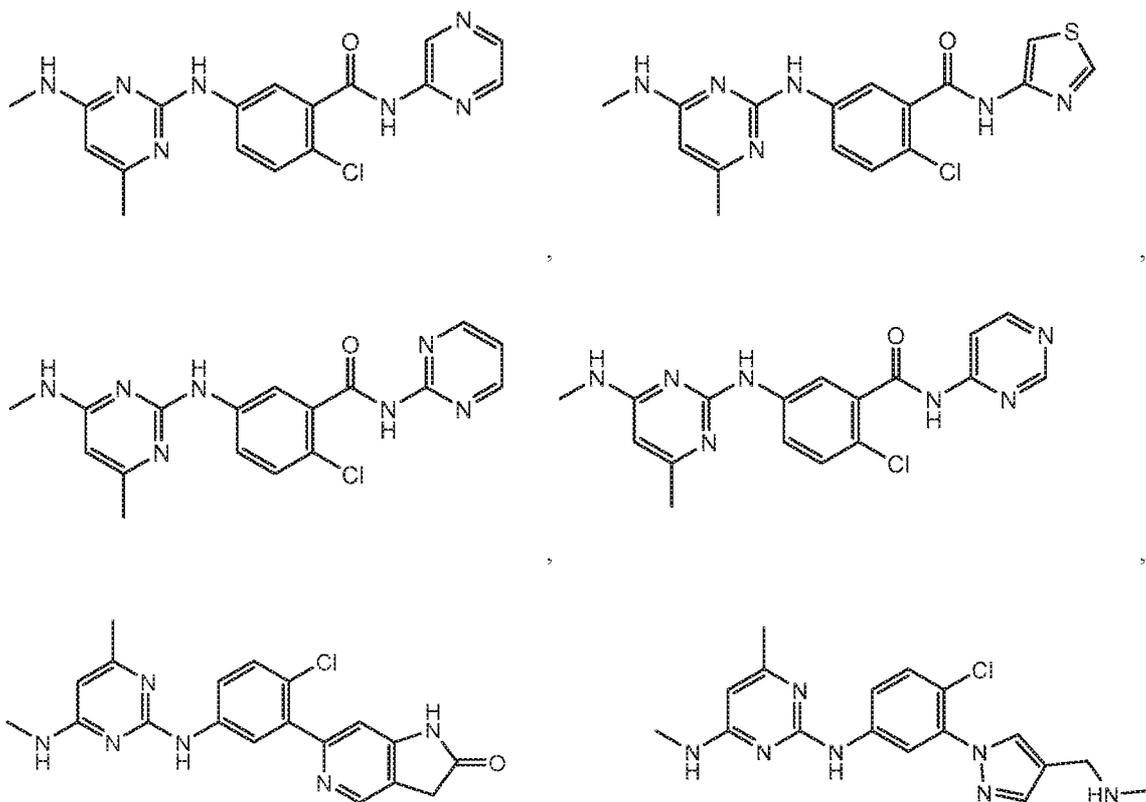
$X^6$  is CH,  $R^1$  is H,  $R^7$  is selected from the group consisting of , ,



R<sup>15</sup> is halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

[047] In some embodiments, the compounds are not one or more of the following compounds:

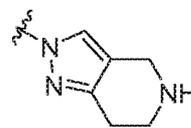




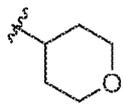
, and

[048] In some embodiments, the compounds are of Formula (II) and tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

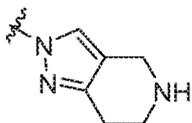
[049] In some embodiments, when  $X^5$  is CH,  $X^7$  is CH,  $R^7$  is

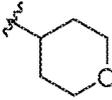
, one of  $R^8$  and  $R^9$ 

is H and the other one is  $CH_3$ ,  $R^{10}$  is

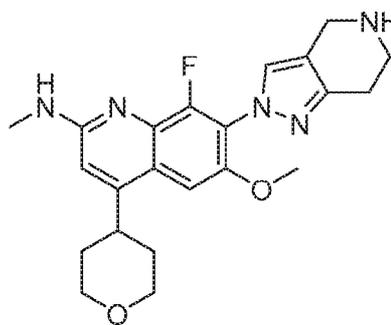
, and  $R^{14}$  is  $OCH_3$ , then

$R^{15}$  is H, halo, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

[050] In some embodiments, when  $X^5$  is CH,  $X^7$  is CH,  $R^7$  is , one of  $R^8$  and  $R^9$

is H and the other one is  $CH_3$ ,  $R^{10}$  is , and  $R^{14}$  is  $OCH_3$ , then

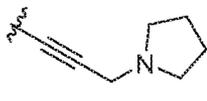
$R^{15}$  is H, Cl, Br, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .



[051] In some embodiments, the compounds are not

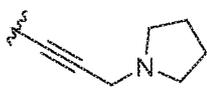
[052] In some embodiments, the compounds are of Formula (III) and tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[053] In some embodiments, when  $X^5$  is CH,  $X^8$  is  $CR^{11}R^{12}$ , in which  $R^{11}$  and  $R^{12}$  together with

the carbon atom to which they are attached form a cyclobutyl,  $R^7$  is , one of  $R^8$  and  $R^9$  is H and the other one is  $CH_3$ , and  $R^{14}$  is  $OCH_3$ , then

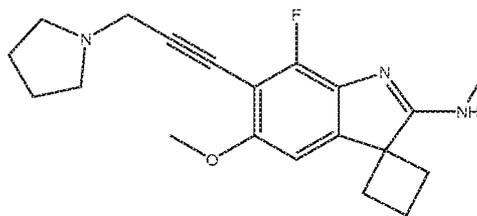
$R^{15}$  is H, halo, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl optionally substituted with one or more of halo or cyano,  $C_3$ - $C_8$  cycloalkyl optionally substituted with one or more of halo or cyano, or  $-OR^6$ .

[054] In some embodiments, when  $X^5$  is CH,  $X^8$  is  $CR^{11}R^{12}$ , in which  $R^{11}$  and  $R^{12}$  together with

the carbon atom to which they are attached form a cyclobutyl,  $R^7$  is , one of  $R^8$  and  $R^9$  is H and the other one is  $CH_3$ , and  $R^{14}$  is  $OCH_3$ , then

$R^{15}$  is H, Cl, Br, cyano,  $C_1$ - $C_6$  alkyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkenyl optionally substituted with one or more of halo or cyano,  $C_2$ - $C_6$  alkynyl

optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.



[055] In some embodiments, the compounds are not

[056] In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is halo. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is F. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is Cl. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is Br. In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is halo. In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is F. In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is Cl. In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is Br. In some embodiments, R<sup>14</sup> is halo. In some embodiments, R<sup>14</sup> is F. In some embodiments, R<sup>14</sup> is Cl. In some embodiments, R<sup>14</sup> is Br. In some embodiments, R<sup>15</sup> is halo. In some embodiments, R<sup>15</sup> is F. In some embodiments, R<sup>15</sup> is Cl. In some embodiments, R<sup>15</sup> is Br. In some embodiments, both of R<sup>14</sup> and R<sup>15</sup> are halo.

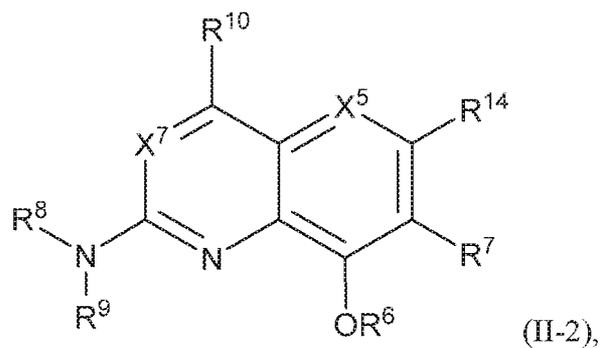
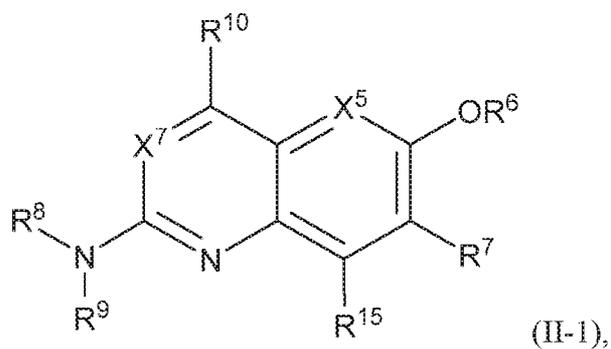
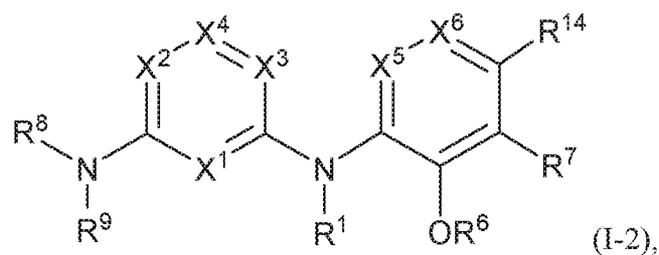
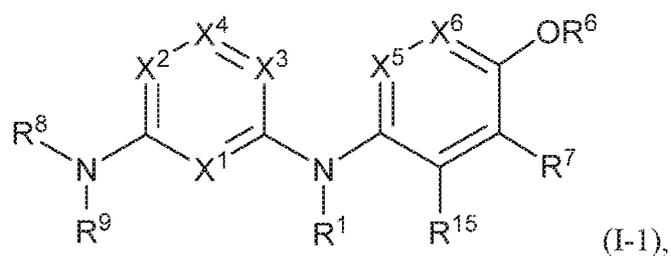
[057] In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

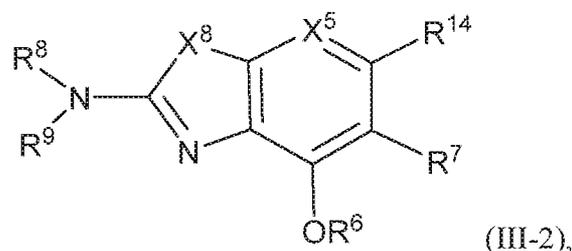
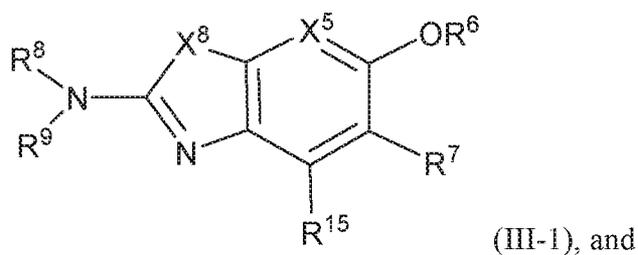
[058] In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano.

[059] In some embodiments, one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>14</sup> is halo, and R<sup>15</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>14</sup> is halo, and R<sup>15</sup> is H. In some embodiments, R<sup>14</sup> is halo, and R<sup>15</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>14</sup> is halo, and R<sup>15</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl. In some embodiments, R<sup>14</sup> is halo, and R<sup>15</sup> is -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>15</sup> is halo, and R<sup>14</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>15</sup> is halo, and R<sup>14</sup> is H. In some embodiments, R<sup>15</sup> is halo, and R<sup>14</sup> is C<sub>1</sub>-C<sub>6</sub>

alkyl. In some embodiments,  $R^{15}$  is halo, and  $R^{14}$  is  $C_3$ - $C_8$  cycloalkyl. In some embodiments,  $R^{15}$  is halo, and  $R^{14}$  is  $-OR^6$ , in which  $R^6$  is  $C_1$ - $C_6$  alkyl. In some embodiments, one of  $R^{14}$  and  $R^{15}$  is halo, and the other one is H,  $-CH_3$ , cyclopropyl, or  $-OCH_3$ .

[060] In some embodiments, the compounds are of any of Formulae (I-1), (I-2), (II-1), (II-2), (III-1), and (III-2):





tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers, wherein

$X^1$  is N or  $CR^2$ ;

$X^2$  is N or  $CR^3$ ;

$X^3$  is N or  $CR^4$ ;

$X^4$  is N or  $CR^5$ ;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$R^1$  is H or  $C_1$ - $C_4$  alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano,  $C_1$ - $C_6$  alkoxy,  $C_6$ - $C_{10}$  aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,  $OC(O)NR^aR^b$ ,  $NR^aC(O)OR^b$ ,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, wherein the  $C_6$ - $C_{10}$  aryl,  $C_3$ - $C_8$  cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl,  $C_1$ - $C_6$  alkoxy,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl, and  $C_2$ - $C_6$  alkynyl, are each optionally substituted with one or more of halo,  $OR^a$ , or  $NR^aR^b$ , in which each of  $R^a$  and  $R^b$  independently is H or  $C_1$ - $C_6$  alkyl;

$R^6$  is  $-Q^1-T^1$ , in which  $Q^1$  is a bond, or  $C_1$ - $C_6$  alkylene,  $C_2$ - $C_6$  alkenylene, or  $C_2$ - $C_6$  alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or  $C_1$ - $C_6$  alkoxy, and  $T^1$  is H, halo, cyano, or  $R^{S1}$ , in which  $R^{S1}$  is  $C_3$ - $C_8$  cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and  $R^{S1}$  is optionally substituted with one or more of halo,  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl,  $C_2$ - $C_6$  alkynyl, hydroxyl, oxo,  $-C(O)R^c$ ,  $-C(O)OR^c$ ,  $-SO_2R^c$ ,  $-SO_2N(R^c)_2$ ,  $-NR^cC(O)R^d$ ,

$-C(O)NR^cR^d$ ,  $-NR^cC(O)OR^d$ ,  $-OC(O)NR^cR^d$ ,  $NR^cR^d$ , or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of R<sup>c</sup> and R<sup>d</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>7</sup> is  $-Q^2-T^2$ , in which Q<sup>2</sup> is a bond, a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more  $-Q^3-T^3$ , wherein each Q<sup>3</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>3</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, C(O)OR<sup>f</sup>, OC(O)R<sup>f</sup>, S(O)<sub>2</sub>R<sup>f</sup>, NR<sup>f</sup>R<sup>g</sup>, OC(O)NR<sup>f</sup>R<sup>g</sup>, NR<sup>f</sup>C(O)OR<sup>g</sup>, C(O)NR<sup>f</sup>R<sup>g</sup>, and NR<sup>f</sup>C(O)R<sup>g</sup>; or  $-Q^3-T^3$  is oxo;

each R<sup>e</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of R<sup>f</sup> and R<sup>g</sup>, independently, is  $-Q^6-T^6$ , in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, halo, OR<sup>m1</sup>, NR<sup>m1</sup>R<sup>m2</sup>, NR<sup>m1</sup>C(O)R<sup>m2</sup>, C(O)NR<sup>m1</sup>R<sup>m2</sup>, C(O)R<sup>m1</sup>, C(O)OR<sup>m1</sup>, NR<sup>m1</sup>C(O)OR<sup>m2</sup>, OC(O)NR<sup>m1</sup>R<sup>m2</sup>, S(O)<sub>2</sub>R<sup>m1</sup>, S(O)<sub>2</sub>NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S3</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more  $-Q^7-T^7$ , wherein each Q<sup>7</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>7</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>n1</sup>, C(O)R<sup>n1</sup>, C(O)OR<sup>n1</sup>, OC(O)R<sup>n1</sup>, S(O)<sub>2</sub>R<sup>n1</sup>, NR<sup>n1</sup>R<sup>n2</sup>, OC(O)NR<sup>n1</sup>R<sup>n2</sup>, NR<sup>n1</sup>C(O)OR<sup>n2</sup>, C(O)NR<sup>n1</sup>R<sup>n2</sup>, and NR<sup>n1</sup>C(O)R<sup>n2</sup>, each of R<sup>n1</sup> and R<sup>n2</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^7-T^7$  is oxo; R<sup>8</sup> is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>9</sup> is  $-Q^4-T^4$ , in which Q<sup>4</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub>

alkoxyl, and  $T^4$  is H, halo,  $OR^h$ ,  $NR^hR^i$ ,  $NR^hC(O)R^i$ ,  $C(O)NR^hR^i$ ,  $C(O)R^h$ ,  $C(O)OR^h$ ,  $NR^hC(O)OR^i$ ,  $OC(O)NR^hR^i$ ,  $S(O)_2R^h$ ,  $S(O)_2NR^hR^i$ , or  $R^{S2}$ , in which each of  $R^h$  and  $R^i$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and  $R^{S2}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $R^{S2}$  is optionally substituted with one or more  $-Q^5-T^5$ , wherein each  $Q^5$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^5$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^j$ ,  $C(O)R^j$ ,  $C(O)OR^j$ ,  $OC(O)R^j$ ,  $S(O)_2R^j$ ,  $NR^jR^k$ ,  $OC(O)NR^jR^k$ ,  $NR^jC(O)OR^k$ ,  $C(O)NR^jR^k$ , and  $NR^jC(O)R^k$ , each of  $R^j$  and  $R^k$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^5-T^5$  is oxo;

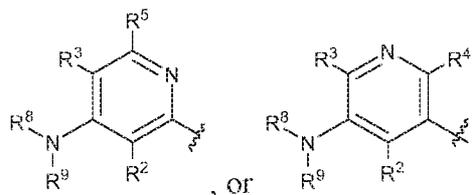
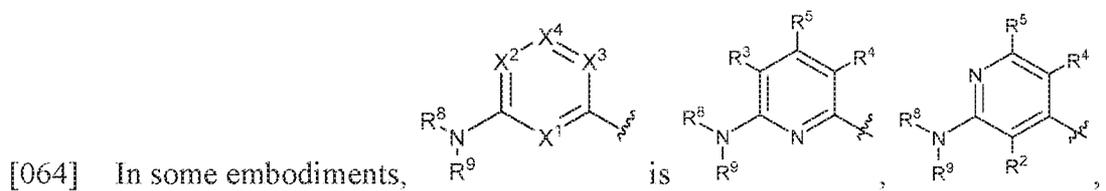
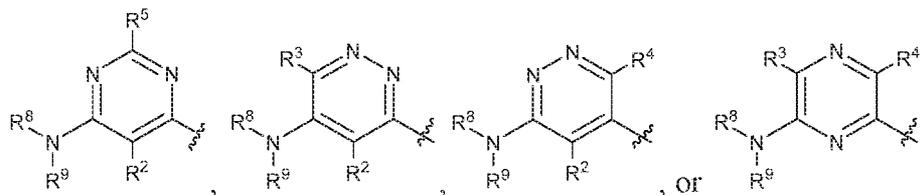
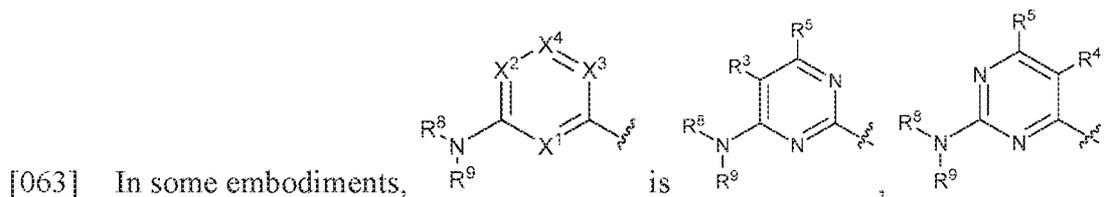
$R^{10}$  is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di- alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy,  $C(O)NR^jR^k$ , or  $NR^jC(O)R^k$ ; and

$R^{11}$  and  $R^{12}$  together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy

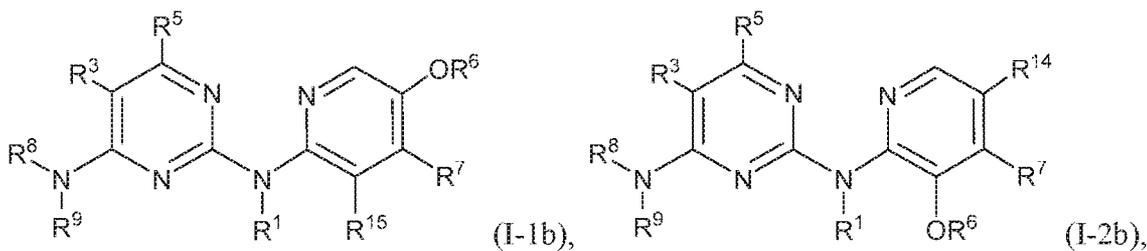
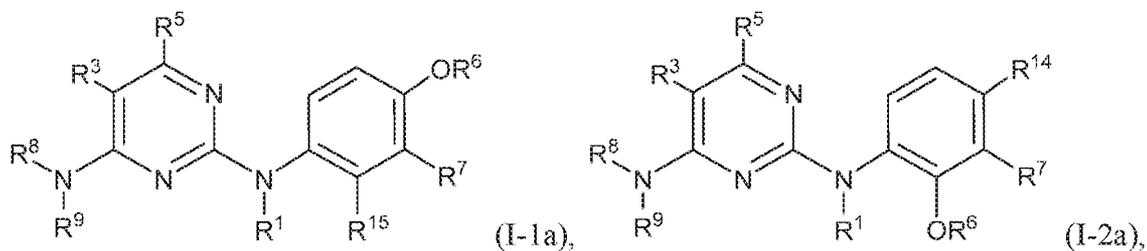
each of  $R^{14}$  and  $R^{15}$ , independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, or C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano.

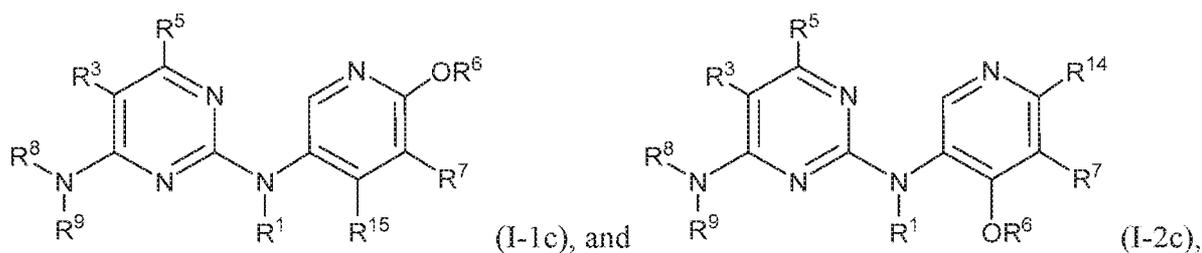
[061] In some embodiments, the compounds are of any of Formulae (I-1) and (I-2), tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[062] In some embodiments, at least one of  $X^1$ ,  $X^2$ ,  $X^3$  and  $X^4$  is N. In some embodiments,  $X^1$  and  $X^3$  are N. In some embodiments,  $X^1$  and  $X^3$  are N,  $X^2$  is  $CR^3$  and  $X^4$  is  $CR^5$ .



[065] In some embodiments, the compounds are of any of Formulae (I-1a), (I-2a), (I-1b), (I-2b), (I-1c), and (I-2c):

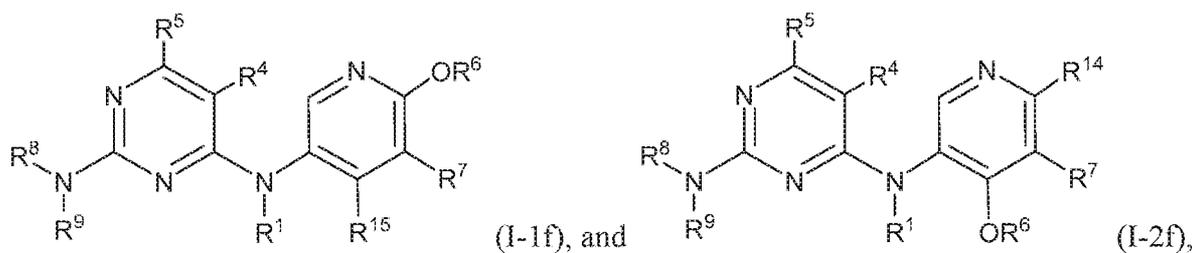
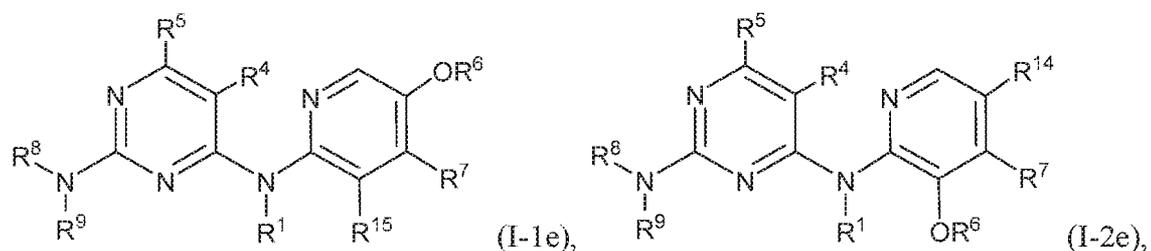
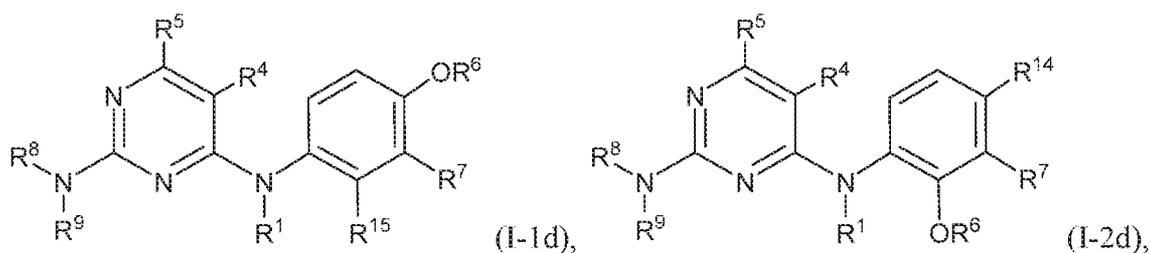




tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[066] In some embodiments, at most one of  $R^3$  and  $R^5$  is not H. In some embodiments, at least one of  $R^3$  and  $R^5$  is not H. In some embodiments,  $R^3$  is H or halo.

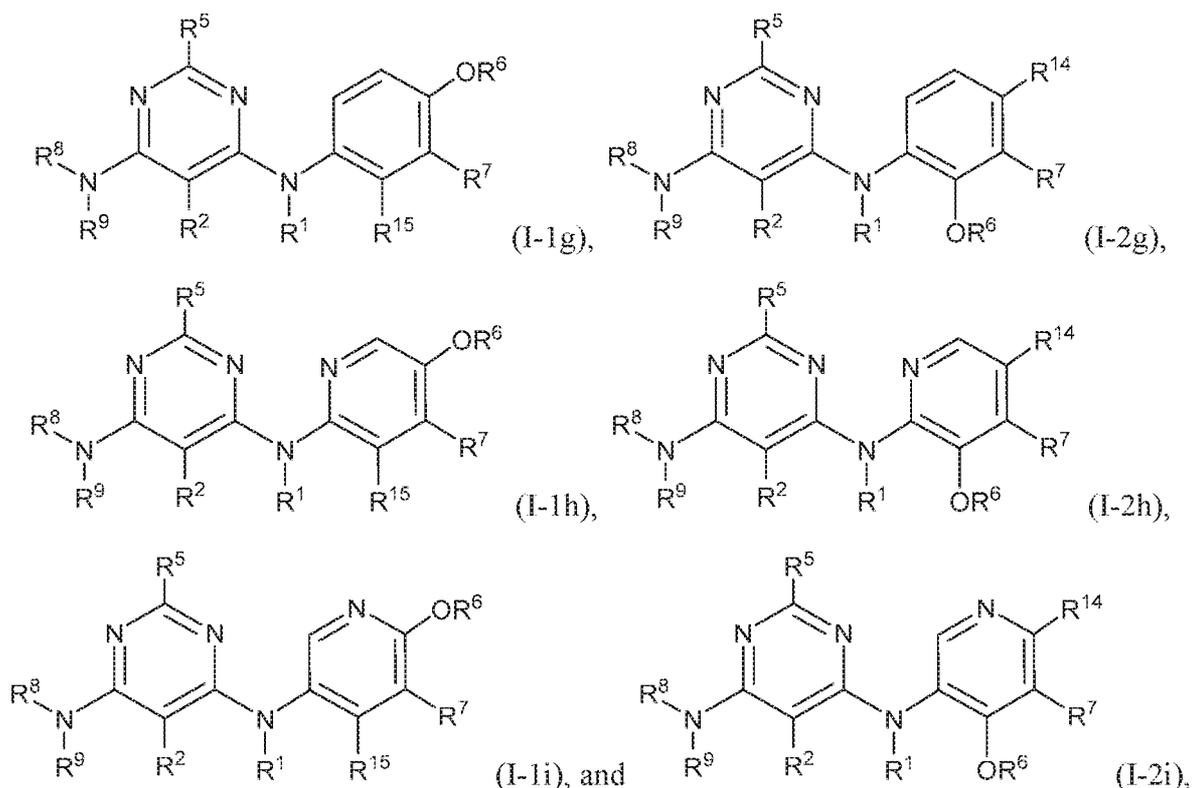
[067] In some embodiments, the compounds are of any of Formulae (I-1d), (I-2d), (I-1e), (I-2e), (I-1f), and (I-2f):



tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[068] In some embodiments, at most one of  $R^4$  and  $R^5$  is not H. In some embodiments, at least one of  $R^4$  and  $R^5$  is not H. In some embodiments,  $R^4$  is H,  $C_1$ - $C_6$  alkyl, or halo.

[069] In some embodiments, the compounds are of any of Formulae (I-1g), (I-2g), (I-1h), (I-2h), (I-1i), and (I-2i):



tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[070] In some embodiments, at most one of  $R^2$  and  $R^5$  is not H. In some embodiments, at least one of  $R^2$  and  $R^5$  is not H. In some embodiments,  $R^2$  is H,  $C_1$ - $C_6$  alkyl, or halo. In some embodiments,  $R^5$  is  $C_1$ - $C_6$  alkyl.

[071] In some embodiments, the compounds are of any of Formulae (II-1) and (II-2), tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[072] In some embodiments, each of  $X^5$ ,  $X^6$  and  $X^7$  is CH. In some embodiments, at least one of  $X^5$ ,  $X^6$  and  $X^7$  is N. In some embodiments, at most one of  $X^5$ ,  $X^6$  and  $X^7$  is N.

[073] In some embodiments,  $R^{10}$  is optionally substituted 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S. In some embodiments,  $R^{10}$  is connected to the bicyclic group of Formula (II-1) or (II-2) via a carbon-carbon bond. In some embodiments,  $R^{10}$  is connected to the bicyclic group of Formula (II-1) or (II-2) via a carbon-nitrogen bond.

[074] In some embodiments, the compounds are of any of Formulae (III-1) and (III-2), tautomers thereof, and pharmaceutically acceptable salts of the compounds and the tautomers.

[075] In some embodiments,  $R^{11}$  and  $R^{12}$  together with the carbon atom to which they are attached form a 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N,

O, and S, wherein the 4- to 7-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy.

[076] In some embodiments, R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>4</sub>-C<sub>8</sub> cycloalkyl which is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy.

[077] In some embodiments, each of X<sup>5</sup> and X<sup>6</sup> is CH. In some embodiments, each of X<sup>5</sup> and X<sup>6</sup> is N. In some embodiments, one of X<sup>5</sup> and X<sup>6</sup> is CH and the other is CH.

[078] In some embodiments, R<sup>6</sup> is -Q<sup>1</sup>-T<sup>1</sup>, in which Q<sup>1</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene linker optionally substituted with one or more of halo, and T<sup>1</sup> is H, halo, cyano, or R<sup>S1</sup>, in which R<sup>S1</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6-membered heteroaryl and R<sup>S1</sup> is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, NR<sup>c</sup>R<sup>d</sup>, or C<sub>1</sub>-C<sub>6</sub> alkoxy.

[079] In some embodiments, wherein R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy. In some embodiments, R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>6</sup> is -CH<sub>3</sub>.

[080] In some embodiments, R<sup>7</sup> is -Q<sup>2</sup>-T<sup>2</sup>, in which Q<sup>2</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di- alkylamino, and T<sup>2</sup> is C(O)NR<sup>e</sup>R<sup>f</sup>.

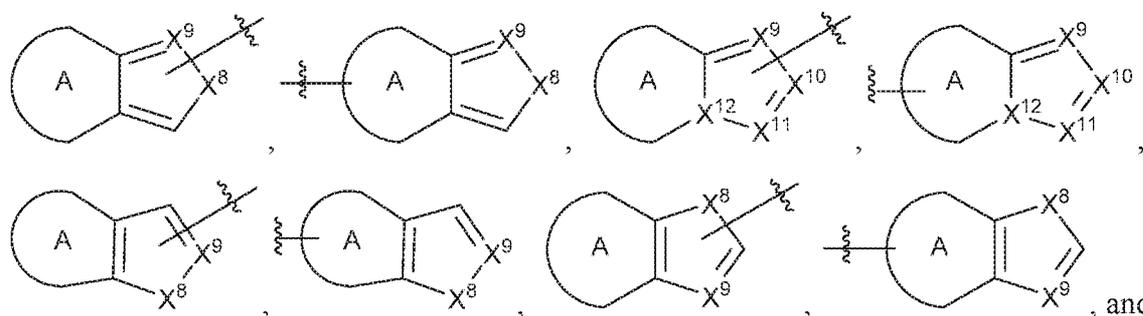
[081] In some embodiments, Q<sup>2</sup> is a bond. In some embodiments, R<sup>e</sup> is H.

[082] In some embodiments, R<sup>f</sup> is -Q<sup>6</sup>-T<sup>6</sup>, in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H, C<sub>1</sub>-C<sub>6</sub> alkyl, or -(C<sub>1</sub>-C<sub>6</sub> alkyl)-R<sup>S3</sup>, and R<sup>S3</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>.

[083] In some embodiments, R<sup>f</sup> is -Q<sup>6</sup>-T<sup>6</sup>, in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S3</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>.

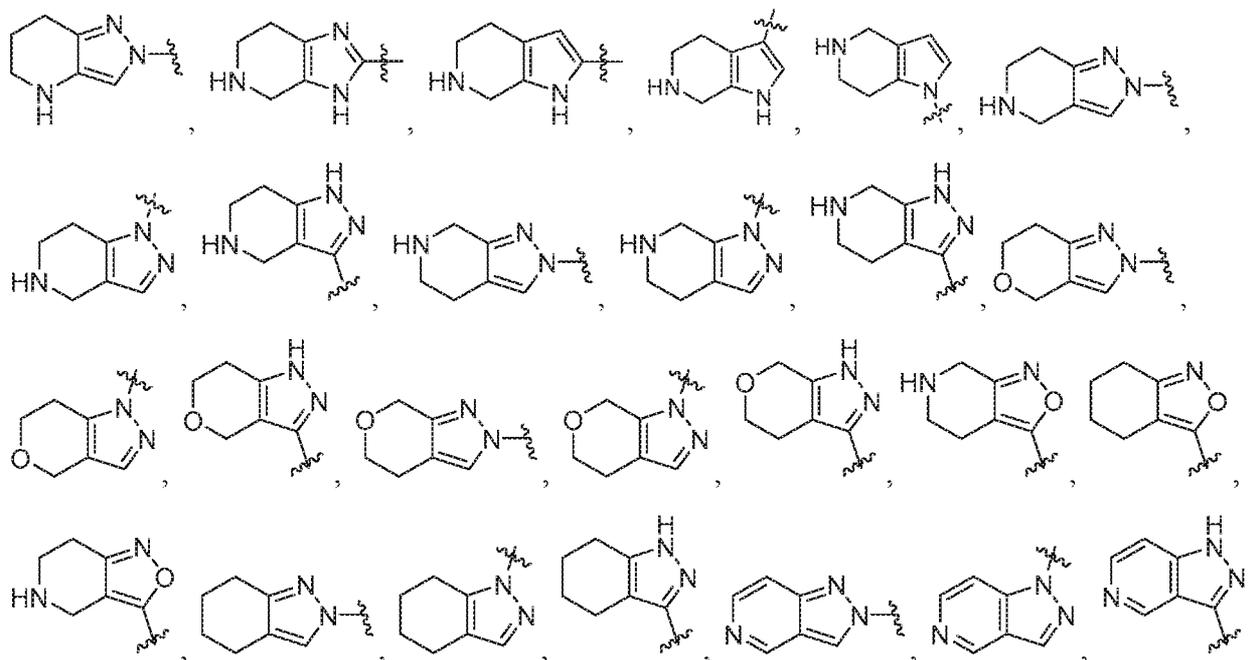
[084] In some embodiments, T<sup>6</sup> is 8- to 12-membered bicyclic heterocycloalkyl that comprises a 5- or 6-membered aryl or heteroaryl ring fused with a non-aromatic ring. In some embodiments, T<sup>6</sup> is 8- to 12-membered bicyclic heterocycloalkyl that comprises a 5- or 6-membered aryl or heteroaryl ring fused with a non-aromatic ring, in which the 5- or 6-membered aryl or heteroaryl ring is connected to Q<sup>2</sup>. In some embodiments, T<sup>6</sup> is 5- to 10-membered heteroaryl.

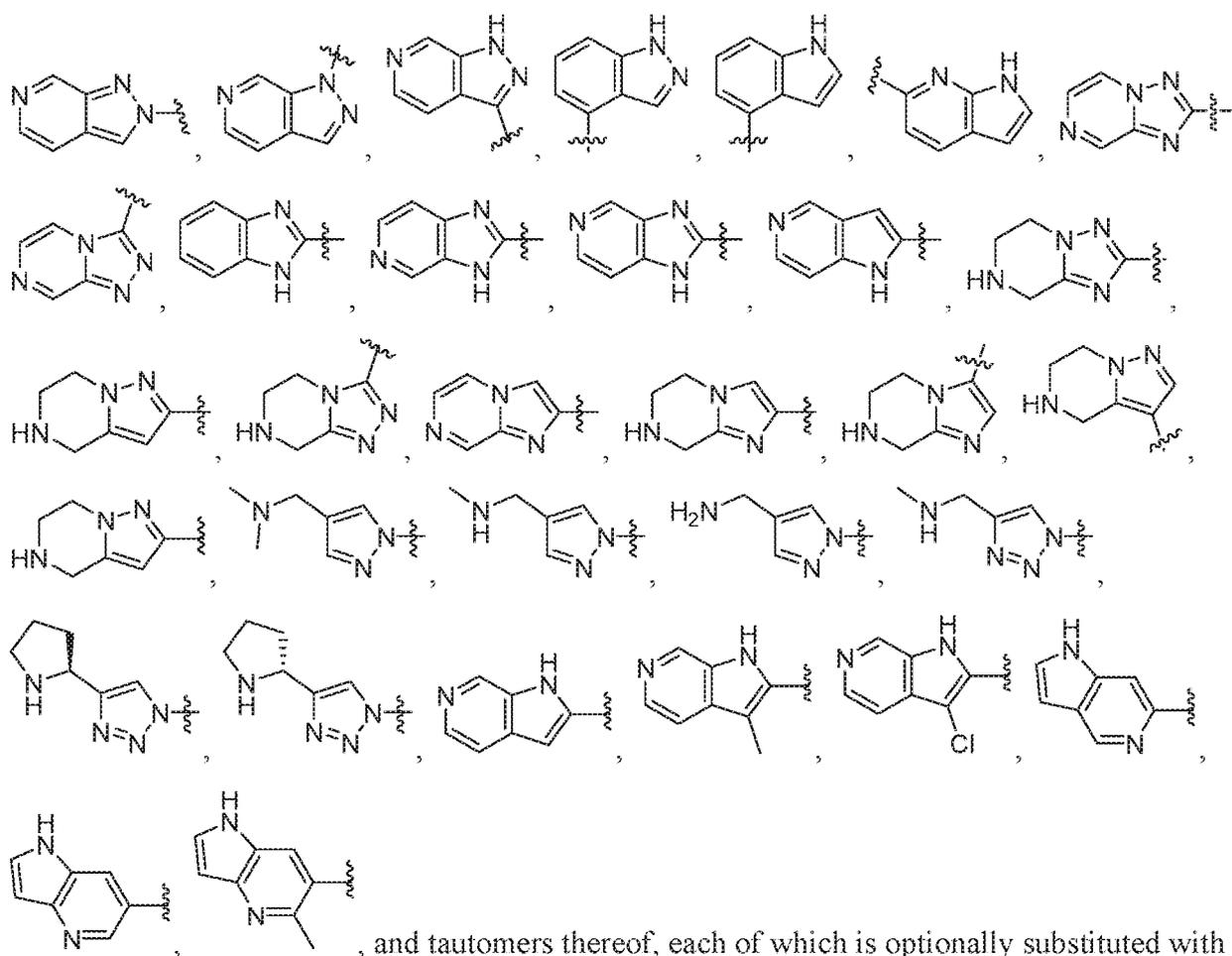
[085] In some embodiments, T<sup>6</sup> is selected from ,



tautomers thereof, each of which is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>, wherein X<sup>8</sup> is NH, O, or S, each of X<sup>9</sup>, X<sup>10</sup>, X<sup>11</sup>, and X<sup>12</sup> is independently CH or N, and at least one of X<sup>9</sup>, X<sup>10</sup>, X<sup>11</sup>, and X<sup>12</sup> is N, and ring A is a C<sub>5</sub>-C<sub>8</sub> cycloalkyl, phenyl, 6-membered heteroaryl, or 4- to 8-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S.

[086] In some embodiments, T<sup>6</sup> is selected from ,

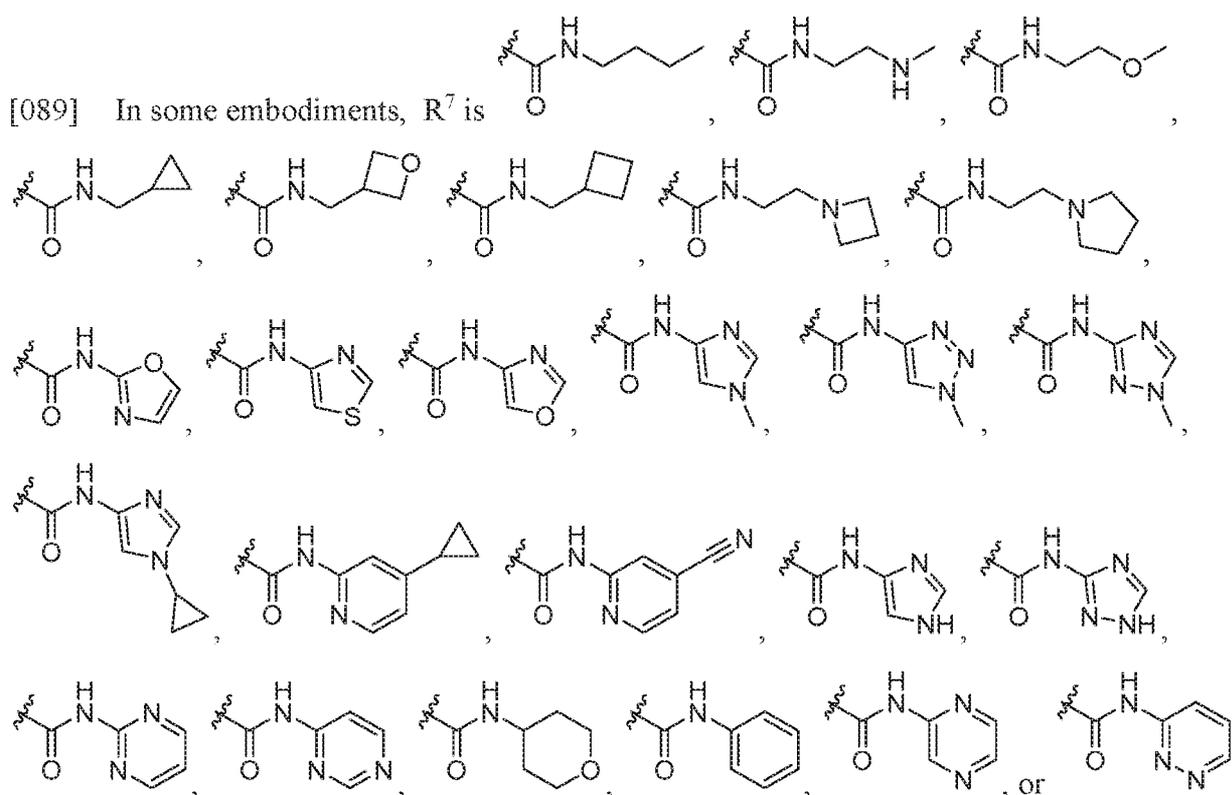




one or more  $-Q^7-T^7$ .

[087] In some embodiments, each  $Q^7$  independently is a bond or  $C_1-C_3$  alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and each  $T^7$  independently is selected the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_8$  cycloalkyl,  $C_6-C_{10}$  aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^{n1}$ ,  $C(O)R^{n1}$ ,  $C(O)OR^{n1}$ ,  $OC(O)R^{n1}$ ,  $S(O)_2R^{n1}$ ,  $NR^{n1}R^{n2}$ ,  $OC(O)NR^{n1}R^{n2}$ ,  $NR^{n1}C(O)OR^{n2}$ ,  $C(O)NR^{n1}R^{n2}$ , and  $NR^{n1}C(O)R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or  $C_1-C_6$  alkyl; or  $-Q^7-T^7$  is oxo.

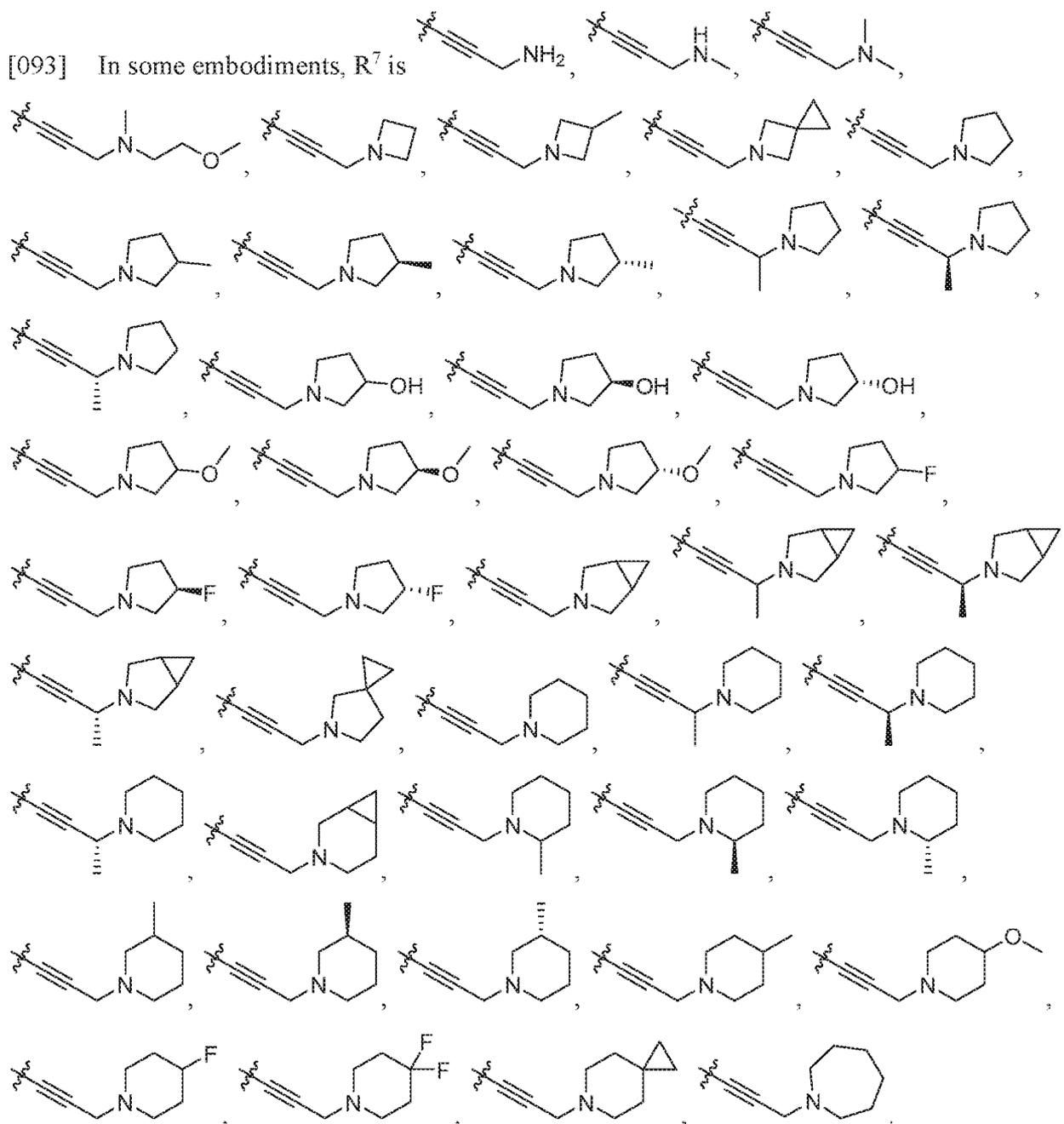
[088] In some embodiments, each  $Q^7$  independently is a bond or  $C_1-C_3$  alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and each  $T^7$  independently is selected from the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl, and  $NR^{n1}R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or  $C_1-C_6$  alkyl.



[090] In some embodiments,  $R^7$  is  $-Q^2-T^2$ , in which  $Q^2$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^2$  independently is H, OR<sup>e</sup>, OR<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl.

[091] In some embodiments,  $R^7$  is , wherein  $T^2$  is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, hydroxyl, cyano, C<sub>1</sub>-C<sub>6</sub> haloalkyl, -SO<sub>2</sub>R<sup>e</sup>, C<sub>1</sub>-C<sub>6</sub> alkoxy or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of NR<sup>e</sup>R<sup>d</sup>.

[092] In some embodiments,  $R^7$  is , wherein  $T^2$  is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl optionally substituted with one or more of halo, hydroxyl, C<sub>1</sub>-C<sub>6</sub> alkoxy or C<sub>1</sub>-C<sub>6</sub> alkyl.



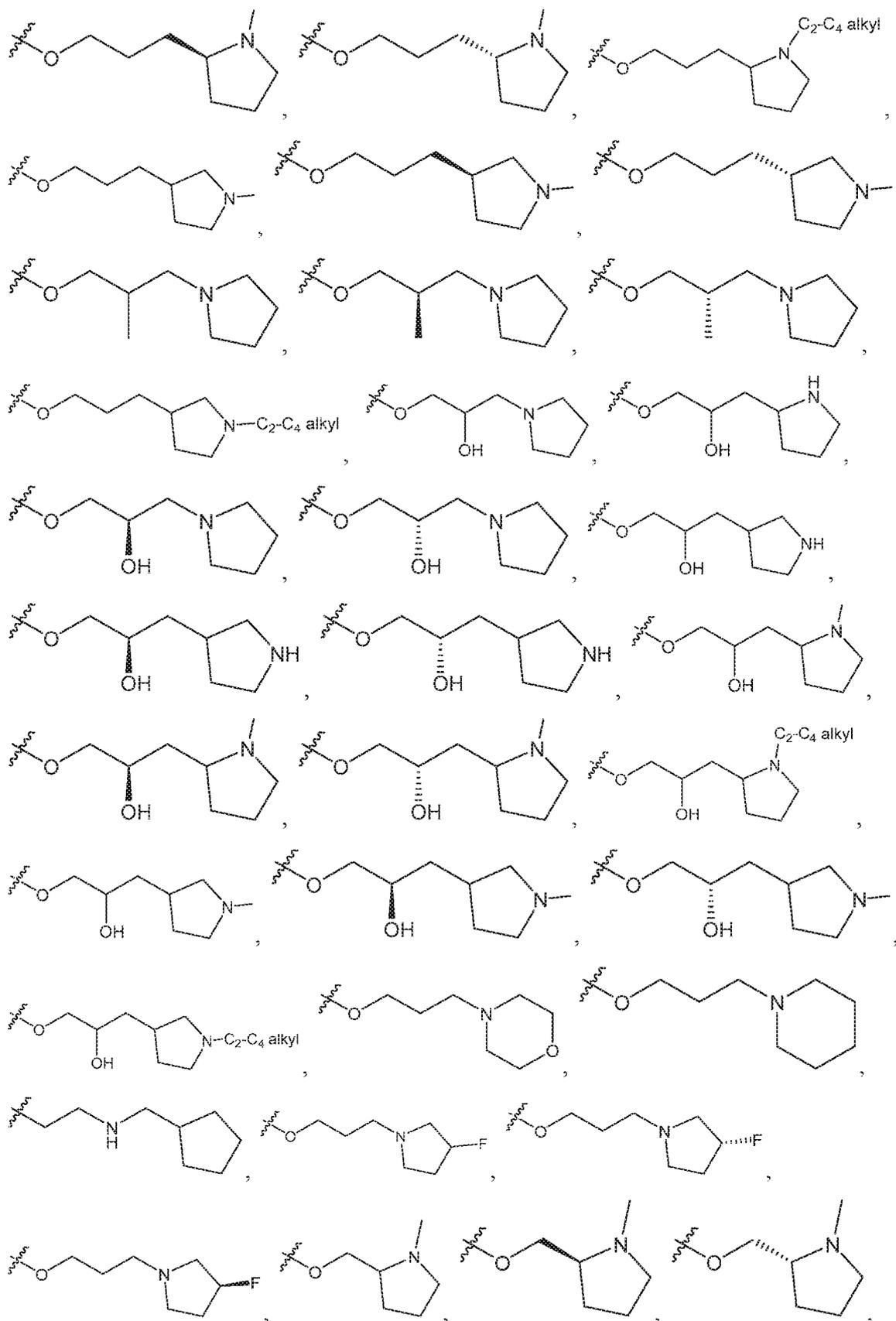
[094] In some embodiments,  $R^7$  is  $\text{OR}^c$ .

[095] In some embodiments,  $R^7$  is  $\text{OR}^f$ .

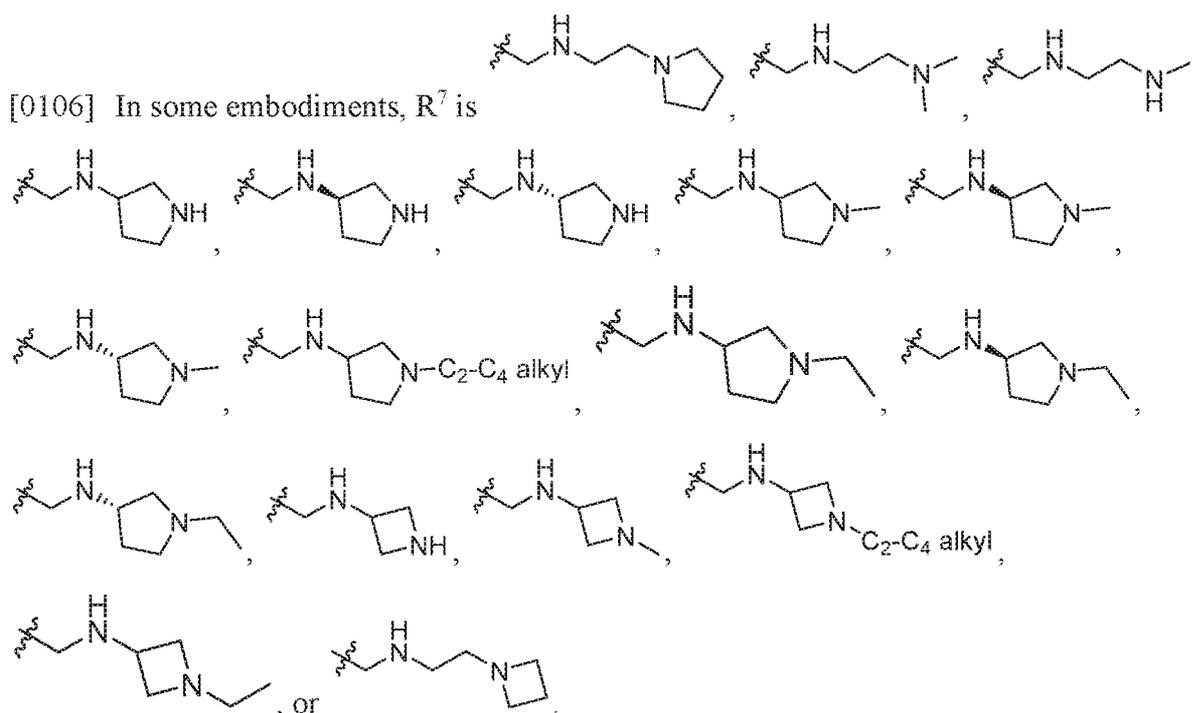
[096] In some embodiments,  $R^7$  is  $\text{O}-\text{Q}^6-\text{NR}^{m1}\text{R}^{m2}$ . In some embodiments,  $R^7$  is  $\text{O}-\text{Q}^6-\text{NH}-(\text{C}_1-\text{C}_6 \text{ alkyl})-\text{R}^{S3}$ .

[097] In some embodiments,  $R^7$  is  $-\text{CH}_2-\text{T}^2$ , wherein  $\text{T}^2$  is H, halo, cyano,  $\text{OR}^c$ ,  $\text{OR}^f$ ,  $\text{C}(\text{O})\text{R}^f$ ,  $\text{NR}^7\text{R}^f$ ,  $\text{C}(\text{O})\text{NR}^c\text{R}^f$ ,  $\text{NR}^c\text{C}(\text{O})\text{R}^f$ ,  $\text{C}_6-\text{C}_{10}$  aryl, 5- to 10-membered heteroaryl,  $\text{C}_3-\text{C}_{12}$  cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, and wherein the  $\text{C}_6-\text{C}_{10}$  aryl, 5- to 10-membered heteroaryl,  $\text{C}_3-\text{C}_{12}$  cycloalkyl or 4- to 12-membered









[0107] In some embodiments, at least one of  $R^8$  and  $R^9$  is H. In some embodiments, each of  $R^8$  and  $R^9$  is H. In some embodiments,  $R^8$  is H.

[0108] In some embodiments,  $R^9$  is  $-Q^4-T^4$ , in which  $Q^4$  is a bond or  $C_1-C_6$  alkylene linker optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and  $T^4$  is H, halo,  $OR^h$ ,  $NR^hR^i$ ,  $NR^hC(O)R^i$ ,  $C(O)NR^hR^i$ ,  $C(O)R^h$ ,  $C(O)OR^h$ , or  $R^{S2}$ , in which  $R^{S2}$  is  $C_3-C_8$  cycloalkyl or 4- to 7-membered heterocycloalkyl, and  $R^{S2}$  is optionally substituted with one or more  $-Q^5-T^5$ .

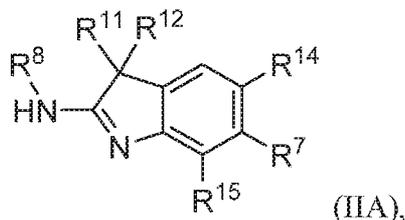
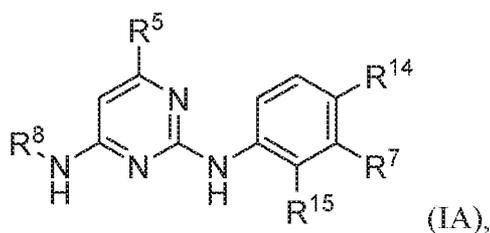
[0109] In some embodiments, each  $Q^5$  independently is a bond or  $C_1-C_3$  alkylene linker.

[0110] In some embodiments, each  $T^5$  independently is selected from the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl,  $OR^j$ ,  $C(O)R^j$ ,  $C(O)OR^j$ ,  $NR^jR^k$ ,  $C(O)NR^jR^k$ , and  $NR^jC(O)R^k$ .

[0111] In some embodiments,  $R^9$  is  $C_1-C_3$  alkyl.

[0112] In some embodiments,  $R^{14}$  is H, halo, or  $C_1-C_6$  alkyl.

[0113] In some aspects, the present disclosure provides a compound of Formula (IA) or (IIA):



a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer, wherein:

$R^8$  is  $C_1$ - $C_6$  alkyl;

$R^5$  is  $C_1$ - $C_6$  alkyl;

$R^{11}$  and  $R^{12}$  each independently is  $C_1$ - $C_6$  alkyl, or  $R^{11}$  and  $R^{12}$  together with the carbon atom to which they are attached form  $C_3$ - $C_{12}$  cycloalkyl;

$R^{14}$  and  $R^{15}$  each independently is H, halogen, or  $C_1$ - $C_6$  alkoxy; and

$R^7$  is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of  $R^{7S}$ ; each  $R^{7S}$  independently is COOH, oxo,  $C_1$ - $C_6$  alkyl,  $C_1$ - $C_6$  haloalkyl, or 4- to 12-membered heterocycloalkyl, wherein the  $C_1$ - $C_6$  alkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of oxo,  $C_1$ - $C_6$  alkyl, or  $NR^{7Sa}R^{7Sb}$ ;  $R^{7Sa}$  and  $R^{7Sb}$  each independently is H or  $C_1$ - $C_6$  alkyl, or  $R^{7Sa}$  and  $R^{7Sb}$  together with the nitrogen atom to which they are attached form  $C_3$ - $C_6$  heterocycloalkyl.

[0114] In some embodiments, the compound is of Formula (IA) or (IIA), a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer, wherein:

R<sup>8</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>5</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>11</sup> and R<sup>12</sup> each independently is C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form C<sub>3</sub>-C<sub>12</sub> cycloalkyl;

R<sup>14</sup> and R<sup>15</sup> each independently is H, halogen, or C<sub>1</sub>-C<sub>6</sub> alkoxy; and

R<sup>7</sup> is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of R<sup>7S</sup>; each R<sup>7S</sup> independently is C<sub>1</sub>-C<sub>6</sub> alkyl or 4- to 12-membered heterocycloalkyl, wherein the C<sub>1</sub>-C<sub>6</sub> alkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of NR<sup>7Sa</sup>R<sup>7Sb</sup>; R<sup>7Sa</sup> and R<sup>7Sb</sup> each independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>7Sa</sup> and R<sup>7Sb</sup> together with the nitrogen atom to which they are attached form C<sub>3</sub>-C<sub>6</sub> heterocycloalkyl.

[0115] In some embodiments, R<sup>8</sup> is methyl or ethyl. In some embodiments, R<sup>8</sup> is methyl.

[0116] In some embodiments, R<sup>5</sup> is methyl, ethyl, n-propyl, or i-propyl. In some embodiments, R<sup>5</sup> is methyl. In some embodiments, R<sup>5</sup> is i-propyl.

[0117] In some embodiments, R<sup>11</sup> and R<sup>12</sup> each independently is C<sub>1</sub>-C<sub>6</sub> alkyl. In some embodiments, R<sup>11</sup> and R<sup>12</sup> each independently is methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, s-butyl, t-butyl, pentyl, or hexyl. In some embodiments, R<sup>2a</sup> and R<sup>2b</sup> each independently is methyl, ethyl, n-propyl, or i-propyl.

[0118] In some embodiments, R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form C<sub>3</sub>-C<sub>12</sub> cycloalkyl. In some embodiments, R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form cyclopropyl, cyclobutyl, cyclopentyl, or cyclohexyl. In some embodiments, R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form cyclobutyl.

[0119] In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is halogen. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is F or Cl. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is F. In some embodiments, at least one of R<sup>14</sup> and R<sup>15</sup> is Cl.

[0120] In some embodiments, R<sup>14</sup> is halogen. In some embodiments, R<sup>14</sup> is F or Cl. In some embodiments, R<sup>14</sup> is F. In some embodiments, R<sup>3</sup> is Cl.

[0121] In some embodiments, R<sup>15</sup> is halogen. In some embodiments, R<sup>15</sup> is F or Cl. In some embodiments, R<sup>15</sup> is F. In some embodiments, R<sup>15</sup> is Cl.

[0122] In some embodiments, one of  $R^{14}$  and  $R^{15}$  is halogen, and the other one is H or or  $C_1-C_6$  alkoxy. In some embodiments, at least one of  $R^{14}$  and  $R^{15}$  is F or Cl, and the other one is H or or  $C_1-C_6$  alkoxy. In some embodiments, at least one of  $R^{14}$  and  $R^{15}$  is F or Cl, and the other one is H. In some embodiments, at least one of  $R^{14}$  and  $R^{15}$  is F or Cl, and the other one is methoxy.

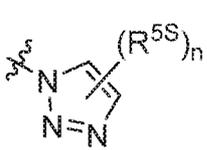
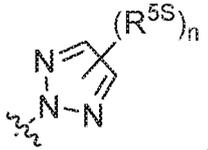
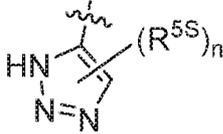
[0123] In some embodiments,  $R^{14}$  is halogen, and  $R^{15}$  is H or or  $C_1-C_6$  alkoxy. In some embodiments,  $R^{14}$  is F or Cl, and  $R^{15}$  is H or or  $C_1-C_6$  alkoxy. In some embodiments,  $R^{14}$  is F or Cl, and  $R^{15}$  is H. In some embodiments,  $R^{14}$  is F or Cl, and  $R^{15}$  is methoxy.

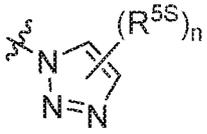
[0124] In some embodiments,  $R^{15}$  is halogen, and  $R^{14}$  is H or or  $C_1-C_6$  alkoxy. In some embodiments,  $R^{15}$  is F or Cl, and  $R^{14}$  is H or or  $C_1-C_6$  alkoxy. In some embodiments,  $R^{15}$  is F or Cl, and  $R^{14}$  is H. In some embodiments,  $R^{15}$  is F or Cl, and  $R^{14}$  is methoxy.

[0125] In some embodiments, both  $R^{14}$  and  $R^{15}$  are halogen. In some embodiments,  $R^{14}$  and  $R^{15}$  each independently is F or Cl. In some embodiments, both  $R^{14}$  and  $R^{15}$  are F. In some embodiments,  $R^{14}$  is F, and  $R^{15}$  is Cl. In some embodiments,  $R^{15}$  is F, and  $R^{14}$  is Cl. In some embodiments, both  $R^{14}$  and  $R^{15}$  are Cl.

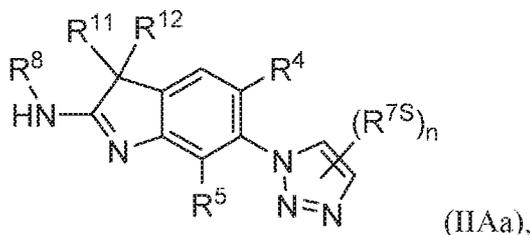
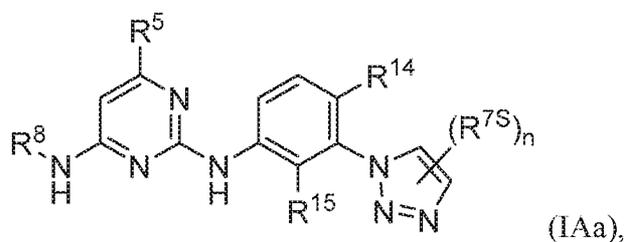
[0126] In some embodiments,  $R^7$  is 5- to 10-membered heteroaryl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl is optionally substituted with one or more of  $R^{7S}$ .

[0127] In some embodiments,  $R^7$  is 5-membered heteroaryl containing 3 of N, wherein the 5-membered heteroaryl is optionally substituted with one or more of  $R^{7S}$ .

[0128] In some embodiments,  $R^7$  is , , or , wherein n is 0, 1, or 2.

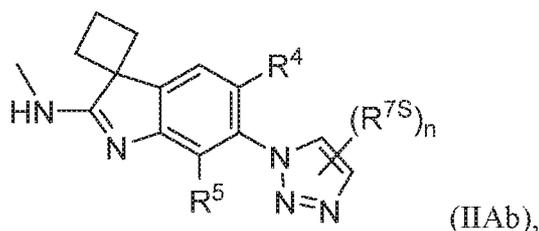
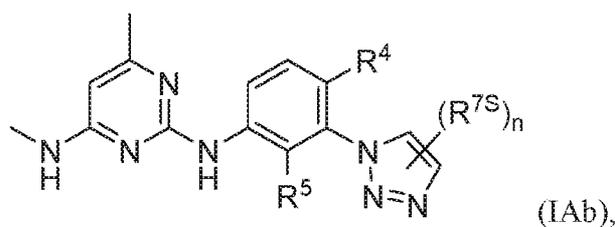
[0129] In some embodiments,  $R^7$  is , wherein n is 0, 1, or 2.

[0130] In some embodiments, the compound is of Formula (IAa) or (IIAa):



a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer.

[0131] In some embodiments, the compound is of Formula (IAb) or (IIAb):



a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer.

[0132] In some embodiments, n is 0 or 1. In some embodiments, n is 0. In some embodiments, n is 1.

[0133] In some embodiments, R<sup>7</sup> is 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of R<sup>7S</sup>.

[0134] In some embodiments, at least one R<sup>7S</sup> is COOH.

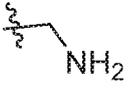
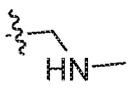
[0135] In some embodiments, at least one R<sup>7S</sup> is oxo.

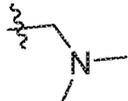
[0136] In some embodiments, at least one R<sup>7S</sup> is C<sub>1</sub>-C<sub>6</sub> haloalkyl (e.g., methyl, ethyl, propyl, butyl, pentyl, or hexyl) in which at least one H is substituted with a halogen (e.g., F, Cl, Br, or I).

In some embodiments, at least one  $R^{7S}$  is  $CH_2F$ ,  $CHF_2$ , or  $CF_3$ . In some embodiments, at least one  $R^{7S}$  is  $CF_3$ .

[0137] In some embodiments, at least one  $R^{7S}$  is  $C_1$ - $C_6$  alkyl optionally substituted with one or more of oxo or  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is  $C_1$ - $C_6$  alkyl substituted with one oxo and one  $NR^{7Sa}R^{7Sb}$ .

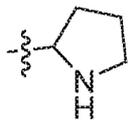
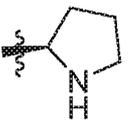
[0138] In some embodiments, at least one  $R^{7S}$  is  $C_1$ - $C_6$  alkyl optionally substituted with one or more of  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is methyl optionally substituted with

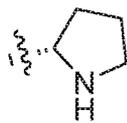
one or more of  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is , , or

. In some embodiments, at least one  $R^{7S}$  is .

[0139] In some embodiments, at least one  $R^{7S}$  is 4- to 12-membered heterocycloalkyl optionally substituted with one or more of oxo,  $C_1$ - $C_6$  alkyl, or  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is 4- to 12-membered heterocycloalkyl optionally substituted with one or more of  $C_1$ - $C_6$  alkyl.

[0140] In some embodiments, at least one  $R^{7S}$  is 4- to 12-membered heterocycloalkyl optionally substituted with one or more of  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is 5-membered heterocycloalkyl optionally substituted with one or more of  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is pyrrolidinyl optionally substituted with one or more of  $NR^{7Sa}R^{7Sb}$ . In some embodiments, at least one  $R^{7S}$  is pyrrolidinyl. In some embodiments, at least one  $R^{7S}$  is

. In some embodiments, at least one  $R^{7S}$  is . In some embodiments, at least

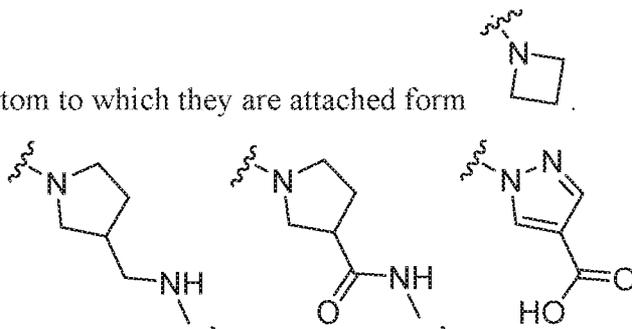
one  $R^{7S}$  is .

[0141] In some embodiments, both of  $R^{7Sa}$  and  $R^{7Sb}$  are H. In some embodiments, one of  $R^{7Sa}$  and  $R^{7Sb}$  is H, and the other is  $C_1$ - $C_6$  alkyl. In some embodiments, one of  $R^{7Sa}$  and  $R^{7Sb}$  is H, and the other is methyl. In some embodiments, both of  $R^{7Sa}$  and  $R^{7Sb}$  are  $C_1$ - $C_6$  alkyl. In some embodiments, both of  $R^{7Sa}$  and  $R^{7Sb}$  are methyl.

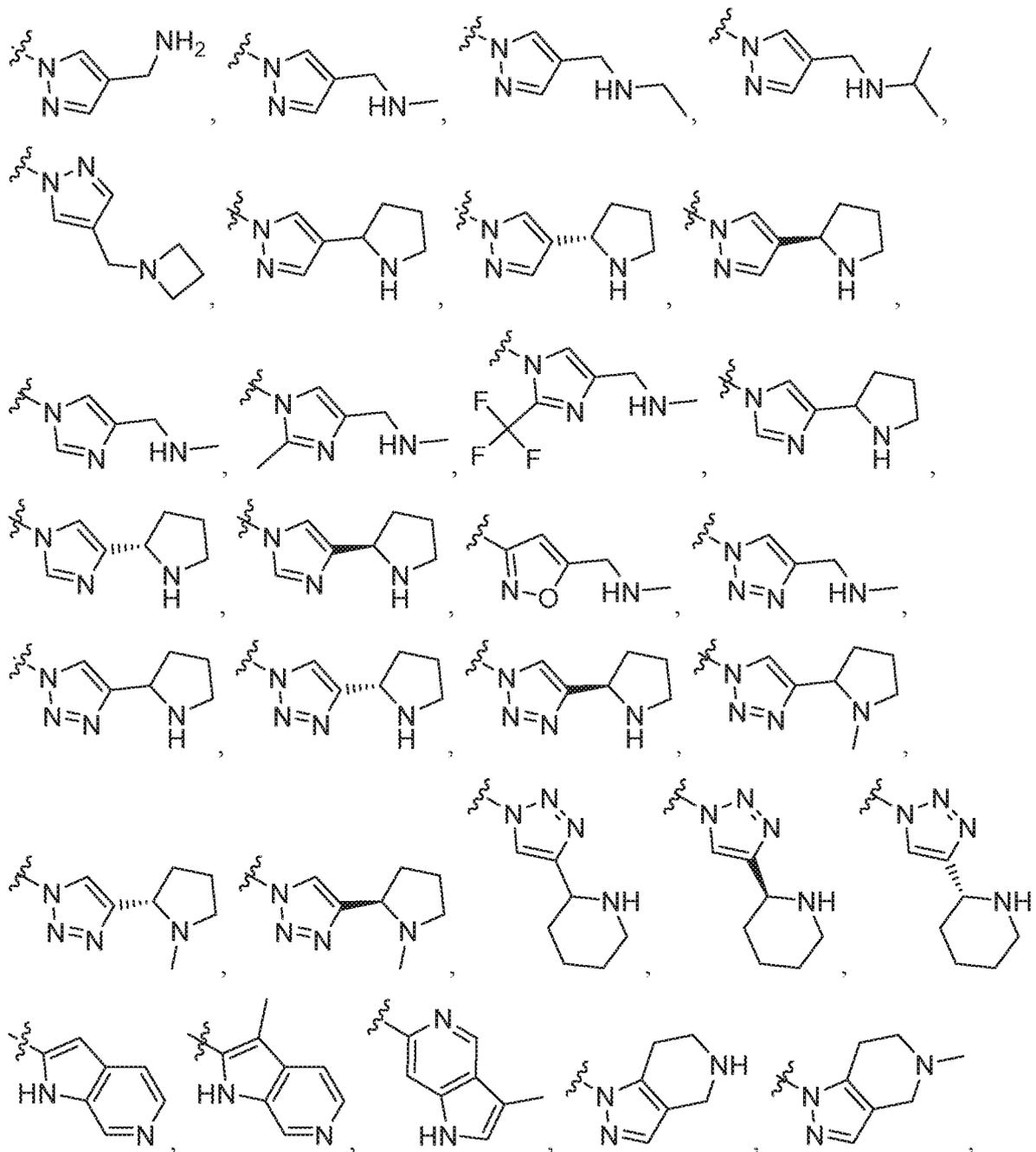
[0142] In some embodiments,  $R^{7Sa}$  and  $R^{7Sb}$  together with the nitrogen atom to which they are attached form  $C_3$ - $C_6$  heterocycloalkyl. In some embodiments,  $R^{7Sa}$  and  $R^{7Sb}$  together with the

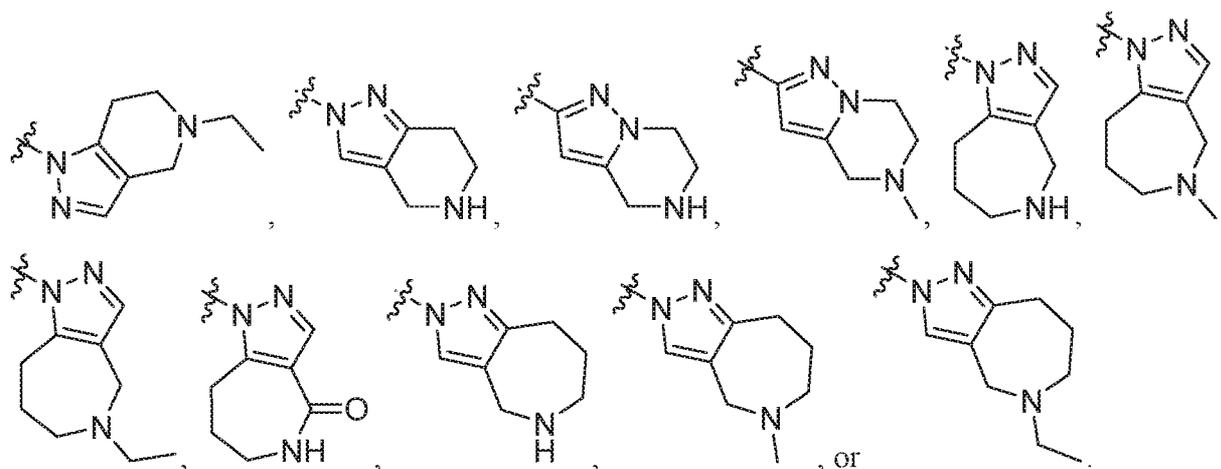
nitrogen atom to which they are attached form C<sub>4</sub> heterocycloalkyl. In some embodiments, R<sup>7Sa</sup>

and R<sup>7Sb</sup> together with the nitrogen atom to which they are attached form



[0143] In some embodiments, R<sup>7</sup> is





[0144] In some embodiments, the compound is selected from the group consisting of the compounds listed in Tables 1 and 1A, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

[0145] In some embodiments, the compound is selected from the group consisting of the compounds listed in Table 1, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

[0146] In some embodiments, the compounds are selected from those in Table 1 and pharmaceutically acceptable salts thereof.

[0147] In some embodiments, the compound is selected from the group consisting of the compounds listed in Table 1A, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

[0148] In some embodiments, one or more of the compounds inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of about 100 nM or greater, 1  $\mu$ M or greater, 10  $\mu$ M or greater, 100  $\mu$ M or greater, or 1000  $\mu$ M or greater.

[0149] In some embodiments, one or more of the compounds inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of about 1 mM or greater.

[0150] In some embodiments, one or more of the compounds inhibit a kinase with an enzyme inhibition  $IC_{50}$  value of 1  $\mu$ M or greater, 2  $\mu$ M or greater, 5  $\mu$ M or greater, or 10  $\mu$ M or greater, wherein the kinase is one or more of the following: Abl, AurA, CHK1, MAP4K, IRAK4, JAK3, EphA2, FGFR3, KDR, Lck, MARK1, MNK2, PKCb2, SIK, and Src.

[0151] In some embodiments, one or more of the compounds of the present disclosure are selective inhibitors of EHMT1. In some embodiments, one or more of the compounds of the

present disclosure are selective inhibitors of EHMT2. In some embodiments, one or more of the compounds of the present disclosure are inhibitors of EHMT1 and EHMT2.

[0152] In another aspect, the present disclosure provides pharmaceutical compositions comprising a compound of the present disclosure and a pharmaceutically acceptable carrier.

[0153] In yet another aspect, the present disclosure provides methods of inhibiting one or more HMTs (e.g., inhibiting one or both of EHMT1 and EHMT2), the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.

[0154] In some embodiments, the subject has an EHMT-mediated disorder (e.g., an EHMT1-mediated disorder, an EHMT2-mediated disorder, or an EHMT1/2-mediated disorder). In some embodiments, the subject has a blood disorder. In some embodiments, the subject has a cancer.

[0155] In yet another aspect, the present disclosure provides methods of preventing or treating a blood disorder (e.g., via inhibition of a methyltransferase enzyme selected from EHMT1 and EHMT2), the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.

[0156] In some embodiments, the blood disorder is sickle cell anemia or  $\beta$ -thalassemia.

[0157] In some embodiments, the blood disorder is a hematological cancer.

[0158] In yet another aspect, the present disclosure provides methods of treating a cancer (e.g., via inhibition of a methyltransferase enzyme selected from EHMT1 and EHMT2), the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of the present disclosure.

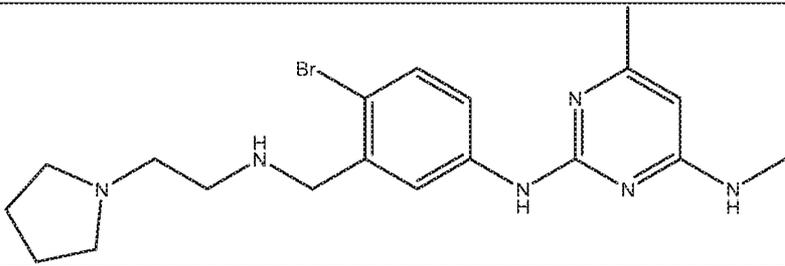
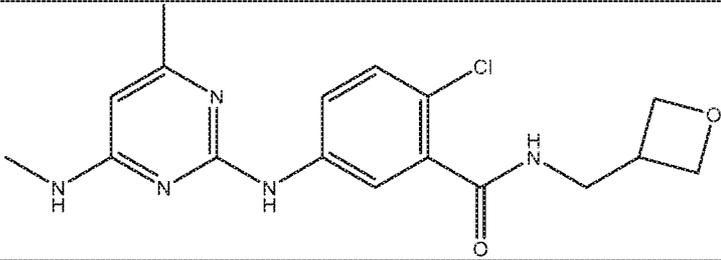
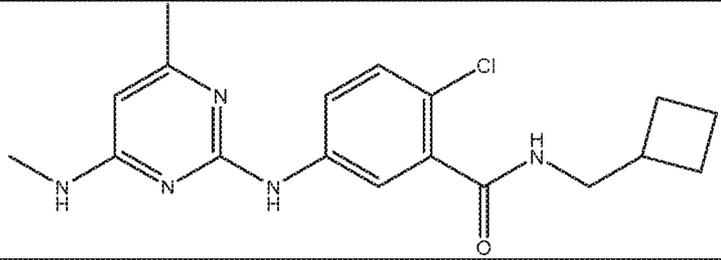
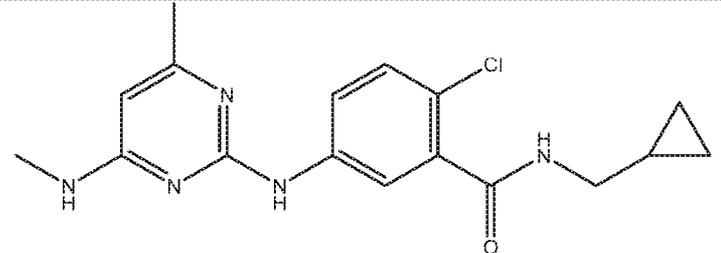
[0159] In some embodiments, the cancer is lymphoma, leukemia, melanoma, breast cancer, ovarian cancer, hepatocellular carcinoma, prostate carcinoma, lung cancer, brain cancer, or hematological cancer. In some embodiments, the hematological cancer is acute myeloid leukemia (AML) or chronic lymphocytic leukemia (CLL). In some embodiments, the lymphoma is diffuse large B-cell lymphoma, follicular lymphoma, Burkitt's lymphoma or Non-Hodgkin's Lymphoma. In some embodiments, the cancer is chronic myelogenous leukemia (CML), acute myeloid leukemia, acute lymphocytic leukemia or mixed lineage leukemia, or myelodysplastic syndromes (MDS).

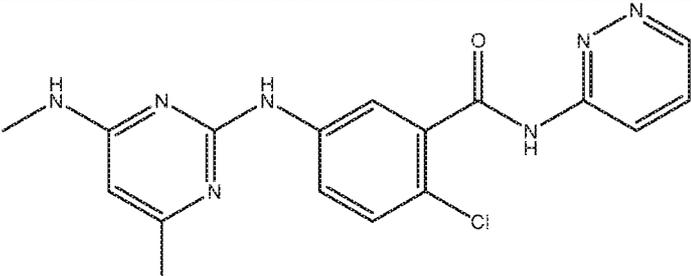
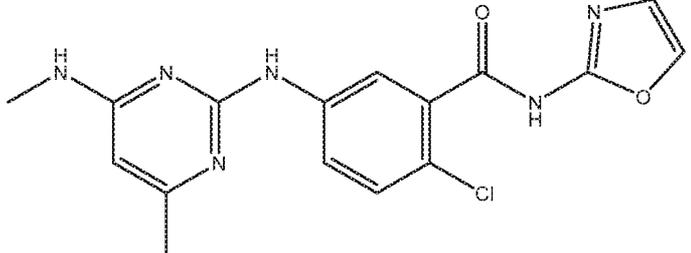
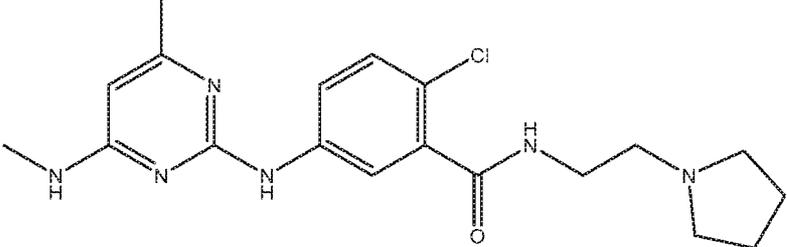
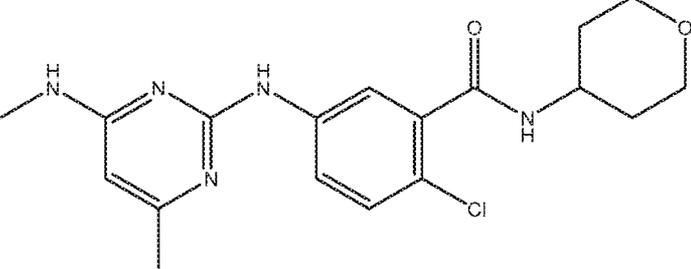
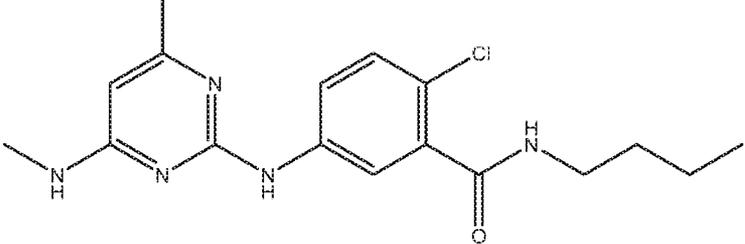
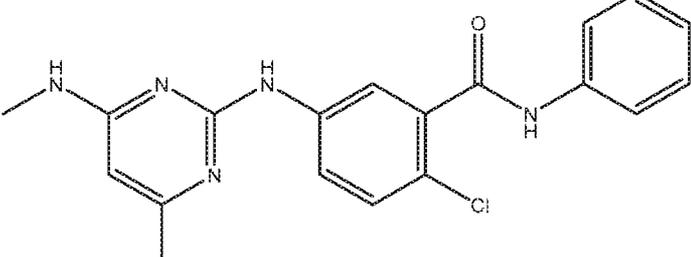
[0160] In some embodiments, the administered compound is a selective inhibitor of EHMT1. In some embodiments, the administered compound is a selective inhibitor of EHMT2. In some embodiments, the administered compound is an inhibitor of EHMT1 and EHMT2.

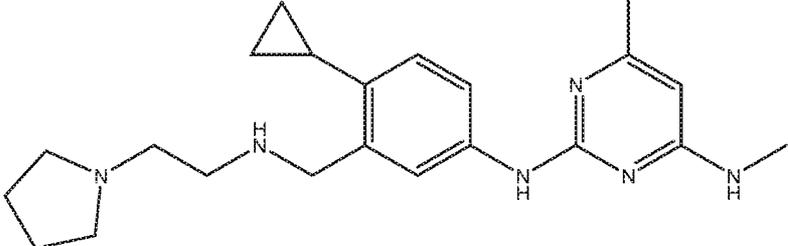
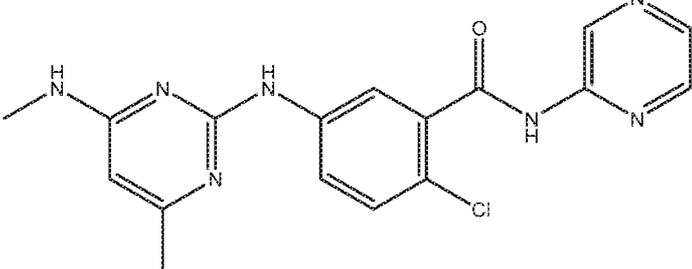
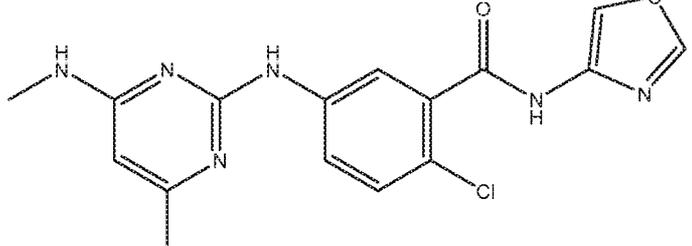
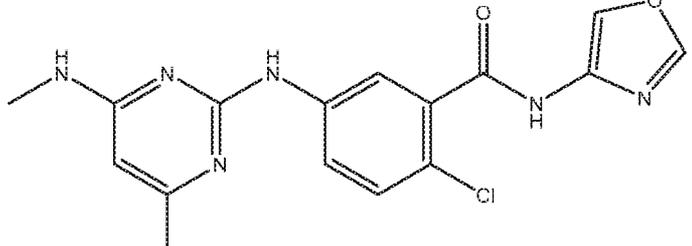
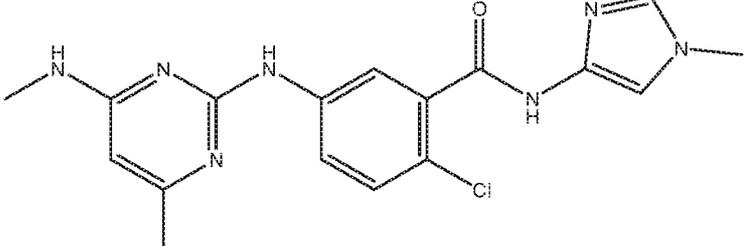
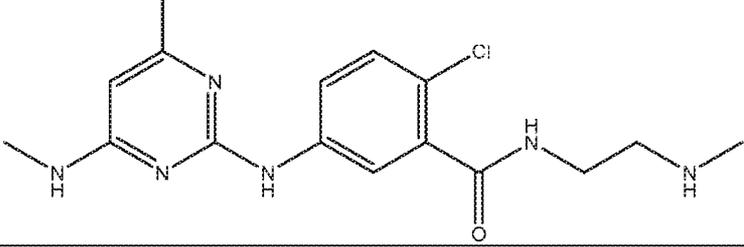
[0161] In some embodiments, the compound is selected from the group consisting of the compounds listed in Tables 1 and 1A below, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

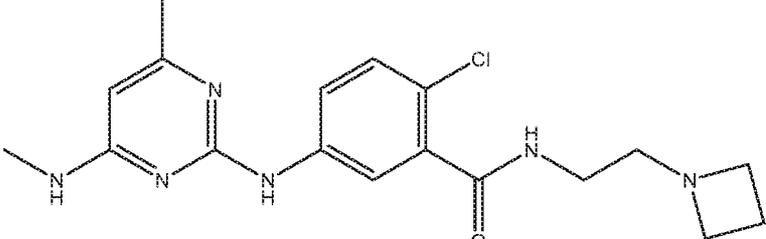
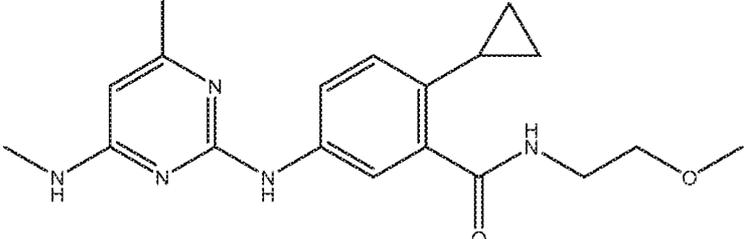
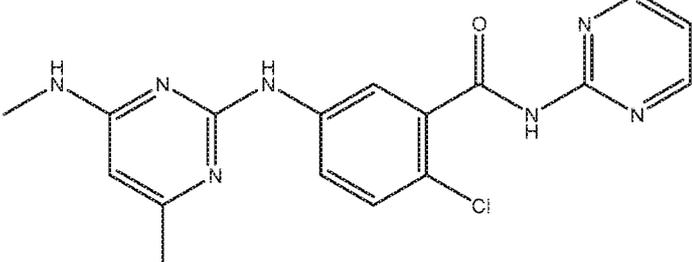
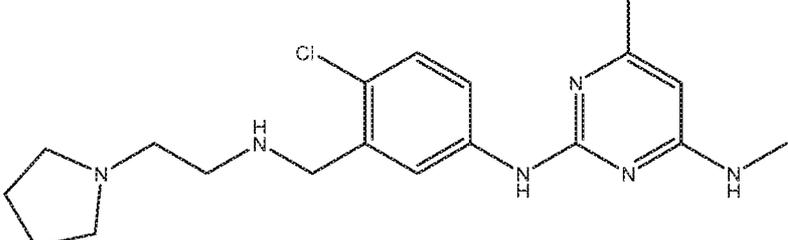
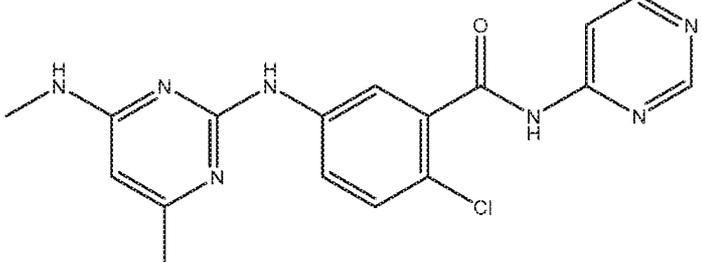
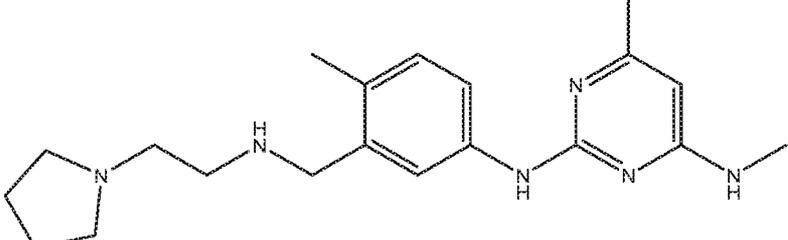
[0162] In some embodiments, the compound is selected from the group consisting of the compounds listed in Table 1 below, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

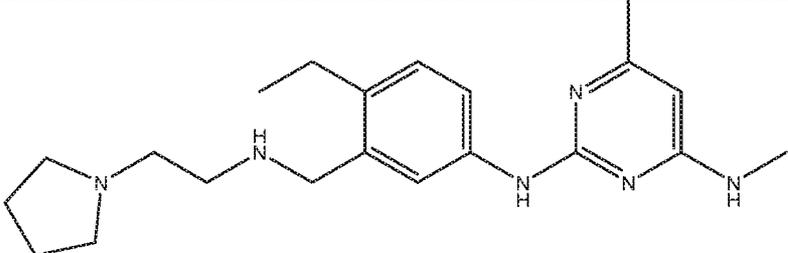
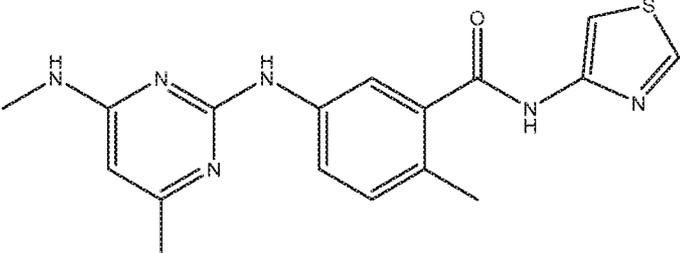
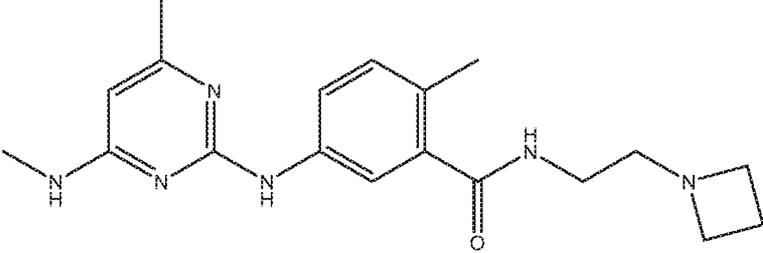
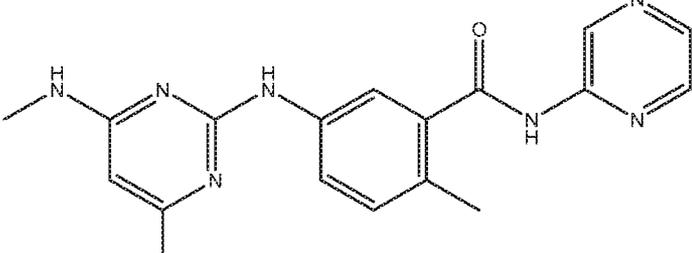
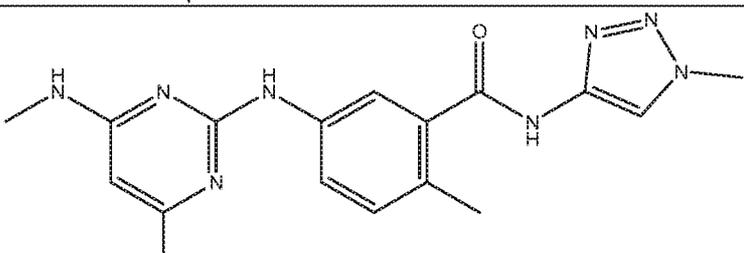
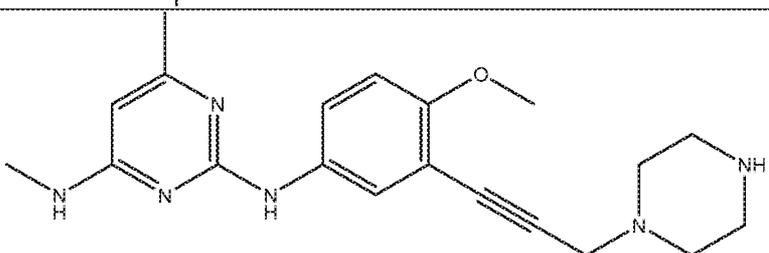
**Table 1**

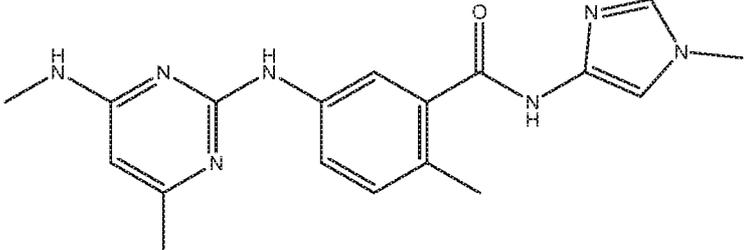
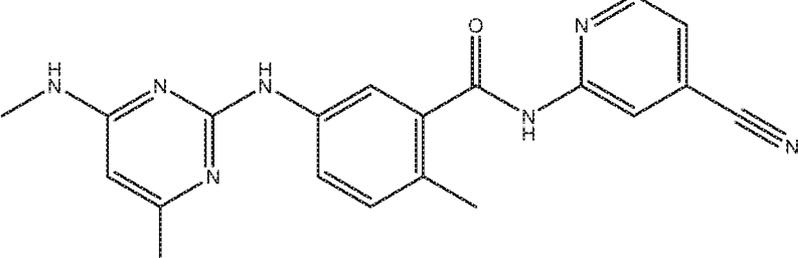
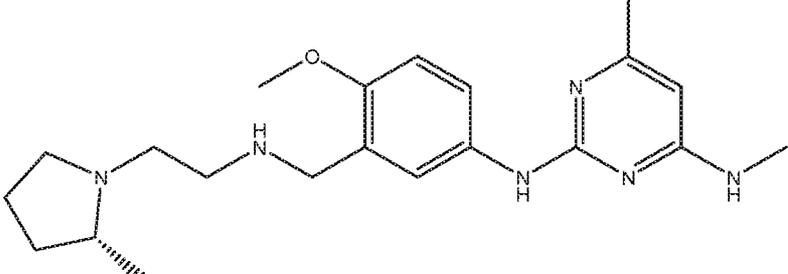
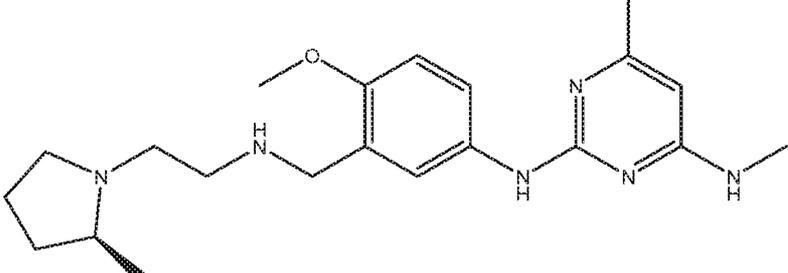
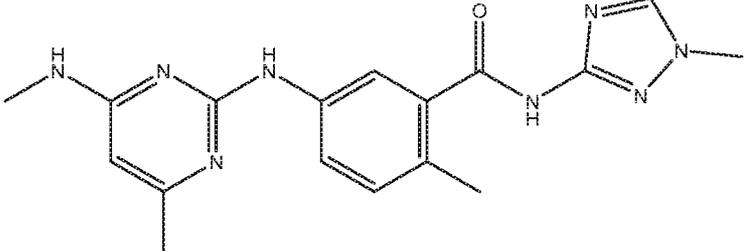
Compound No.	Structure
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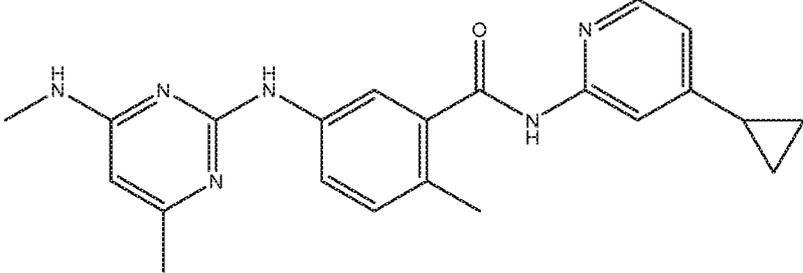
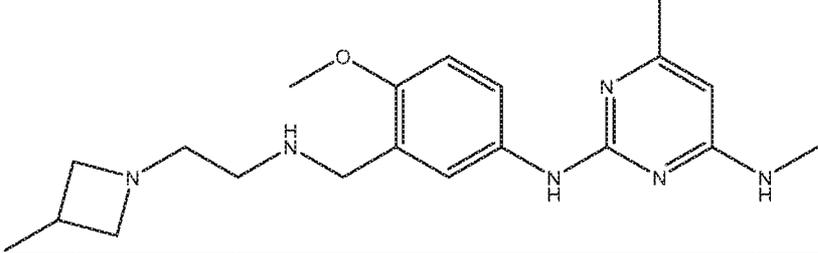
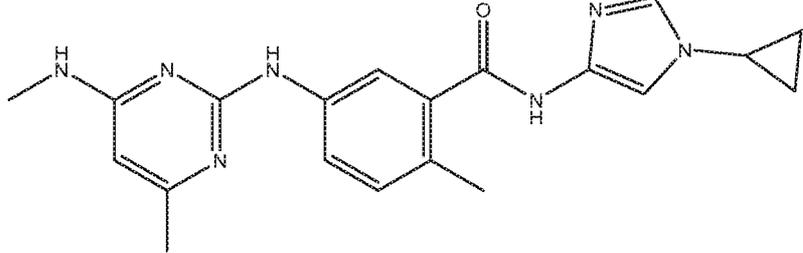
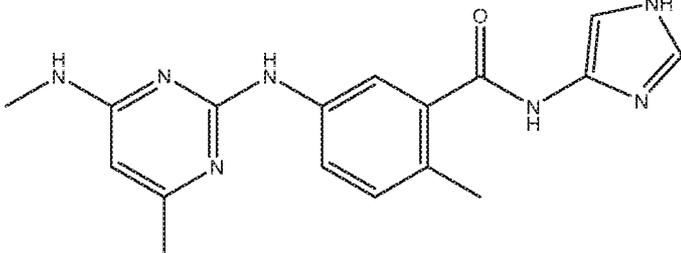
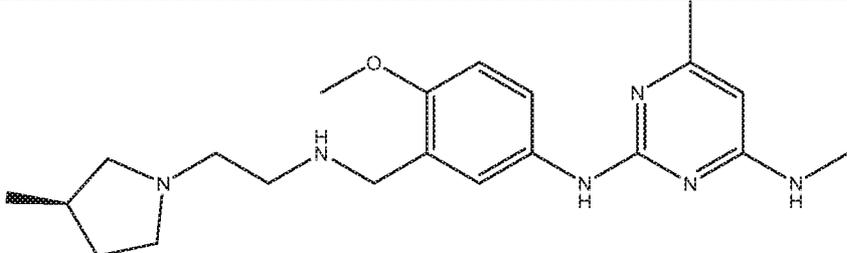
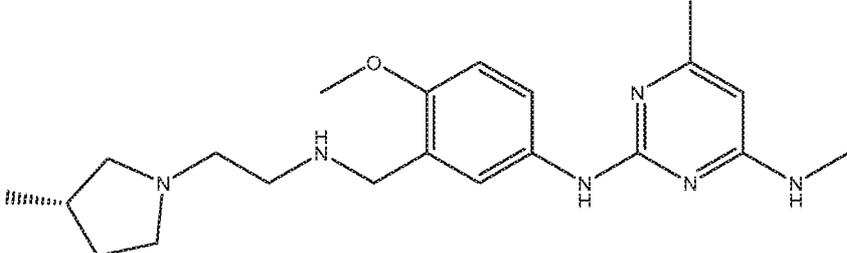
Compound No.	Structure
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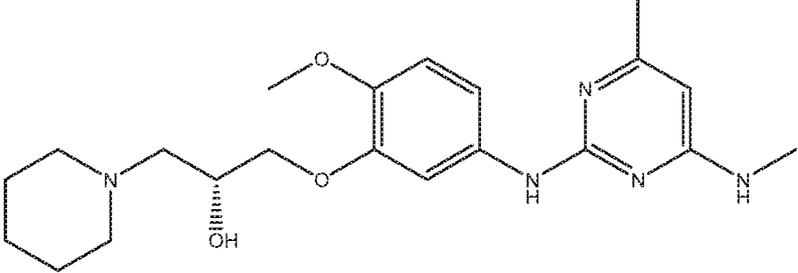
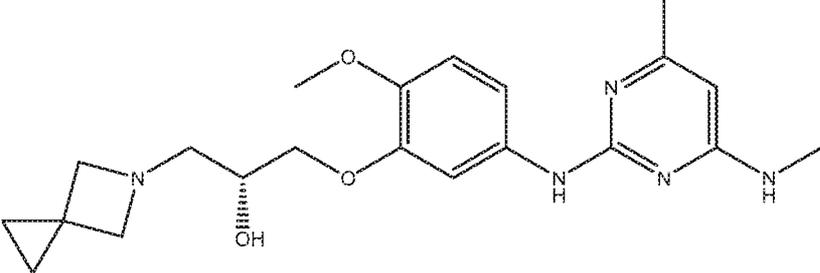
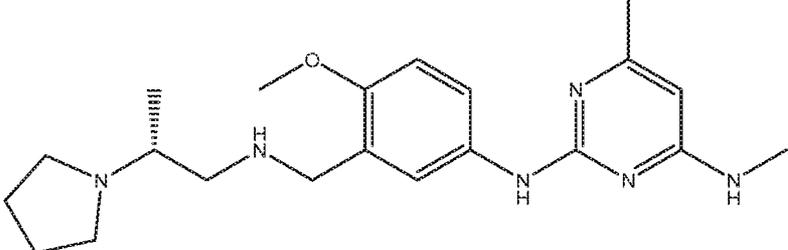
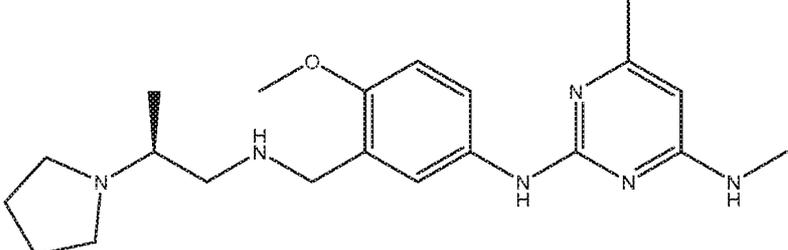
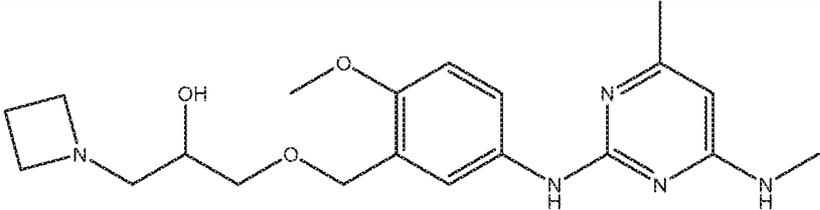
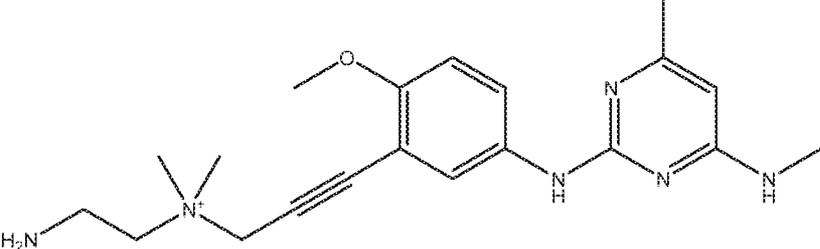
Compound No.	Structure
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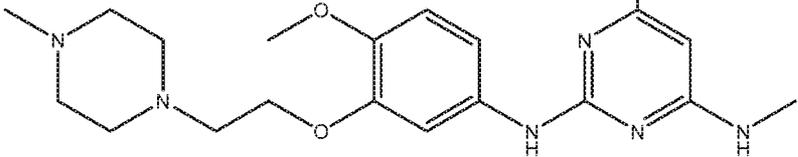
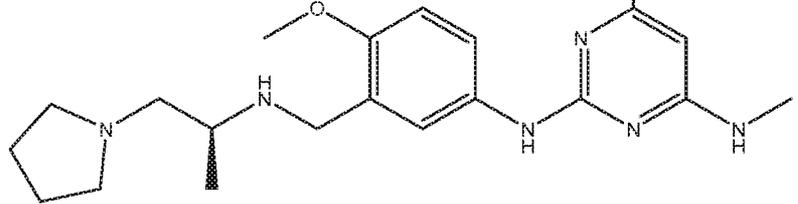
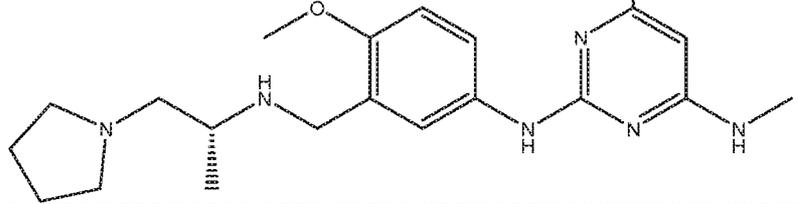
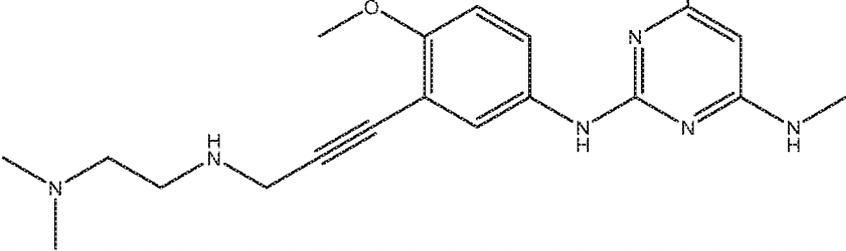
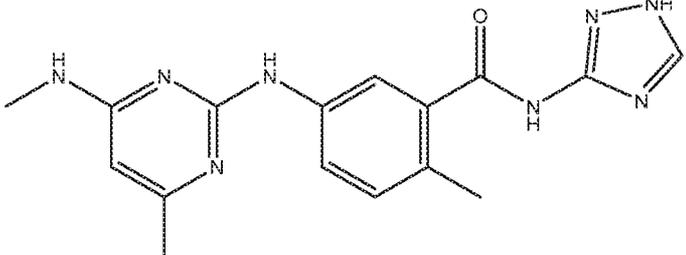
Compound No.	Structure
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22	 <chem>CN1C=NC(NC2=CC(Cl)=CC2CCN3CCCC3)=CN1</chem>

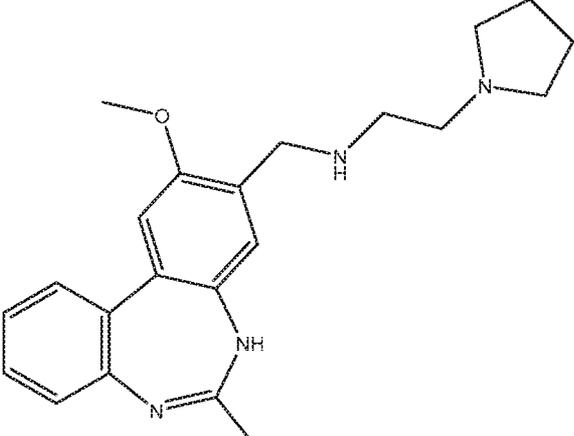
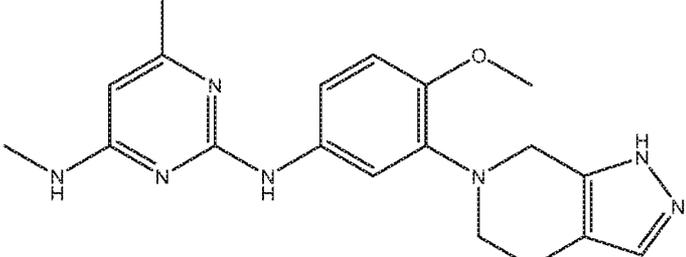
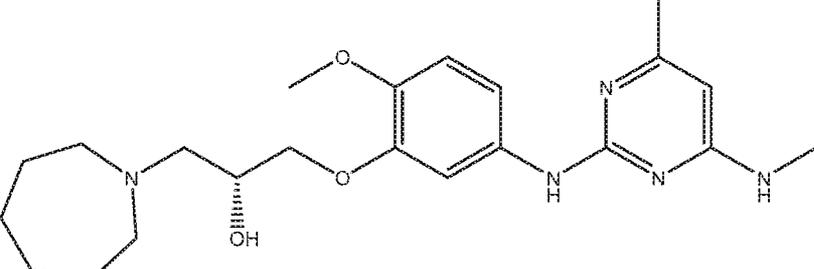
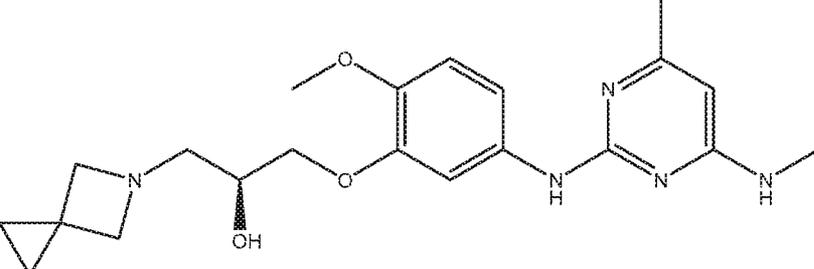
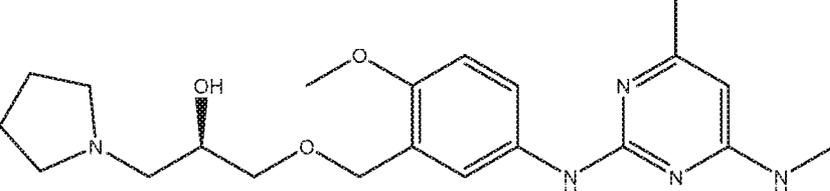
Compound No.	Structure
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Compound No.	Structure
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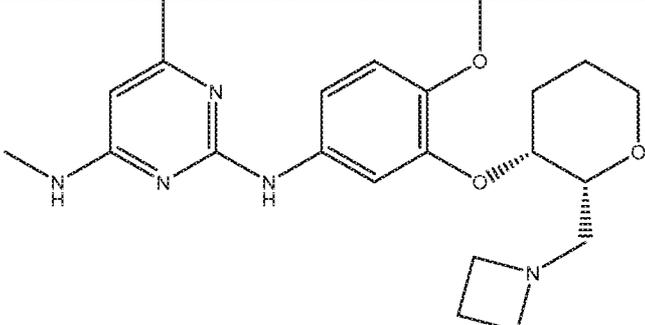
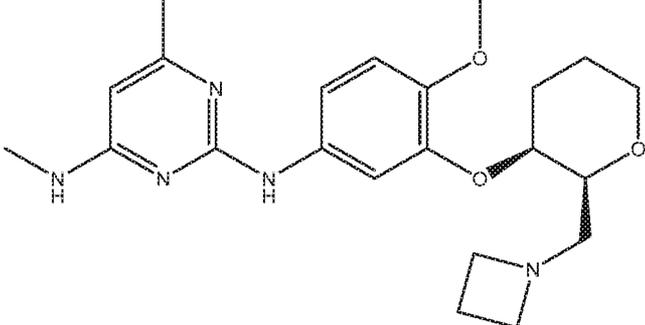
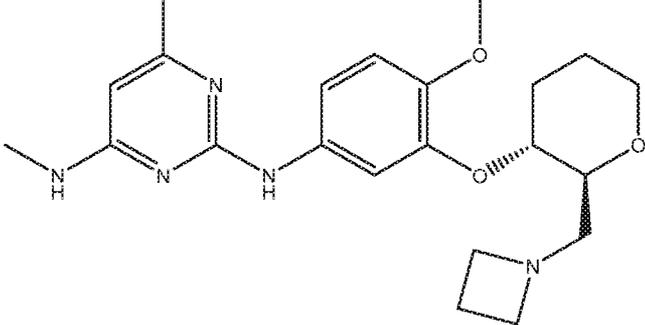
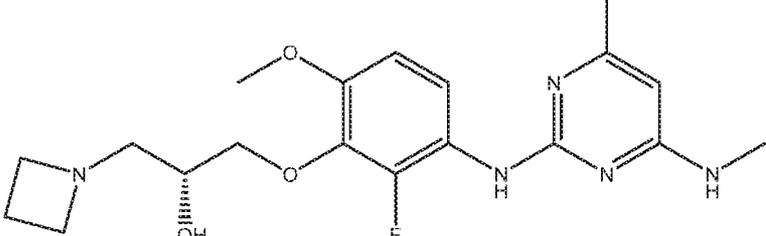
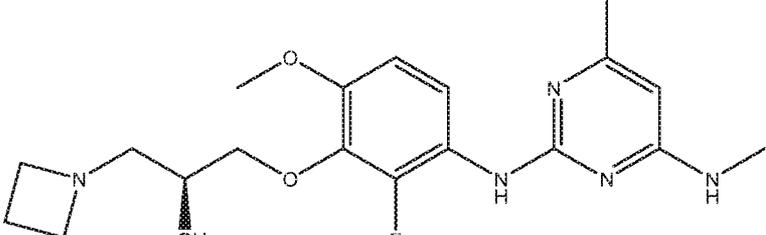
Compound No.	Structure
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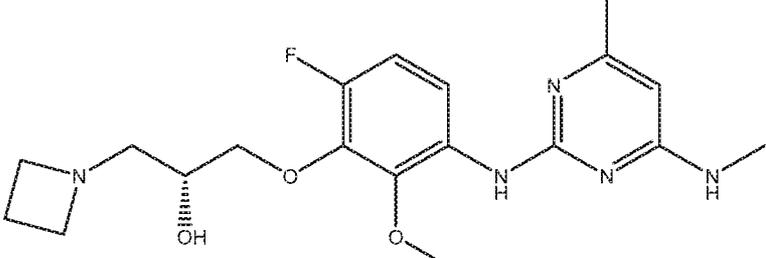
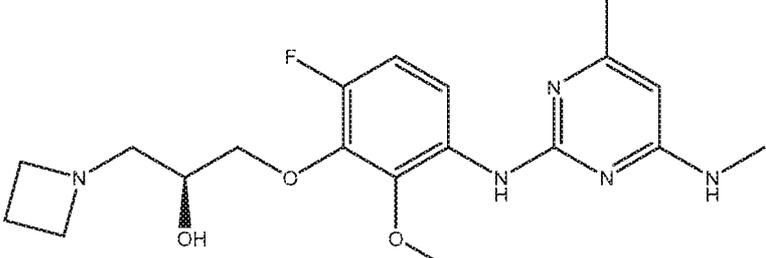
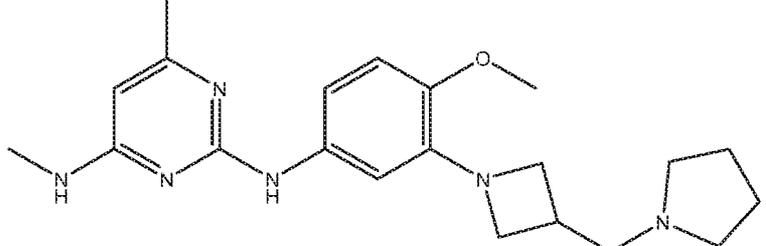
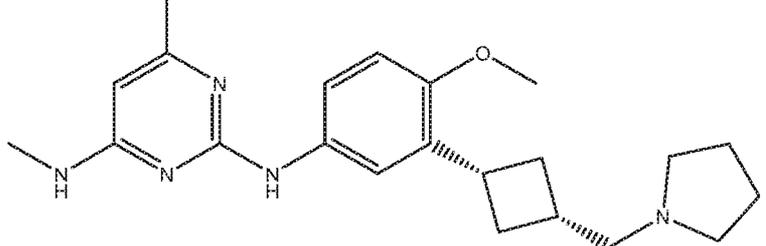
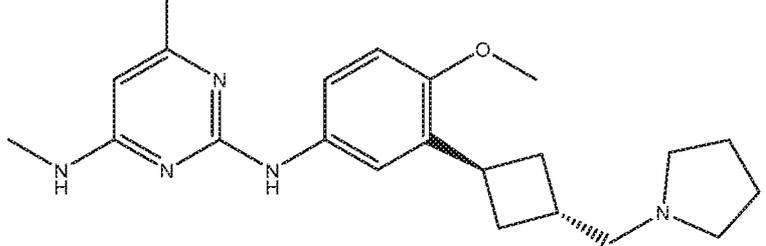
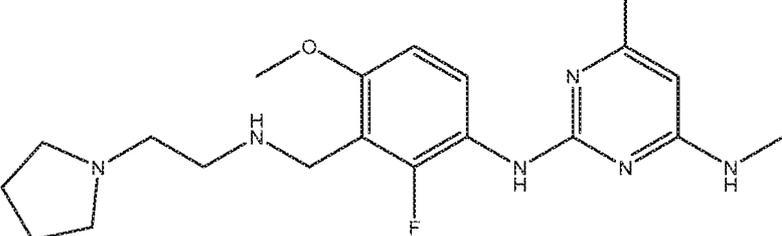
Compound No.	Structure
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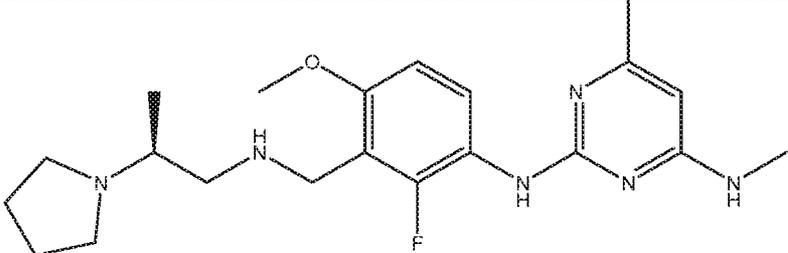
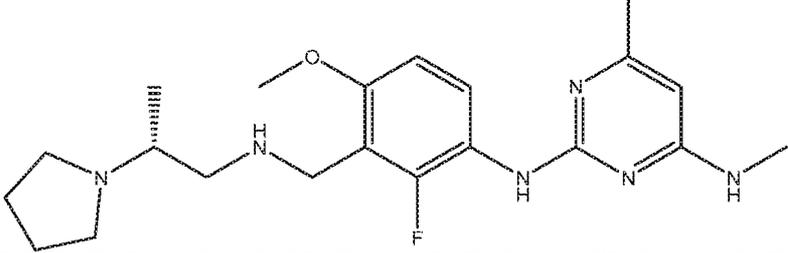
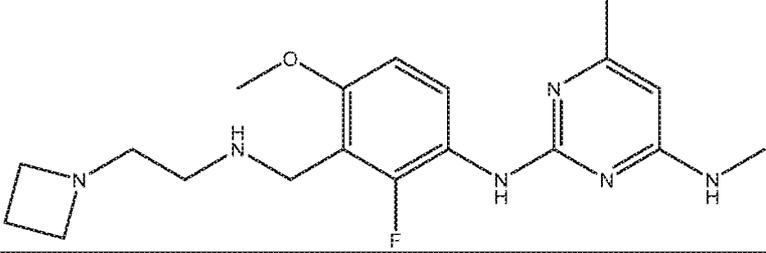
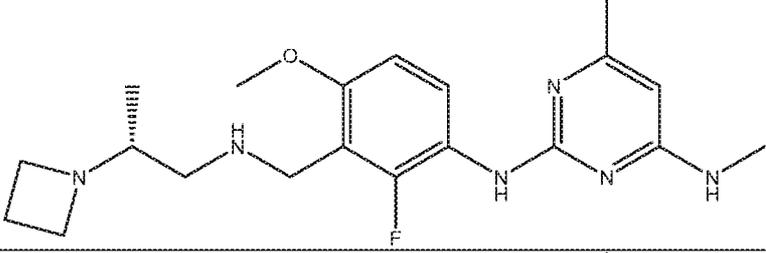
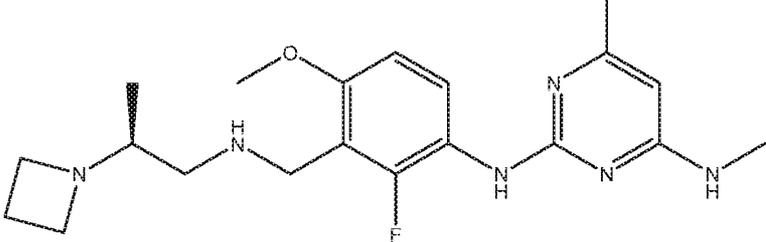
Compound No.	Structure
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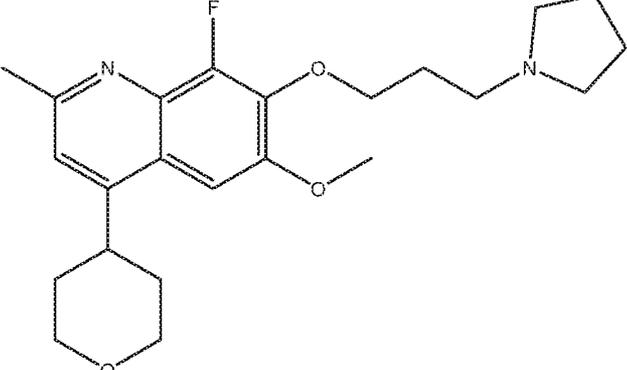
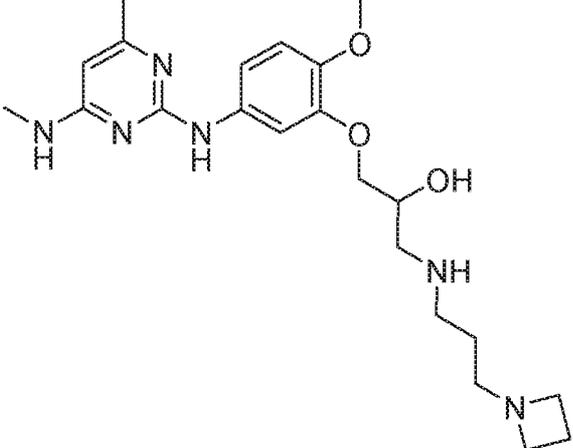
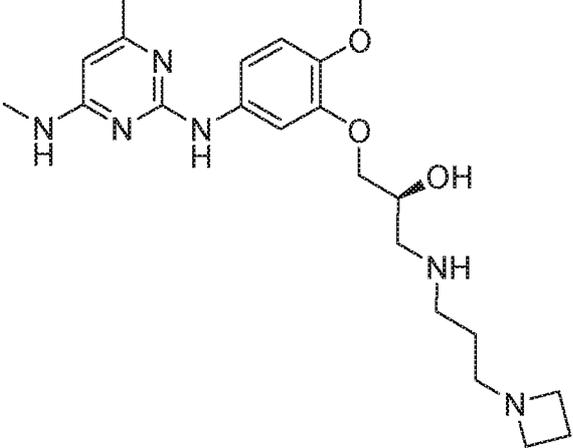
Compound No.	Structure
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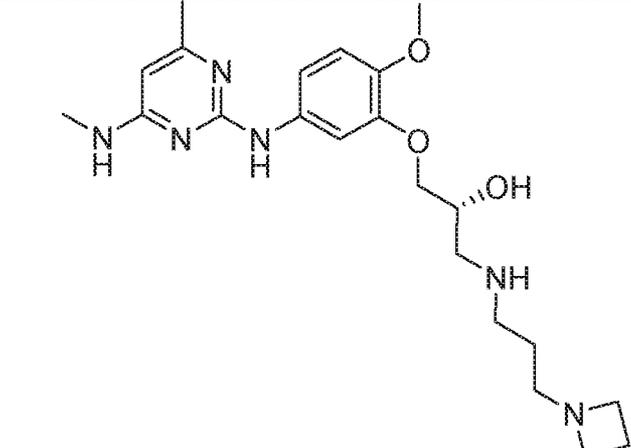
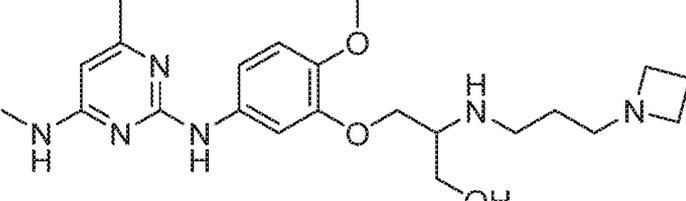
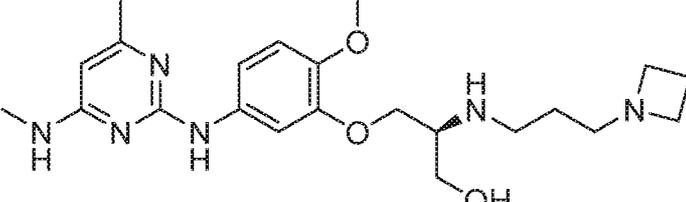
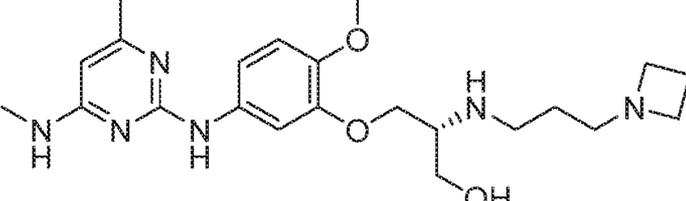
Compound No.	Structure
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Compound No.	Structure
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Compound No.	Structure
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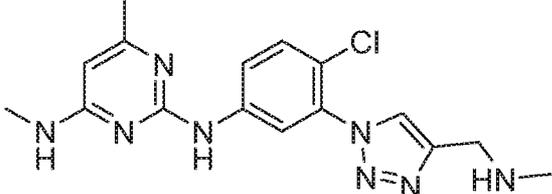
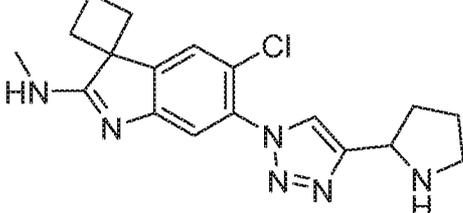
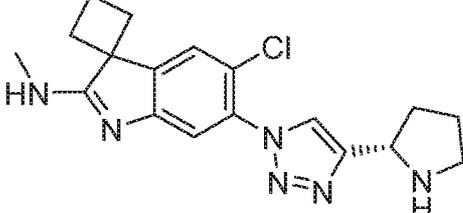
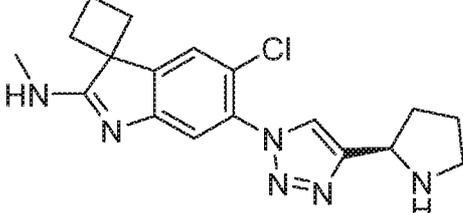
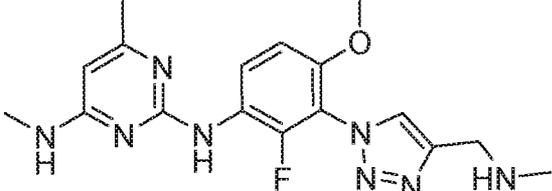
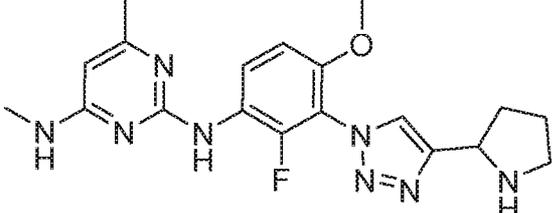
Compound No.	Structure
73	
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Compound No.	Structure
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79	 <chem>CN1C=NC(=N1)N(C)C2=CC(OC)=C(OC)C2OCC(O)CNCCN3CCCC3</chem>
79S	 <chem>CN1C=NC(=N1)N(C)C2=CC(OC)=C(OC)C2OCC(O)CNCCN3CCCC3</chem>

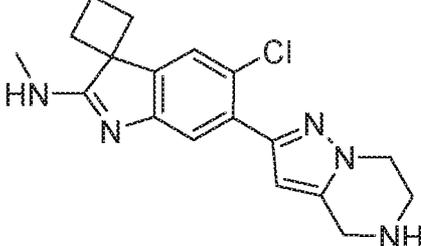
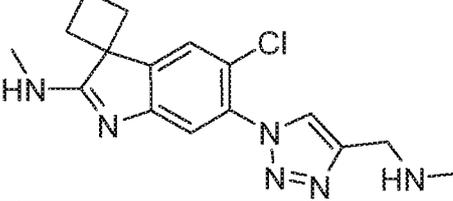
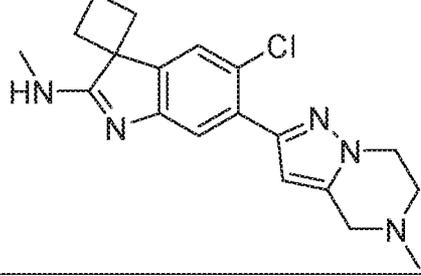
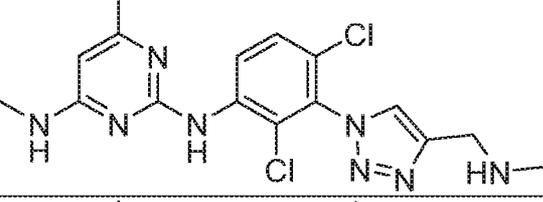
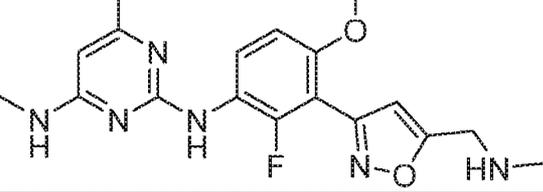
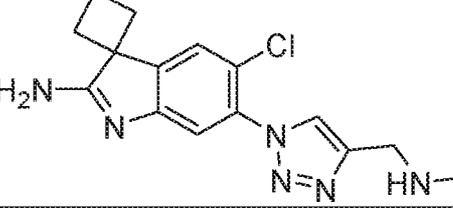
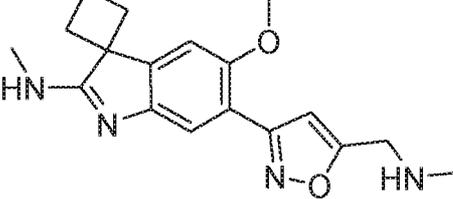
Compound No.	Structure
79R	 <p>Chemical structure of compound 79R: A pyrimidine ring substituted with a methyl group at the 5-position and a methylamino group at the 2-position. The 4-position of the pyrimidine ring is linked via an NH group to a benzene ring. The benzene ring has a methoxy group at the 1-position and a propyl chain at the 3-position. The propyl chain is connected to a chiral carbon atom bonded to a hydroxyl group (OH) and an NH group. The NH group is further connected to a propyl chain, which is terminated by a nitrogen atom in a four-membered ring (azetidine).</p>
80	 <p>Chemical structure of compound 80: Similar to 79R, but the propyl chain is connected to a chiral carbon atom bonded to a hydroxyl group (OH) and an NH group. The NH group is further connected to a propyl chain, which is terminated by a nitrogen atom in a four-membered ring (azetidine).</p>
80S	 <p>Chemical structure of compound 80S: Similar to 80, but the propyl chain is connected to a chiral carbon atom bonded to a hydroxyl group (OH) and an NH group. The NH group is further connected to a propyl chain, which is terminated by a nitrogen atom in a four-membered ring (azetidine).</p>
80R	 <p>Chemical structure of compound 80R: Similar to 80, but the propyl chain is connected to a chiral carbon atom bonded to a hydroxyl group (OH) and an NH group. The NH group is further connected to a propyl chain, which is terminated by a nitrogen atom in a four-membered ring (azetidine).</p>

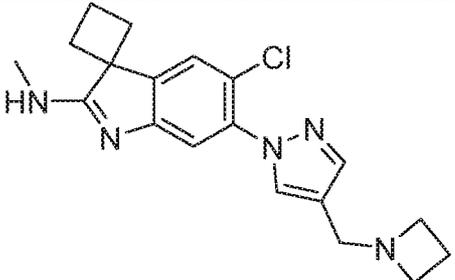
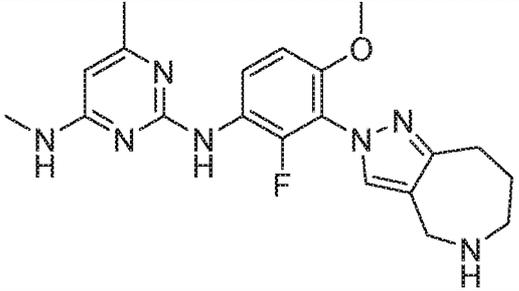
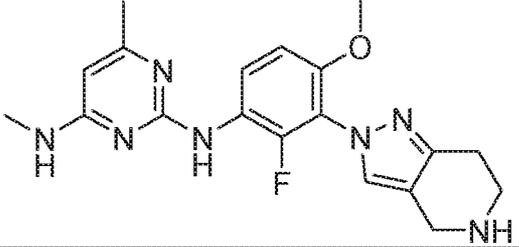
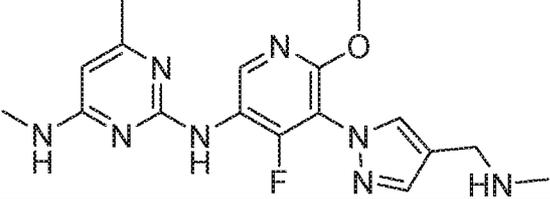
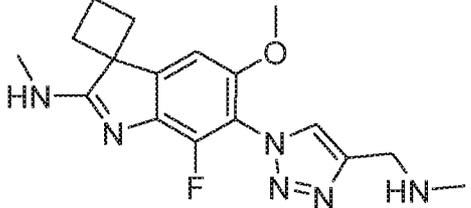
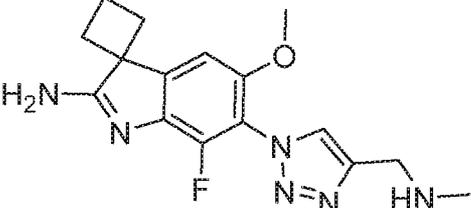
[0163] In some embodiments, the compound is selected from the group consisting of the compounds listed in Table 1A below, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

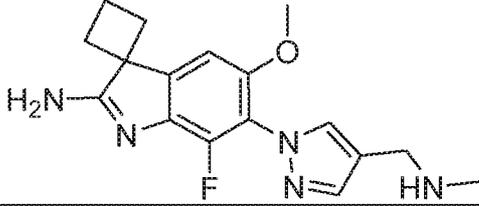
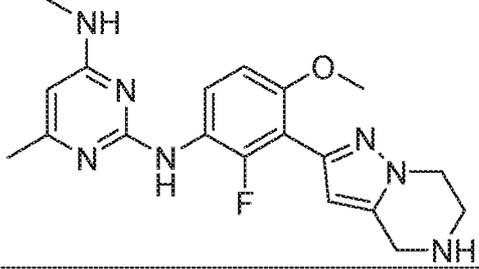
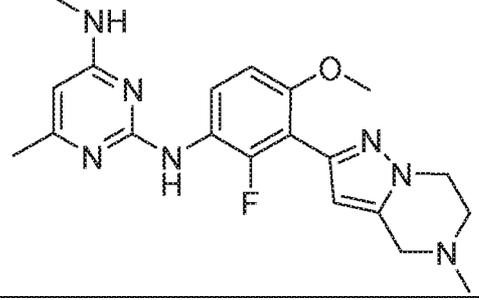
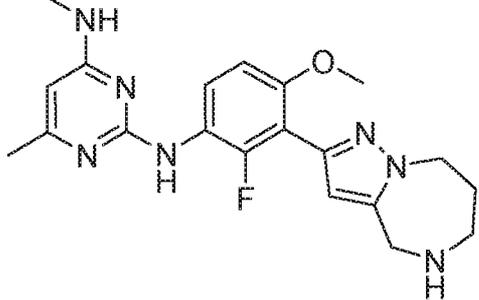
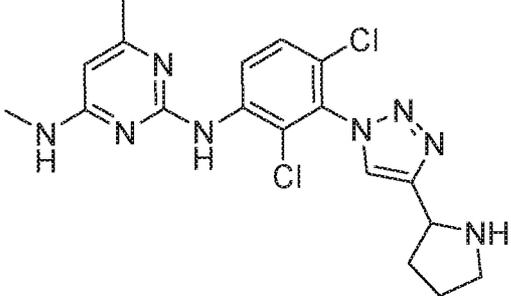
Table 1A

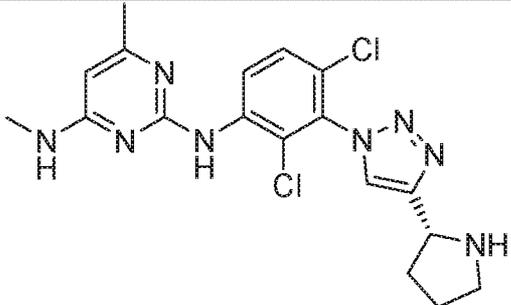
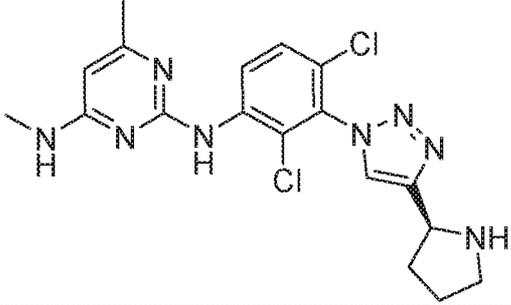
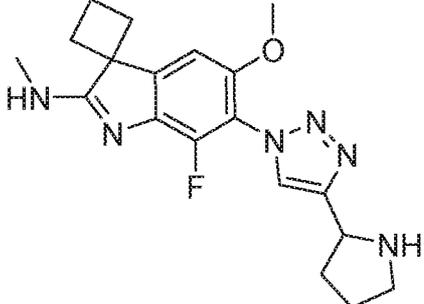
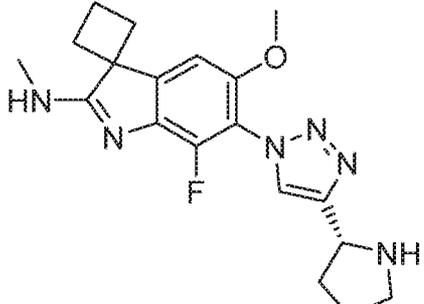
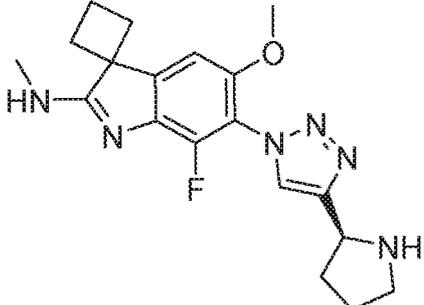
Compound No.	Structure
A1	
A2	
A2S	
A2R	
A3	
A4	

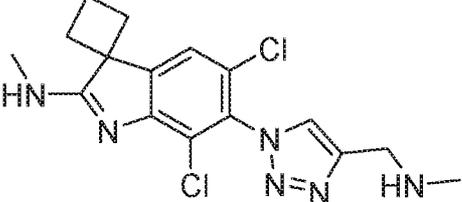
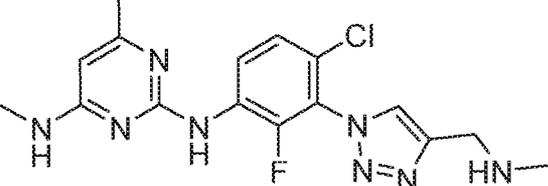
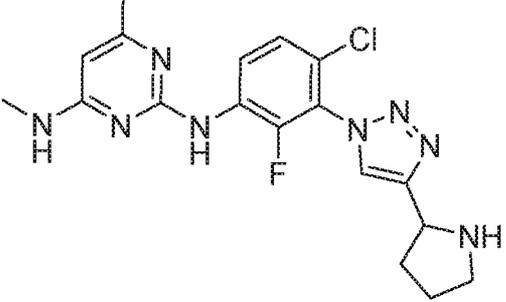
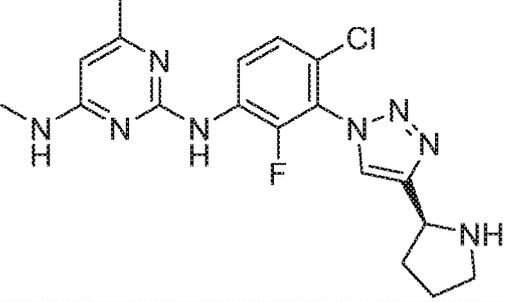
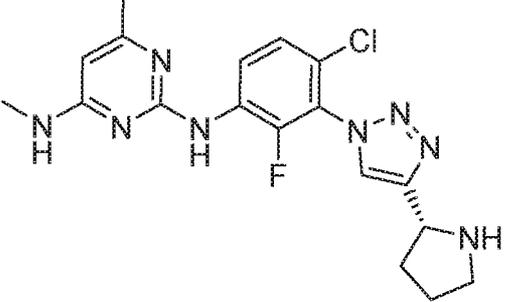
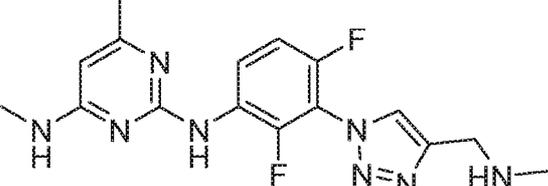
Compound No.	Structure
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A4R	
A5	
A6	
A7	
A8	
A9	

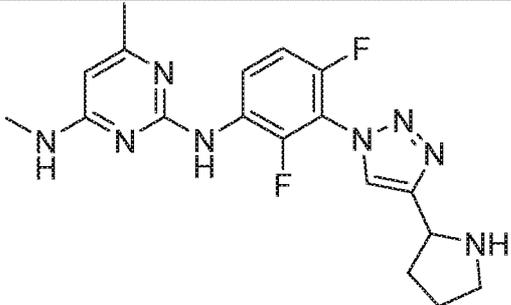
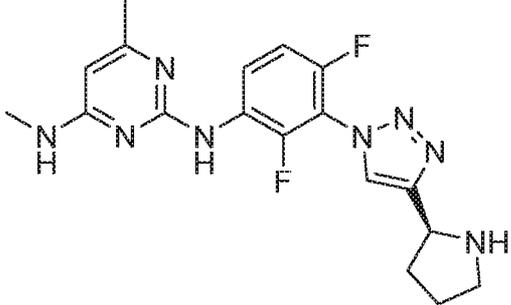
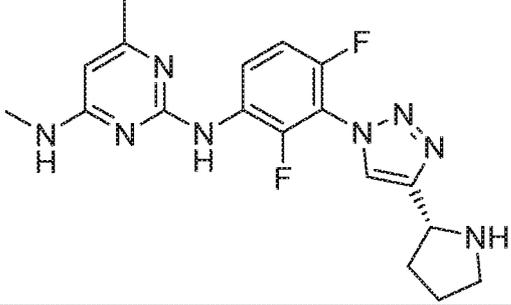
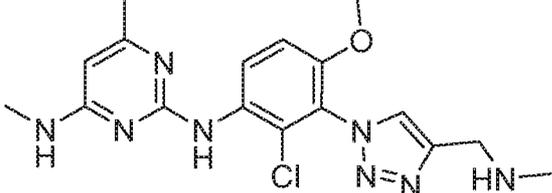
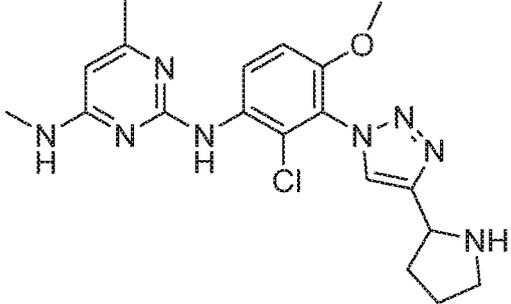
Compound No.	Structure
A10	
A11	
A12	
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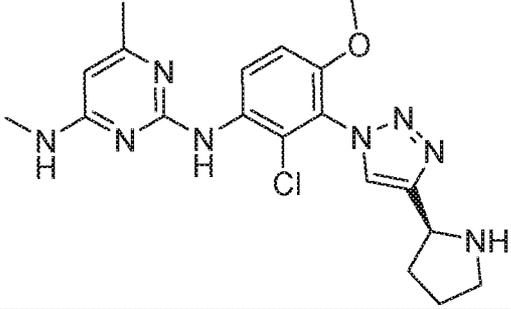
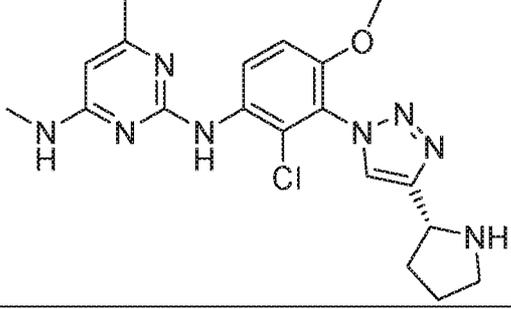
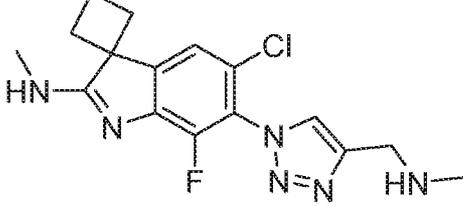
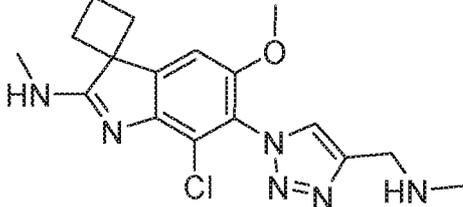
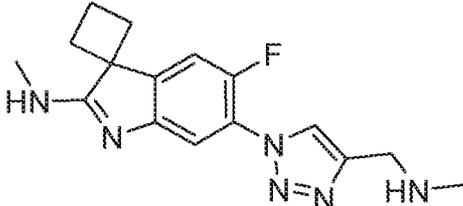
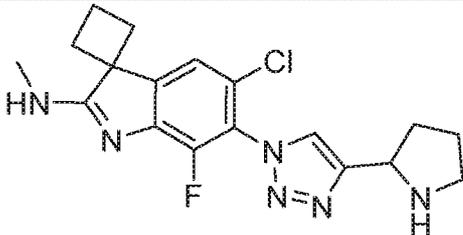
Compound No.	Structure
A17	
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Compound No.	Structure
A23	
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A26	
A27	

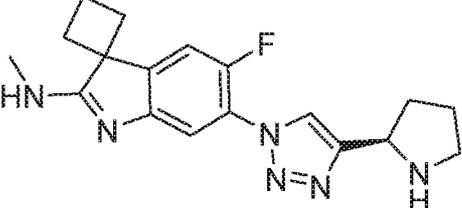
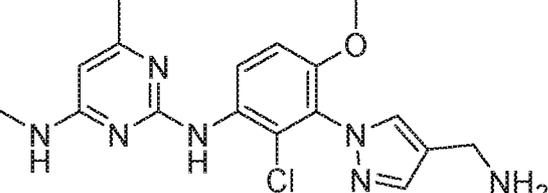
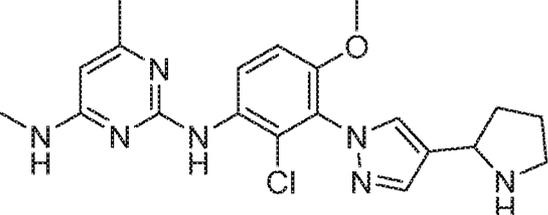
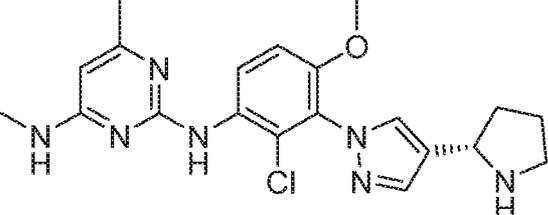
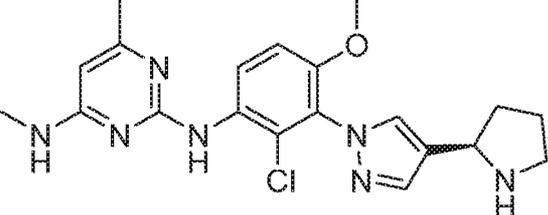
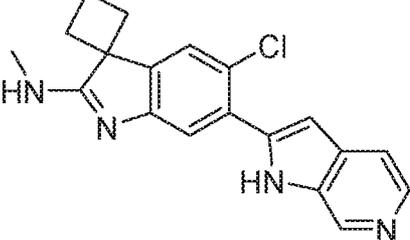
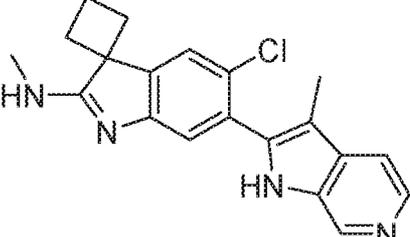
Compound No.	Structure
A27R	
A27S	
A28	
A28R	
A28S	

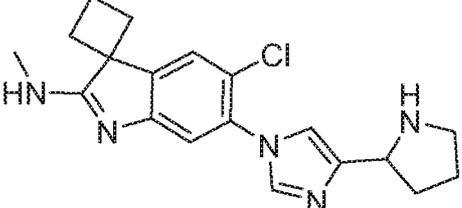
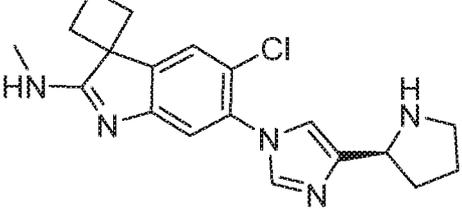
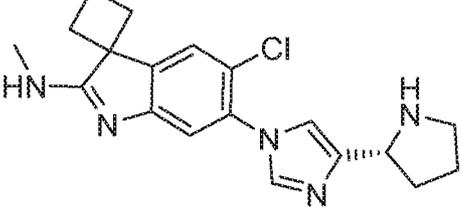
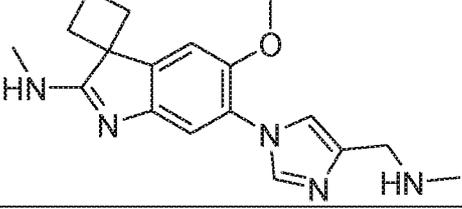
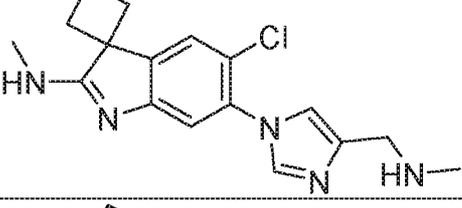
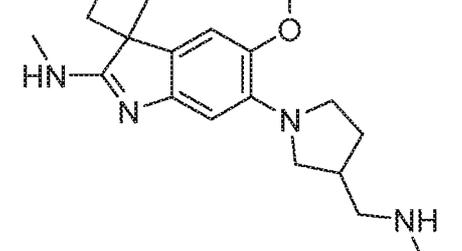
Compound No.	Structure
A29	
A30	
A31	
A31S	
A31R	
A32	

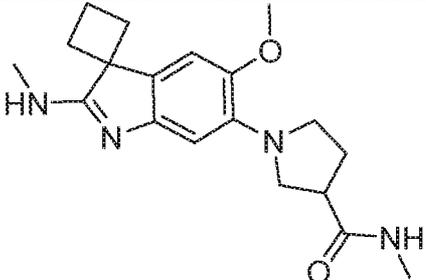
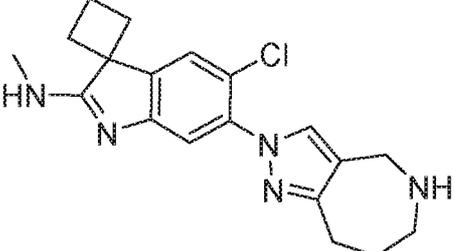
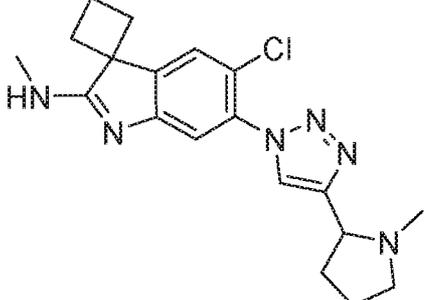
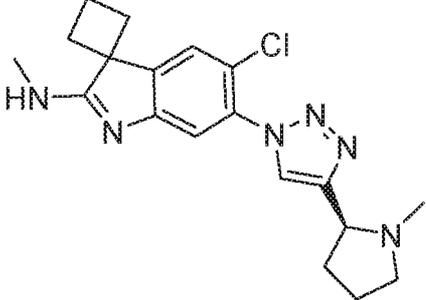
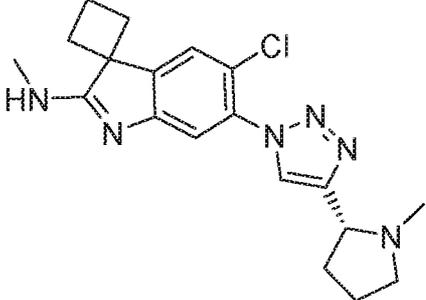
Compound No.	Structure
A33	
A33S	
A33R	
A34	
A35	

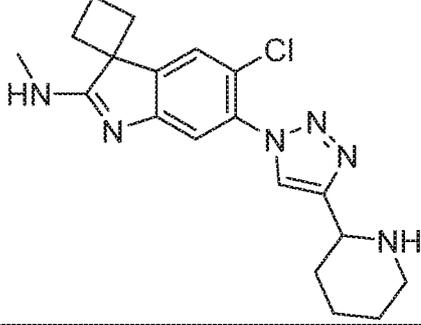
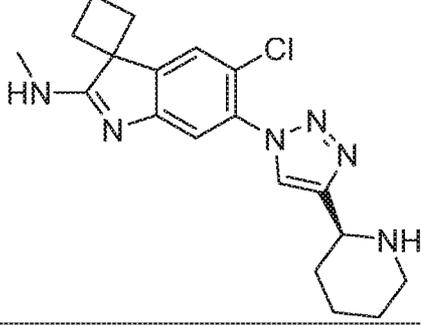
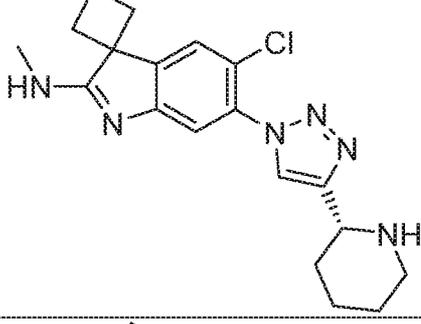
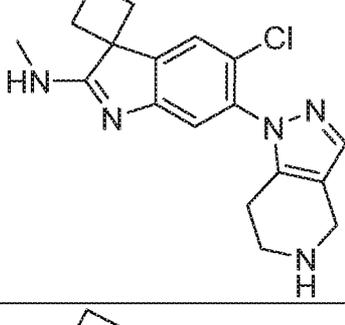
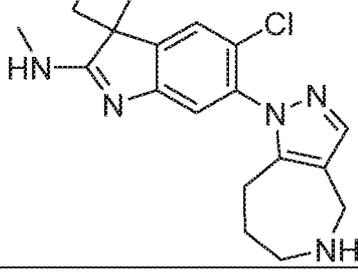
Compound No.	Structure
A35S	
A35R	
A36	
A37	
A38	
A39	

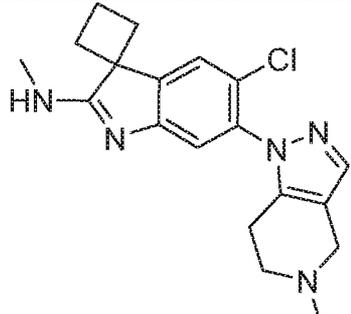
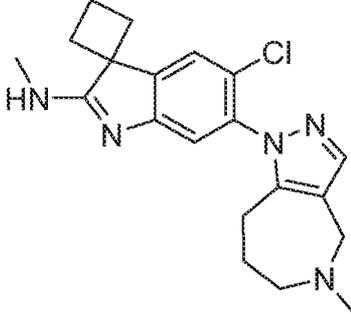
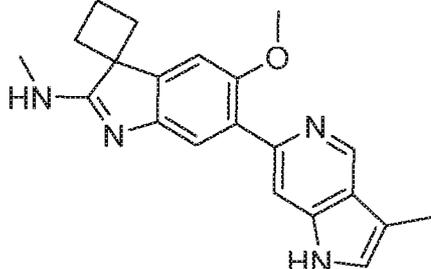
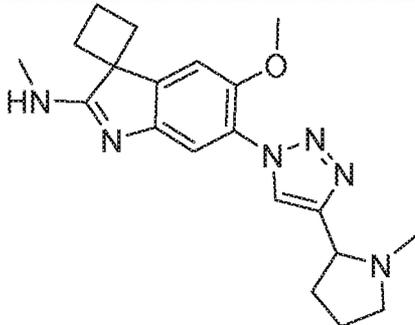
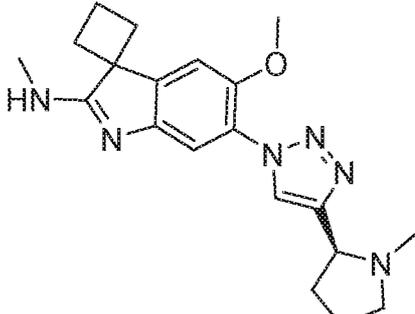
Compound No.	Structure
A39S	
A39R	
A40	
A40S	
A40R	
A41	
A41S	

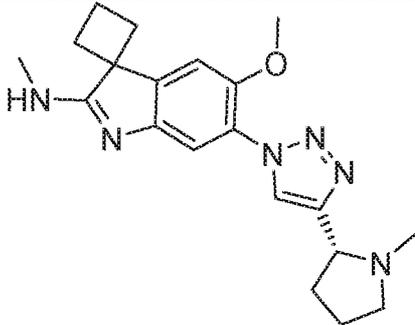
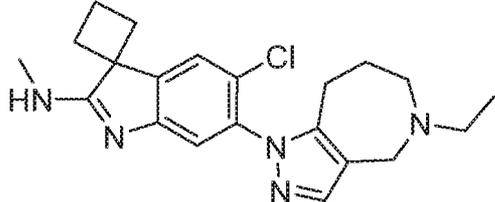
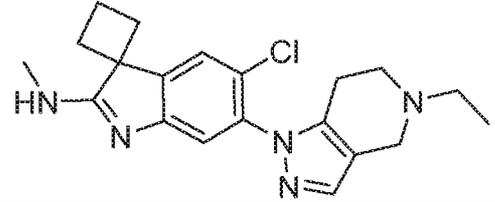
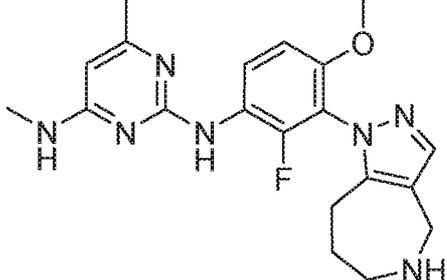
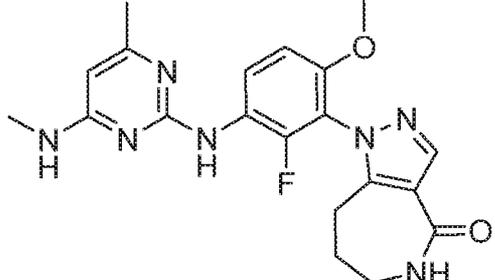
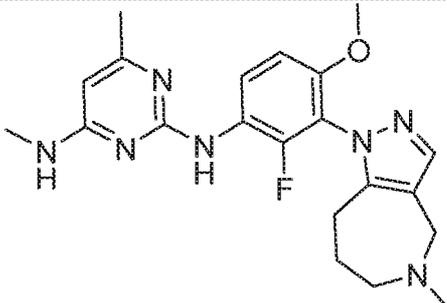
Compound No.	Structure
A41R	
A42	
A43	
A43S	
A43R	
A44	
A45	

Compound No.	Structure
A46	
A46S	
A46R	
A47	
A48	
A49	

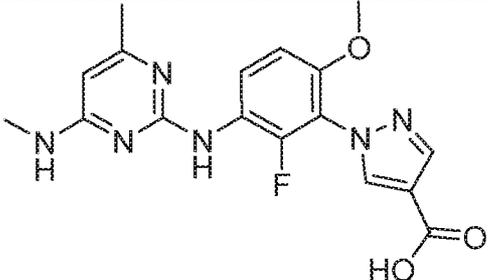
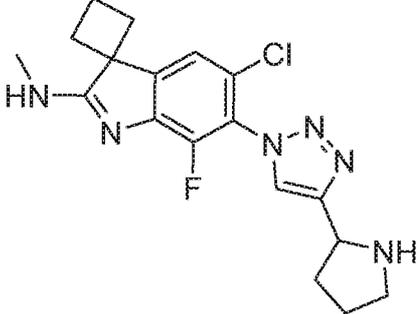
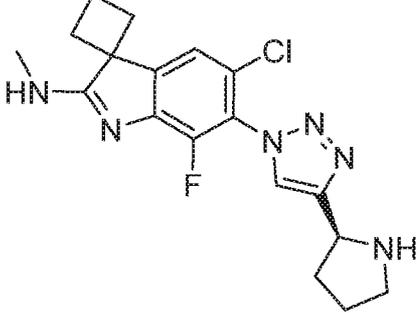
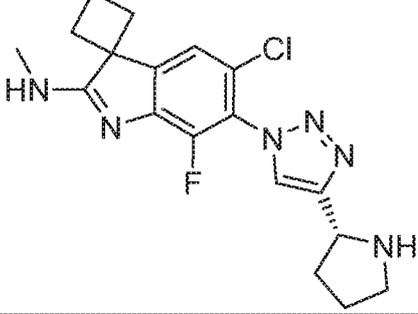
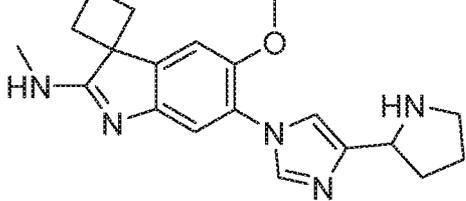
Compound No.	Structure
A50	
A51	
A52	
A52S	
A52R	

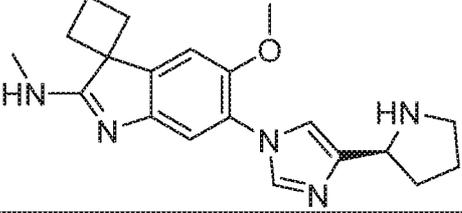
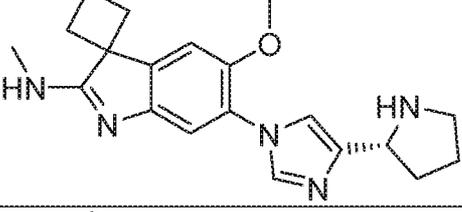
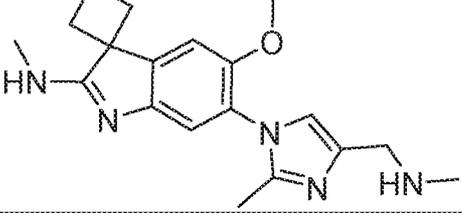
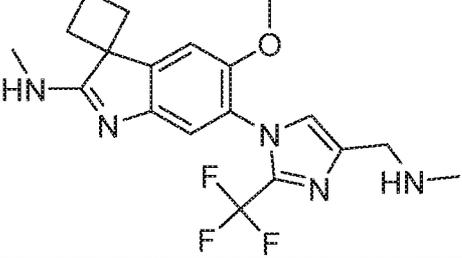
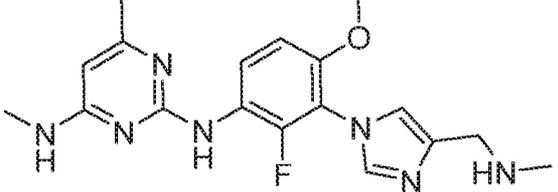
Compound No.	Structure
A53	
A53S	
A53R	
A54	
A55	

Compound No.	Structure
A56	
A57	
A58	
A59	
A59S	

Compound No.	Structure
A59R	
A60	
A61	
A62	
A63	
A64	

Compound No.	Structure
A65	
A66	
A67	
A68	
A69	
A70	

Compound No.	Structure
A71	
A72	
A72S	
A72R	
A73	

Compound No.	Structure
A73S	
A73R	
A74	
A75	
A76	

[0164] In some embodiments, the compound is Compound No. 1, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0165] In some embodiments, the compound is Compound No. A1.

[0166] In some embodiments, the compound is Compound No. A2, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0167] In some embodiments, the compound is Compound No. A2.

[0168] In some embodiments, the compound is Compound No. A2S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

- [0169] In some embodiments, the compound is Compound No. A2S.
- [0170] In some embodiments, the compound is Compound No. A2R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0171] In some embodiments, the compound is Compound No. A2R.
- [0172] In some embodiments, the compound is Compound No. A3, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0173] In some embodiments, the compound is Compound No. A3.
- [0174] In some embodiments, the compound is Compound No. A4, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0175] In some embodiments, the compound is Compound No. A4.
- [0176] In some embodiments, the compound is Compound No. A4S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0177] In some embodiments, the compound is Compound No. A4S.
- [0178] In some embodiments, the compound is Compound No. A4R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0179] In some embodiments, the compound is Compound No. A4R.
- [0180] In some embodiments, the compound is Compound No. A5, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0181] In some embodiments, the compound is Compound No. A5.
- [0182] In some embodiments, the compound is Compound No. A6, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0183] In some embodiments, the compound is Compound No. A6.
- [0184] In some embodiments, the compound is Compound No. A7, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0185] In some embodiments, the compound is Compound No. A7.
- [0186] In some embodiments, the compound is Compound No. A8, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0187] In some embodiments, the compound is Compound No. A8.
- [0188] In some embodiments, the compound is Compound No. A9, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0189] In some embodiments, the compound is Compound No. A9.

[0190] In some embodiments, the compound is Compound No. A10, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0191] In some embodiments, the compound is Compound No. A10.

[0192] In some embodiments, the compound is Compound No. A11, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0193] In some embodiments, the compound is Compound No. A11.

[0194] In some embodiments, the compound is Compound No. A12, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0195] In some embodiments, the compound is Compound No. A12.

[0196] In some embodiments, the compound is Compound No. A13, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0197] In some embodiments, the compound is Compound No. A13.

[0198] In some embodiments, the compound is Compound No. A14, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0199] In some embodiments, the compound is Compound No. A14.

[0200] In some embodiments, the compound is Compound No. A15, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0201] In some embodiments, the compound is Compound No. A15.

[0202] In some embodiments, the compound is Compound No. A16, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0203] In some embodiments, the compound is Compound No. A16.

[0204] In some embodiments, the compound is Compound No. A17, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0205] In some embodiments, the compound is Compound No. A17.

[0206] In some embodiments, the compound is Compound No. A18, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0207] In some embodiments, the compound is Compound No. A18.

[0208] In some embodiments, the compound is Compound No. A19, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0209] In some embodiments, the compound is Compound No. A19.

[0210] In some embodiments, the compound is Compound No. A20, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

- [0211] In some embodiments, the compound is Compound No. A20.
- [0212] In some embodiments, the compound is Compound No. A21, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0213] In some embodiments, the compound is Compound No. A21.
- [0214] In some embodiments, the compound is Compound No. A22, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0215] In some embodiments, the compound is Compound No. A22.
- [0216] In some embodiments, the compound is Compound No. A23, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0217] In some embodiments, the compound is Compound No. A23.
- [0218] In some embodiments, the compound is Compound No. A24, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0219] In some embodiments, the compound is Compound No. A24.
- [0220] In some embodiments, the compound is Compound No. A25, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0221] In some embodiments, the compound is Compound No. A25.
- [0222] In some embodiments, the compound is Compound No. A26, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0223] In some embodiments, the compound is Compound No. A26.
- [0224] In some embodiments, the compound is Compound No. A27, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0225] In some embodiments, the compound is Compound No. A27.
- [0226] In some embodiments, the compound is Compound No. A27S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0227] In some embodiments, the compound is Compound No. A27S.
- [0228] In some embodiments, the compound is Compound No. A27R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0229] In some embodiments, the compound is Compound No. A27R.
- [0230] In some embodiments, the compound is Compound No. A28, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0231] In some embodiments, the compound is Compound No. A28.

[0232] In some embodiments, the compound is Compound No. A28S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0233] In some embodiments, the compound is Compound No. A28S.

[0234] In some embodiments, the compound is Compound No. A28R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0235] In some embodiments, the compound is Compound No. A28R.

[0236] In some embodiments, the compound is Compound No. A29, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0237] In some embodiments, the compound is Compound No. A29.

[0238] In some embodiments, the compound is Compound No. A30, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0239] In some embodiments, the compound is Compound No. A30.

[0240] In some embodiments, the compound is Compound No. A31, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0241] In some embodiments, the compound is Compound No. A31.

[0242] In some embodiments, the compound is Compound No. A31S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0243] In some embodiments, the compound is Compound No. A31S.

[0244] In some embodiments, the compound is Compound No. A31R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0245] In some embodiments, the compound is Compound No. A31R.

[0246] In some embodiments, the compound is Compound No. A32, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0247] In some embodiments, the compound is Compound No. A32.

[0248] In some embodiments, the compound is Compound No. A33, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0249] In some embodiments, the compound is Compound No. A33.

[0250] In some embodiments, the compound is Compound No. A33S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0251] In some embodiments, the compound is Compound No. A33S.

[0252] In some embodiments, the compound is Compound No. A33R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

- [0253] In some embodiments, the compound is Compound No. A33R.
- [0254] In some embodiments, the compound is Compound No. A34, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0255] In some embodiments, the compound is Compound No. A34.
- [0256] In some embodiments, the compound is Compound No. A35, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0257] In some embodiments, the compound is Compound No. A35.
- [0258] In some embodiments, the compound is Compound No. A35S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0259] In some embodiments, the compound is Compound No. A35S.
- [0260] In some embodiments, the compound is Compound No. A35R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0261] In some embodiments, the compound is Compound No. A35R.
- [0262] In some embodiments, the compound is Compound No. A36, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0263] In some embodiments, the compound is Compound No. A36.
- [0264] In some embodiments, the compound is Compound No. A37, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0265] In some embodiments, the compound is Compound No. A37.
- [0266] In some embodiments, the compound is Compound No. A38, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0267] In some embodiments, the compound is Compound No. A38.
- [0268] In some embodiments, the compound is Compound No. A39, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0269] In some embodiments, the compound is Compound No. A39.
- [0270] In some embodiments, the compound is Compound No. A39S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0271] In some embodiments, the compound is Compound No. A39S.
- [0272] In some embodiments, the compound is Compound No. A39R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0273] In some embodiments, the compound is Compound No. A39R.

[0274] In some embodiments, the compound is Compound No. A40, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0275] In some embodiments, the compound is Compound No. A40.

[0276] In some embodiments, the compound is Compound No. A40S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0277] In some embodiments, the compound is Compound No. A40S.

[0278] In some embodiments, the compound is Compound No. A40R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0279] In some embodiments, the compound is Compound No. A40R.

[0280] In some embodiments, the compound is Compound No. A41, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0281] In some embodiments, the compound is Compound No. A41.

[0282] In some embodiments, the compound is Compound No. A41S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0283] In some embodiments, the compound is Compound No. A41S.

[0284] In some embodiments, the compound is Compound No. A41R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0285] In some embodiments, the compound is Compound No. A41R.

[0286] In some embodiments, the compound is Compound No. A42, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0287] In some embodiments, the compound is Compound No. A42.

[0288] In some embodiments, the compound is Compound No. A43, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0289] In some embodiments, the compound is Compound No. A43.

[0290] In some embodiments, the compound is Compound No. A43S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0291] In some embodiments, the compound is Compound No. A43S.

[0292] In some embodiments, the compound is Compound No. A43R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0293] In some embodiments, the compound is Compound No. A43R.

[0294] In some embodiments, the compound is Compound No. A44, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

- [0295] In some embodiments, the compound is Compound No. A44.
- [0296] In some embodiments, the compound is Compound No. A45, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0297] In some embodiments, the compound is Compound No. A45.
- [0298] In some embodiments, the compound is Compound No. A46, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0299] In some embodiments, the compound is Compound No. A46.
- [0300] In some embodiments, the compound is Compound No. A46S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0301] In some embodiments, the compound is Compound No. A46S.
- [0302] In some embodiments, the compound is Compound No. A46R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0303] In some embodiments, the compound is Compound No. A46R.
- [0304] In some embodiments, the compound is Compound No. A47, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0305] In some embodiments, the compound is Compound No. A47.
- [0306] In some embodiments, the compound is Compound No. A48, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0307] In some embodiments, the compound is Compound No. A48.
- [0308] In some embodiments, the compound is Compound No. A49, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0309] In some embodiments, the compound is Compound No. A49.
- [0310] In some embodiments, the compound is Compound No. A50, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0311] In some embodiments, the compound is Compound No. A50.
- [0312] In some embodiments, the compound is Compound No. A51, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0313] In some embodiments, the compound is Compound No. A51.
- [0314] In some embodiments, the compound is Compound No. A52, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0315] In some embodiments, the compound is Compound No. A52.

[0316] In some embodiments, the compound is Compound No. A52S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0317] In some embodiments, the compound is Compound No. A52S.

[0318] In some embodiments, the compound is Compound No. A52R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0319] In some embodiments, the compound is Compound No. A52R.

[0320] In some embodiments, the compound is Compound No. A53, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0321] In some embodiments, the compound is Compound No. A53.

[0322] In some embodiments, the compound is Compound No. A53S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0323] In some embodiments, the compound is Compound No. A53S.

[0324] In some embodiments, the compound is Compound No. A53R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0325] In some embodiments, the compound is Compound No. A53R.

[0326] In some embodiments, the compound is Compound No. A54, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0327] In some embodiments, the compound is Compound No. A54.

[0328] In some embodiments, the compound is Compound No. A55, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0329] In some embodiments, the compound is Compound No. A55.

[0330] In some embodiments, the compound is Compound No. A56, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0331] In some embodiments, the compound is Compound No. A56.

[0332] In some embodiments, the compound is Compound No. A57, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0333] In some embodiments, the compound is Compound No. A57.

[0334] In some embodiments, the compound is Compound No. A58, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0335] In some embodiments, the compound is Compound No. A58.

[0336] In some embodiments, the compound is Compound No. A59, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

- [0337] In some embodiments, the compound is Compound No. A59.
- [0338] In some embodiments, the compound is Compound No. A59S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0339] In some embodiments, the compound is Compound No. A59S.
- [0340] In some embodiments, the compound is Compound No. A59R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0341] In some embodiments, the compound is Compound No. A59R.
- [0342] In some embodiments, the compound is Compound No. A60, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0343] In some embodiments, the compound is Compound No. A60.
- [0344] In some embodiments, the compound is Compound No. A61, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0345] In some embodiments, the compound is Compound No. A61.
- [0346] In some embodiments, the compound is Compound No. A62, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0347] In some embodiments, the compound is Compound No. A62.
- [0348] In some embodiments, the compound is Compound No. A63, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0349] In some embodiments, the compound is Compound No. A63.
- [0350] In some embodiments, the compound is Compound No. A64, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0351] In some embodiments, the compound is Compound No. A64.
- [0352] In some embodiments, the compound is Compound No. A65, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0353] In some embodiments, the compound is Compound No. A65.
- [0354] In some embodiments, the compound is Compound No. A66, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0355] In some embodiments, the compound is Compound No. A66.
- [0356] In some embodiments, the compound is Compound No. A67, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.
- [0357] In some embodiments, the compound is Compound No. A67.

[0358] In some embodiments, the compound is Compound No. A68, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0359] In some embodiments, the compound is Compound No. A68.

[0360] In some embodiments, the compound is Compound No. A69, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0361] In some embodiments, the compound is Compound No. A69.

[0362] In some embodiments, the compound is Compound No. A70, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0363] In some embodiments, the compound is Compound No. A70.

[0364] In some embodiments, the compound is Compound No. A71, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0365] In some embodiments, the compound is Compound No. A71.

[0366] In some embodiments, the compound is Compound No. A72, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0367] In some embodiments, the compound is Compound No. A72.

[0368] In some embodiments, the compound is Compound No. A72S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0369] In some embodiments, the compound is Compound No. A72S.

[0370] In some embodiments, the compound is Compound No. A72R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0371] In some embodiments, the compound is Compound No. A72R.

[0372] In some embodiments, the compound is Compound No. A73, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0373] In some embodiments, the compound is Compound No. A73.

[0374] In some embodiments, the compound is Compound No. A73S, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0375] In some embodiments, the compound is Compound No. A73S.

[0376] In some embodiments, the compound is Compound No. A73R, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0377] In some embodiments, the compound is Compound No. A73R.

[0378] In some embodiments, the compound is Compound No. A74, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0379] In some embodiments, the compound is Compound No. A74.

[0380] In some embodiments, the compound is Compound No. A75, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0381] In some embodiments, the compound is Compound No. A75.

[0382] In some embodiments, the compound is Compound No. A76, the tautomer thereof, the pharmaceutically acceptable salt thereof, or the pharmaceutically acceptable salt of the tautomer.

[0383] In some embodiments, the compound is Compound No. A76.

[0384] As used herein, "alkyl", "C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> alkyl" or "C<sub>1</sub>-C<sub>6</sub> alkyl" is intended to include C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> straight chain (linear) saturated aliphatic hydrocarbon groups and C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> branched saturated aliphatic hydrocarbon groups. For example, C<sub>1</sub>-C<sub>6</sub> alkyl is intended to include C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> and C<sub>6</sub> alkyl groups. Examples of alkyl include, moieties having from one to six carbon atoms, such as, but not limited to, methyl, ethyl, n-propyl, i-propyl, n-butyl, s-butyl, t-butyl, n-pentyl, s-pentyl or n-hexyl.

[0385] In certain embodiments, a straight chain or branched alkyl has six or fewer carbon atoms (e.g., C<sub>1</sub>-C<sub>6</sub> for straight chain, C<sub>3</sub>-C<sub>6</sub> for branched chain), and in another embodiment, a straight chain or branched alkyl has four or fewer carbon atoms.

[0386] As used herein, the term "cycloalkyl" refers to a saturated or unsaturated nonaromatic hydrocarbon mono- or multi-ring (e.g., fused, bridged, or spiro rings) system having 3 to 30 carbon atoms (e.g., C<sub>3</sub>-C<sub>12</sub>, C<sub>3</sub>-C<sub>10</sub>, or C<sub>3</sub>-C<sub>8</sub>). Examples of cycloalkyl include, but are not limited to, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclopentenyl, cyclohexenyl, cycloheptenyl, 1,2,3,4-tetrahydronaphthalenyl, and adamantyl.

[0387] The term "heterocycloalkyl" refers to a saturated, partially unsaturated, or unsaturated nonaromatic 3-8 membered monocyclic, 7-12 membered bicyclic (fused, bridged, or spiro rings), or 11-14 membered tricyclic ring system (fused, bridged, or spiro rings) having one or more heteroatoms (such as O, N, S, P, or Se), e.g., 1 or 1-2 or 1-3 or 1-4 or 1-5 or 1-6 heteroatoms, or e.g., 1, 2, 3, 4, 5, or 6 heteroatoms, independently selected from the group consisting of nitrogen, oxygen and sulfur, unless specified otherwise. Examples of heterocycloalkyl groups include, but are not limited to, piperidinyl, piperazinyl, pyrrolidinyl, dioxanyl, tetrahydrofuranyl, isoindolinyl, indolinyl, imidazolidinyl, pyrazolidinyl, oxazolidinyl, isoxazolidinyl, triazolidinyl, oxiranyl, azetidiny, oxetanyl, thietanyl, 1,2,3,6-tetrahydropyridinyl, tetrahydropyranyl, dihydropyranyl, pyranyl, morpholinyl, tetrahydrothiopyranyl, 1,4-diazepanyl, 1,4-oxazepanyl, 2-oxa-5-azabicyclo[2.2.1]heptanyl, 2,5-diazabicyclo[2.2.1]heptanyl, 2-oxa-6-azaspiro[3.3]heptanyl, 2,6-

diazaspiro[3.3]heptanyl, 1,4-dioxo-8-azaspiro[4.5]decanyl, 1,4-dioxaspiro[4.5]decanyl, 1-oxaspiro[4.5]decanyl, 1-azaspiro[4.5]decanyl, 3'H-spiro[cyclohexane-1,1'-isobenzofuran]-yl, 7'H-spiro[cyclohexane-1,5'-furo[3,4-b]pyridin]-yl, 3'H-spiro[cyclohexane-1,1'-furo[3,4-c]pyridin]-yl, 3-azabicyclo[3.1.0]hexanyl, 3-azabicyclo[3.1.0]hexan-3-yl, 1,4,5,6-tetrahydropyrrolo[3,4-c]pyrazolyl, 3,4,5,6,7,8-hexahydropyrido[4,3-d]pyrimidinyl, 4,5,6,7-tetrahydro-1H-pyrazolo[3,4-c]pyridinyl, 5,6,7,8-tetrahydropyrido[4,3-d]pyrimidinyl, 2-azaspiro[3.3]heptanyl, 2-methyl-2-azaspiro[3.3]heptanyl, 2-azaspiro[3.5]nonanyl, 2-methyl-2-azaspiro[3.5]nonanyl, 2-azaspiro[4.5]decanyl, 2-methyl-2-azaspiro[4.5]decanyl, 2-oxa-azaspiro[3.4]octanyl, 2-oxa-azaspiro[3.4]octan-6-yl, and the like. In the case of multicyclic non-aromatic rings, only one of the rings needs to be non-aromatic (*e.g.*, 1,2,3,4-tetrahydronaphthalenyl or 2,3-dihydroindole). Examples of heterocycloalkyl groups further include, but are not limited to, 4,5,6,7-tetrahydro-1H-pyrazolo[4,3-c]pyridinyl, 4,5,6,7-tetrahydropyrazolo[1,5-a]pyrazinyl, 2,4,5,6,7,8-hexahydropyrazolo[4,3-c]azepinyl, 5,6,7,8-tetrahydro-4H-pyrazolo[1,5-a][1,4]diazepinyl, and 5,6,7,8-tetrahydropyrazolo[4,3-c]azepin-4(1H)-one.

[0388] The term “optionally substituted alkyl” refers to unsubstituted alkyl or alkyl having designated substituents replacing one or more hydrogen atoms on one or more carbons of the hydrocarbon backbone. Such substituents can include, for example, alkyl, alkenyl, alkynyl, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxy carbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonate, phosphinate, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonate, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moiety.

[0389] As used herein, “alkyl linker” or “alkylene linker” is intended to include C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> straight chain (linear) saturated divalent aliphatic hydrocarbon groups and C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> branched saturated aliphatic hydrocarbon groups. For example, C<sub>1</sub>-C<sub>6</sub> alkylene linker is intended to include C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> and C<sub>6</sub> alkylene linker groups. Examples of alkylene linker include, moieties having from one to six carbon atoms, such as, but not limited to, methyl (-CH<sub>2</sub>-), ethyl (-CH<sub>2</sub>CH<sub>2</sub>-), n-propyl (-CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-), i-propyl (-CHCH<sub>3</sub>CH<sub>2</sub>-), n-butyl (-CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-),

s-butyl (-CHCH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>-), i-butyl (-C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>-), n-pentyl (-CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-), s-pentyl (-CHCH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-) or n-hexyl (-CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-).

[0390] “Alkenyl” includes unsaturated aliphatic groups analogous in length and possible substitution to the alkyls described above, but that contain at least one double bond. For example, the term “alkenyl” includes straight chain alkenyl groups (*e.g.*, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl), and branched alkenyl groups.

[0391] In certain embodiments, a straight chain or branched alkenyl group has six or fewer carbon atoms in its backbone (*e.g.*, C<sub>2</sub>-C<sub>6</sub> for straight chain, C<sub>3</sub>-C<sub>6</sub> for branched chain). The term “C<sub>2</sub>-C<sub>6</sub>” includes alkenyl groups containing two to six carbon atoms. The term “C<sub>3</sub>-C<sub>6</sub>” includes alkenyl groups containing three to six carbon atoms.

[0392] The term “optionally substituted alkenyl” refers to unsubstituted alkenyl or alkenyl having designated substituents replacing one or more hydrogen atoms on one or more hydrocarbon backbone carbon atoms. Such substituents can include, for example, alkyl, alkenyl, alkynyl, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxy carbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxy, phosphate, phosphonate, phosphinate, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonate, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moiety.

[0393] “Alkynyl” includes unsaturated aliphatic groups analogous in length and possible substitution to the alkyls described above, but which contain at least one triple bond. For example, “alkynyl” includes straight chain alkynyl groups (*e.g.*, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl), and branched alkynyl groups. In certain embodiments, a straight chain or branched alkynyl group has six or fewer carbon atoms in its backbone (*e.g.*, C<sub>2</sub>-C<sub>6</sub> for straight chain, C<sub>3</sub>-C<sub>6</sub> for branched chain). The term “C<sub>2</sub>-C<sub>6</sub>” includes alkynyl groups containing two to six carbon atoms. The term “C<sub>3</sub>-C<sub>6</sub>” includes alkynyl groups containing three to six carbon atoms. As used herein, “C<sub>2</sub>-C<sub>6</sub> alkenylene linker” or “C<sub>2</sub>-C<sub>6</sub> alkynylene linker” is intended to include C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> or C<sub>6</sub> chain (linear or branched) divalent unsaturated aliphatic hydrocarbon groups. For example, C<sub>2</sub>-C<sub>6</sub> alkenylene linker is intended to include C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> and C<sub>6</sub> alkenylene linker groups.

[0394] The term “optionally substituted alkynyl” refers to unsubstituted alkynyl or alkynyl having designated substituents replacing one or more hydrogen atoms on one or more hydrocarbon backbone carbon atoms. Such substituents can include, for example, alkyl, alkenyl, alkynyl, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxycarbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, arylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonato, phosphinato, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moiety.

[0395] Other optionally substituted moieties (such as optionally substituted cycloalkyl, heterocycloalkyl, aryl, or heteroaryl) include both the unsubstituted moieties and the moieties having one or more of the designated substituents. For example, substituted heterocycloalkyl includes those substituted with one or more alkyl groups, such as 2,2,6,6-tetramethyl-piperidinyl and 2,2,6,6-tetramethyl-1,2,3,6-tetrahydropyridinyl.

[0396] “Aryl” includes groups with aromaticity, including “conjugated,” or multicyclic systems with one or more aromatic rings and do not contain any heteroatom in the ring structure. Examples include phenyl, naphthalenyl, etc.

[0397] “Heteroaryl” groups are aryl groups, as defined above, except having from one to four heteroatoms in the ring structure, and may also be referred to as “aryl heterocycles” or “heteroaromatics.” As used herein, the term “heteroaryl” is intended to include a stable 5-, 6-, or 7-membered monocyclic or 7-, 8-, 9-, 10-, 11- or 12-membered bicyclic aromatic heterocyclic ring which consists of carbon atoms and one or more heteroatoms, *e.g.*, 1 or 1-2 or 1-3 or 1-4 or 1-5 or 1-6 heteroatoms, or *e.g.*, 1, 2, 3, 4, 5, or 6 heteroatoms, independently selected from the group consisting of nitrogen, oxygen and sulfur. The nitrogen atom may be substituted or unsubstituted (*i.e.*, N or NR wherein R is H or other substituents, as defined). The nitrogen and sulfur heteroatoms may optionally be oxidized (*i.e.*, N→O and S(O)<sub>p</sub>, where p = 1 or 2). It is to be noted that total number of S and O atoms in the aromatic heterocycle is not more than 1.

[0398] Examples of heteroaryl groups include pyrrole, furan, thiophene, thiazole, isothiazole, imidazole, triazole, tetrazole, pyrazole, oxazole, isoxazole, pyridine, pyrazine, pyridazine, pyrimidine, and the like.

[0399] Furthermore, the terms “aryl” and “heteroaryl” include multicyclic aryl and heteroaryl groups, *e.g.*, tricyclic, bicyclic, *e.g.*, naphthalene, benzoxazole, benzodioxazole, benzothiazole, benzoimidazole, benzothiophene, quinoline, isoquinoline, naphthrydine, indole, benzofuran, purine, benzofuran, deazapurine, indolizine.

[0400] The cycloalkyl, heterocycloalkyl, aryl, or heteroaryl ring can be substituted at one or more ring positions (*e.g.*, the ring-forming carbon or heteroatom such as N) with such substituents as described above, for example, alkyl, alkenyl, alkynyl, halogen, hydroxyl, alkoxy, alkylcarbonyloxy, arylcarbonyloxy, alkoxy carbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, alkylaminocarbonyl, aralkylaminocarbonyl, alkenylaminocarbonyl, alkylcarbonyl, arylcarbonyl, aralkylcarbonyl, alkenylcarbonyl, alkoxy carbonyl, aminocarbonyl, alkylthiocarbonyl, phosphate, phosphonate, phosphinate, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonate, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moiety. Aryl and heteroaryl groups can also be fused or bridged with alicyclic or heterocyclic rings, which are not aromatic so as to form a multicyclic system (*e.g.*, tetralin, methylenedioxyphenyl such as benzo[d][1,3]dioxole-5-yl).

[0401] As used herein, “carbocycle” or “carbocyclic ring” is intended to include any stable monocyclic, bicyclic or tricyclic ring having the specified number of carbons, any of which may be saturated, unsaturated, or aromatic. Carbocycle includes cycloalkyl and aryl. For example, a C<sub>3</sub>-C<sub>14</sub> carbocycle is intended to include a monocyclic, bicyclic or tricyclic ring having 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 or 14 carbon atoms. Examples of carbocycles include, but are not limited to, cyclopropyl, cyclobutyl, cyclobutenyl, cyclopentyl, cyclopentenyl, cyclohexyl, cycloheptenyl, cycloheptyl, cycloheptenyl, adamantyl, cyclooctyl, cyclooctenyl, cyclooctadienyl, fluorenyl, phenyl, naphthyl, indanyl, adamantyl and tetrahydronaphthyl. Bridged rings are also included in the definition of carbocycle, including, for example, [3.3.0]bicyclooctane, [4.3.0]bicyclononane, and [4.4.0] bicyclodecane and [2.2.2] bicyclooctane. A bridged ring occurs when one or more carbon atoms link two non-adjacent carbon atoms. In one embodiment, bridge rings are one or two carbon atoms. It is noted that a bridge always converts a monocyclic ring into a tricyclic ring. When a ring is bridged, the substituents recited for the ring may also be present on the bridge. Fused (*e.g.*, naphthyl, tetrahydronaphthyl) and spiro rings are also included.

[0402] As used herein, “heterocycle” or “heterocyclic group” includes any ring structure (saturated, unsaturated, or aromatic) which contains at least one ring heteroatom (*e.g.*, 1-4 heteroatoms selected from N, O and S). Heterocycle includes heterocycloalkyl and heteroaryl. Examples of heterocycles include, but are not limited to, morpholine, pyrrolidine, tetrahydrothiophene, piperidine, piperazine, oxetane, pyran, tetrahydropyran, azetidine, and tetrahydrofuran.

[0403] Examples of heterocyclic groups include, but are not limited to, acridinyl, azocinyl, benzimidazolyl, benzofuranyl, benzothiofuranyl, benzothiophenyl, benzoxazolyl, benzoxazoliny, benzthiazolyl, benztriazolyl, benztetrazolyl, benzisoxazolyl, benzisothiazolyl, benzimidazoliny, carbazolyl, 4*aH*-carbazolyl, carbolinyl, chromanyl, chromenyl, cinnolinyl, decahydroquinolinyl, 2*H*,6*H*-1,5,2-dithiazinyl, dihydrofuro[2,3-*b*]tetrahydrofuran, furanyl, furazanyl, imidazolidinyl, imidazoliny, imidazolyl, 1*H*-indazolyl, indolenyl, indolinyl, indoliziny, indolyl, 3*H*-indolyl, isatinoyl, isobenzofuranyl, isochromanyl, isoindazolyl, isoindolinyl, isoindolyl, isoquinolinyl, isothiazolyl, isoxazolyl, methylenedioxyphenyl (*e.g.*, benzo[d][1,3]dioxole-5-yl), morpholinyl, naphthyridinyl, octahydroisoquinolinyl, oxadiazolyl, 1,2,3-oxadiazolyl, 1,2,4-oxadiazolyl, 1,2,5-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2,4-oxadiazol5(4*H*)-one, oxazolidinyl, oxazolyl, oxindolyl, pyrimidinyl, phenanthridinyl, phenanthrolinyl, phenazinyl, phenothiazinyl, phenoxathinyl, phenoxazinyl, phthalazinyl, piperazinyl, piperidinyl, piperidonyl, 4-piperidonyl, piperonyl, pteridinyl, purinyl, pyranyl, pyrazinyl, pyrazolidinyl, pyrazolinyl, pyrazolyl, pyridazinyl, pyridooxazole, pyridoimidazole, pyridothiazole, pyridinyl, pyridyl, pyrimidinyl, pyrrolidinyl, pyrrolinyl, 2*H*-pyrrolyl, pyrrolyl, quinazoliny, quinolinyl, 4*H*-quinoliziny, quinoxaliny, quinuclidinyl, tetrahydrofuranyl, tetrahydroisoquinolinyl, tetrahydroquinolinyl, tetrazolyl, 6*H*-1,2,5-thiadiazinyl, 1,2,3-thiadiazolyl, 1,2,4-thiadiazolyl, 1,2,5-thiadiazolyl, 1,3,4-thiadiazolyl, thianthrenyl, thiazolyl, thienyl, thienothiazolyl, thienooxazolyl, thienoimidazolyl, thiophenyl, triazinyl, 1,2,3-triazolyl, 1,2,4-triazolyl, 1,2,5-triazolyl, 1,3,4-triazolyl and xanthenyl.

[0404] The term “substituted,” as used herein, means that any one or more hydrogen atoms on the designated atom is replaced with a selection from the indicated groups, provided that the designated atom’s normal valency is not exceeded, and that the substitution results in a stable compound. When a substituent is oxo or keto (*i.e.*, =O), then two hydrogen atoms on the atom are replaced. Keto substituents are not present on aromatic moieties. Ring double bonds, as used herein, are double bonds that are formed between two adjacent ring atoms (*e.g.*, C=C, C=N or N=N). “Stable compound” and “stable structure” are meant to indicate a compound that is

sufficiently robust to survive isolation to a useful degree of purity from a reaction mixture, and formulation into an efficacious therapeutic agent.

[0405] When a bond to a substituent is shown to cross a bond connecting two atoms in a ring, then such substituent may be bonded to any atom in the ring. When a substituent is listed without indicating the atom via which such substituent is bonded to the rest of the compound of a given formula, then such substituent may be bonded via any atom in such formula. Combinations of substituents and/or variables are permissible, but only if such combinations result in stable compounds.

[0406] When any variable (*e.g.*, R) occurs more than one time in any constituent or formula for a compound, its definition at each occurrence is independent of its definition at every other occurrence. Thus, for example, if a group is shown to be substituted with 0-2 R moieties, then the group may optionally be substituted with up to two R moieties and R at each occurrence is selected independently from the definition of R. Also, combinations of substituents and/or variables are permissible, but only if such combinations result in stable compounds.

[0407] The term “hydroxy” or “hydroxyl” includes groups with an -OH or -O<sup>•</sup>.

[0408] As used herein, “halo” or “halogen” refers to fluoro, chloro, bromo and iodo. The term “perhalogenated” generally refers to a moiety wherein all hydrogen atoms are replaced by halogen atoms. The term “haloalkyl” or “haloalkoxy” refers to an alkyl or alkoxy substituted with one or more halogen atoms.

[0409] The term “carbonyl” includes compounds and moieties which contain a carbon connected with a double bond to an oxygen atom. Examples of moieties containing a carbonyl include, but are not limited to, aldehydes, ketones, carboxylic acids, amides, esters, anhydrides, etc.

[0410] The term “carboxyl” refers to -COOH or its C<sub>1</sub>-C<sub>6</sub> alkyl ester.

[0411] “Acy” includes moieties that contain the acyl radical (R-C(O)-) or a carbonyl group. “Substituted acyl” includes acyl groups where one or more of the hydrogen atoms are replaced by, for example, alkyl groups, alkynyl groups, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxy carbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxy, phosphate, phosphonate, phosphinate, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio,

thiocarboxylate, sulfates, alkylsulfinyl, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moiety.

[0412] "Aroyl" includes moieties with an aryl or heteroaromatic moiety bound to a carbonyl group. Examples of aroyl groups include phenylcarboxy, naphthyl carboxy, etc.

[0413] "Alkoxyalkyl," "alkylaminoalkyl," and "thioalkoxyalkyl" include alkyl groups, as described above, wherein oxygen, nitrogen, or sulfur atoms replace one or more hydrocarbon backbone carbon atoms.

[0414] The term "alkoxy" or "alkoxyl" includes substituted and unsubstituted alkyl, alkenyl and alkynyl groups covalently linked to an oxygen atom. Examples of alkoxy groups or alkoxy radicals include, but are not limited to, methoxy, ethoxy, isopropoxy, propoxy, butoxy and pentoxy groups. Examples of substituted alkoxy groups include halogenated alkoxy groups. The alkoxy groups can be substituted with groups such as alkenyl, alkynyl, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxy carbonyloxy, aryloxy carbonyloxy, carboxylate, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxy, phosphate, phosphonato, phosphinato, amino (including alkylamino, dialkylamino, arylamino, diarylamino, and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moieties. Examples of halogen substituted alkoxy groups include, but are not limited to, fluoromethoxy, difluoromethoxy, trifluoromethoxy, chloromethoxy, dichloromethoxy and trichloromethoxy.

[0415] The term "ether" or "alkoxy" includes compounds or moieties which contain an oxygen bonded to two carbon atoms or heteroatoms. For example, the term includes "alkoxyalkyl," which refers to an alkyl, alkenyl, or alkynyl group covalently bonded to an oxygen atom which is covalently bonded to an alkyl group.

[0416] The term "ester" includes compounds or moieties which contain a carbon or a heteroatom bound to an oxygen atom which is bonded to the carbon of a carbonyl group. The term "ester" includes alkoxy carboxy groups such as methoxycarbonyl, ethoxycarbonyl, propoxycarbonyl, butoxycarbonyl, pentoxycarbonyl, etc.

[0417] The term "thioalkyl" includes compounds or moieties which contain an alkyl group connected with a sulfur atom. The thioalkyl groups can be substituted with groups such as alkyl,

alkenyl, alkynyl, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxycarbonyloxy, aryloxycarbonyloxy, carboxylate, carboxylic acid, alkylcarbonyl, arylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylthiocarbonyl, alkoxyl, amino (including alkylamino, dialkylamino, arylamino, diarylamino and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, alkylsulfinyl, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkylaryl, or an aromatic or heteroaromatic moieties.

[0418] The term “thiocarbonyl” or “thiocarboxy” includes compounds and moieties which contain a carbon connected with a double bond to a sulfur atom.

[0419] The term “thioether” includes moieties which contain a sulfur atom bonded to two carbon atoms or heteroatoms. Examples of thioethers include, but are not limited to alkthioalkyls, alkthioalkenyls, and alkthioalkynyls. The term “alkthioalkyls” include moieties with an alkyl, alkenyl, or alkynyl group bonded to a sulfur atom which is bonded to an alkyl group. Similarly, the term “alkthioalkenyls” refers to moieties wherein an alkyl, alkenyl or alkynyl group is bonded to a sulfur atom which is covalently bonded to an alkenyl group; and “alkthioalkynyls” refers to moieties wherein an alkyl, alkenyl or alkynyl group is bonded to a sulfur atom which is covalently bonded to an alkynyl group.

[0420] As used herein, “amine” or “amino” refers to  $-NH_2$ . “Alkylamino” includes groups of compounds wherein the nitrogen of  $-NH_2$  is bound to at least one alkyl group. Examples of alkylamino groups include benzylamino, methylamino, ethylamino, phenethylamino, etc. “Dialkylamino” includes groups wherein the nitrogen of  $-NH_2$  is bound to two alkyl groups. Examples of dialkylamino groups include, but are not limited to, dimethylamino and diethylamino. “Arylamino” and “diarylamino” include groups wherein the nitrogen is bound to at least one or two aryl groups, respectively. “Aminoaryl” and “aminoaryloxy” refer to aryl and aryloxy substituted with amino. “Alkylarylamino,” “alkylaminoaryl” or “arylaminoalkyl” refers to an amino group which is bound to at least one alkyl group and at least one aryl group. “Alkaminoalkyl” refers to an alkyl, alkenyl, or alkynyl group bound to a nitrogen atom which is also bound to an alkyl group. “Acylamino” includes groups wherein nitrogen is bound to an acyl group. Examples of acylamino include, but are not limited to, alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido groups.

[0421] The term “amide” or “aminocarboxy” includes compounds or moieties that contain a nitrogen atom that is bound to the carbon of a carbonyl or a thiocarbonyl group. The term includes “alkaminocarboxy” groups that include alkyl, alkenyl or alkynyl groups bound to an amino group which is bound to the carbon of a carbonyl or thiocarbonyl group. It also includes “arylaminocarboxy” groups that include aryl or heteroaryl moieties bound to an amino group that is bound to the carbon of a carbonyl or thiocarbonyl group. The terms “alkylaminocarboxy”, “alkenylaminocarboxy”, “alkynylaminocarboxy” and “arylaminocarboxy” include moieties wherein alkyl, alkenyl, alkynyl and aryl moieties, respectively, are bound to a nitrogen atom which is in turn bound to the carbon of a carbonyl group. Amides can be substituted with substituents such as straight chain alkyl, branched alkyl, cycloalkyl, aryl, heteroaryl or heterocycle. Substituents on amide groups may be further substituted.

[0422] Compounds of the present disclosure that contain nitrogens can be converted to N-oxides by treatment with an oxidizing agent (*e.g.*, 3-chloroperoxybenzoic acid (*m*CPBA) and/or hydrogen peroxides) to afford other compounds of the present disclosure. Thus, all shown and claimed nitrogen-containing compounds are considered, when allowed by valency and structure, to include both the compound as shown and its N-oxide derivative (which can be designated as N→O or N<sup>+</sup>-O<sup>-</sup>). Furthermore, in other instances, the nitrogens in the compounds of the present disclosure can be converted to N-hydroxy or N-alkoxy compounds. For example, N-hydroxy compounds can be prepared by oxidation of the parent amine by an oxidizing agent such as *m*-CPBA. All shown and claimed nitrogen-containing compounds are also considered, when allowed by valency and structure, to cover both the compound as shown and its N-hydroxy (*i.e.*, N-OH) and N-alkoxy (*i.e.*, N-OR, wherein R is substituted or unsubstituted C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> alkenyl, C<sub>1</sub>-C<sub>6</sub> alkynyl, 3-14-membered carbocycle or 3-14-membered heterocycle) derivatives.

[0423] In the present specification, the structural formula of the compound represents a certain isomer for convenience in some cases, but the present disclosure includes all isomers, such as geometrical isomers, optical isomers based on an asymmetrical carbon, stereoisomers, tautomers, and the like, it being understood that not all isomers may have the same level of activity. In addition, a crystal polymorphism may be present for the compounds represented by the formula. It is noted that any crystal form, crystal form mixture, or anhydride or hydrate thereof is included in the scope of the present disclosure.

[0424] “Isomerism” means compounds that have identical molecular formulae but differ in the sequence of bonding of their atoms or in the arrangement of their atoms in space. Isomers that

differ in the arrangement of their atoms in space are termed “stereoisomers.” Stereoisomers that are not mirror images of one another are termed “diastereoisomers,” and stereoisomers that are non-superimposable mirror images of each other are termed “enantiomers” or sometimes optical isomers. A mixture containing equal amounts of individual enantiomeric forms of opposite chirality is termed a “racemic mixture.”

[0425] A carbon atom bonded to four nonidentical substituents is termed a “chiral center.”

[0426] “Chiral isomer” means a compound with at least one chiral center. Compounds with more than one chiral center may exist either as an individual diastereomer or as a mixture of diastereomers, termed “diastereomeric mixture.” When one chiral center is present, a stereoisomer may be characterized by the absolute configuration (R or S) of that chiral center. Absolute configuration refers to the arrangement in space of the substituents attached to the chiral center. The substituents attached to the chiral center under consideration are ranked in accordance with the *Sequence Rule* of Cahn, Ingold and Prelog. (Cahn *et al.*, *Angew. Chem. Inter. Edit.* 1966, 5, 385; errata 511; Cahn *et al.*, *Angew. Chem.* 1966, 78, 413; Cahn and Ingold, *J. Chem. Soc.* 1951 (London), 612; Cahn *et al.*, *Experientia* 1956, 12, 81; Cahn, *J. Chem. Educ.* 1964, 41, 116).

[0427] “Geometric isomer” means the diastereomers that owe their existence to hindered rotation about double bonds or a cycloalkyl linker (e.g., 1,3-cyclobutyl). These configurations are differentiated in their names by the prefixes *cis* and *trans*, or *Z* and *E*, which indicate that the groups are on the same or opposite side of the double bond in the molecule according to the Cahn-Ingold-Prelog rules.

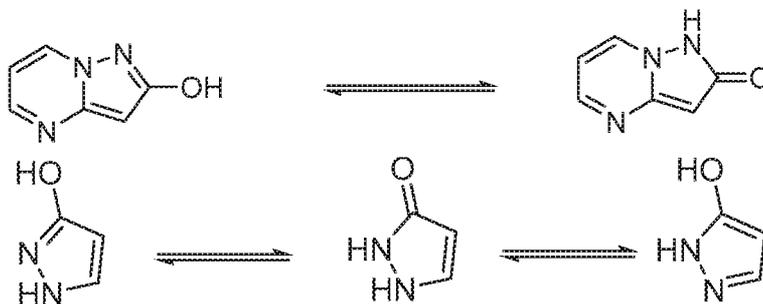
[0428] It is to be understood that the compounds of the present disclosure may be depicted as different chiral isomers or geometric isomers. It should also be understood that when compounds have chiral isomeric or geometric isomeric forms, all isomeric forms are intended to be included in the scope of the present disclosure, and the naming of the compounds does not exclude any isomeric forms, it being understood that not all isomers may have the same level of activity.

[0429] Furthermore, the structures and other compounds discussed in this disclosure include all atropic isomers thereof, it being understood that not all atropic isomers may have the same level of activity. “Atropic isomers” are a type of stereoisomer in which the atoms of two isomers are arranged differently in space. Atropic isomers owe their existence to a restricted rotation caused by hindrance of rotation of large groups about a central bond. Such atropic isomers typically exist as a mixture, however as a result of recent advances in chromatography techniques, it has been possible to separate mixtures of two atropic isomers in select cases.

[0430] “Tautomer” is one of two or more structural isomers that exist in equilibrium and is readily converted from one isomeric form to another. This conversion results in the formal migration of a hydrogen atom accompanied by a switch of adjacent conjugated double bonds. Tautomers exist as a mixture of a tautomeric set in solution. In solutions where tautomerization is possible, a chemical equilibrium of the tautomers will be reached. The exact ratio of the tautomers depends on several factors, including temperature, solvent and pH. The concept of tautomers that are interconvertible by tautomerizations is called tautomerism.

[0431] Of the various types of tautomerism that are possible, two are commonly observed. In keto-enol tautomerism a simultaneous shift of electrons and a hydrogen atom occurs. Ring-chain tautomerism arises as a result of the aldehyde group (-CHO) in a sugar chain molecule reacting with one of the hydroxy groups (-OH) in the same molecule to give it a cyclic (ring-shaped) form as exhibited by glucose.

[0432] Common tautomeric pairs are: ketone-enol, amide-nitrile, lactam-lactim, amide-imidic acid tautomerism in heterocyclic rings (e.g., in nucleobases such as guanine, thymine and cytosine), imine-enamine and enamine-enamine. Examples of lactam-lactim tautomerism are as shown below.



[0433] It is to be understood that the compounds of the present disclosure may be depicted as different tautomers. It should also be understood that when compounds have tautomeric forms, all tautomeric forms are intended to be included in the scope of the present disclosure, and the naming of the compounds does not exclude any tautomer form. It will be understood that certain tautomers may have a higher level of activity than others.

[0434] The term “crystal polymorphs”, “polymorphs” or “crystal forms” means crystal structures in which a compound (or a salt or solvate thereof) can crystallize in different crystal packing arrangements, all of which have the same elemental composition. Different crystal forms usually have different X-ray diffraction patterns, infrared spectral, melting points, density hardness, crystal shape, optical and electrical properties, stability and solubility. Recrystallization solvent,

rate of crystallization, storage temperature, and other factors may cause one crystal form to dominate. Crystal polymorphs of the compounds can be prepared by crystallization under different conditions.

[0435] The compounds of any Formula described herein include the compounds themselves, as well as their salts, and their solvates, if applicable. A salt, for example, can be formed between an anion and a positively charged group (e.g., amino) on a substituted benzene compound. Suitable anions include chloride, bromide, iodide, sulfate, bisulfate, sulfamate, nitrate, phosphate, citrate, methanesulfonate, trifluoroacetate, glutamate, glucuronate, glutarate, malate, maleate, succinate, fumarate, tartrate, tosylate, salicylate, lactate, naphthalenesulfonate, and acetate (e.g., trifluoroacetate). The term “pharmaceutically acceptable anion” refers to an anion suitable for forming a pharmaceutically acceptable salt. Likewise, a salt can also be formed between a cation and a negatively charged group (e.g., carboxylate) on a substituted benzene compound. Suitable cations include sodium ion, potassium ion, magnesium ion, calcium ion, and an ammonium cation such as tetramethylammonium ion. The substituted benzene compounds also include those salts containing quaternary nitrogen atoms.

[0436] Additionally, the compounds of the present disclosure, for example, the salts of the compounds, can exist in either hydrated or unhydrated (the anhydrous) form or as solvates with other solvent molecules. Nonlimiting examples of hydrates include monohydrates, dihydrates, etc. Nonlimiting examples of solvates include ethanol solvates, acetone solvates, etc.

[0437] “Solvate” means solvent addition forms that contain either stoichiometric or non-stoichiometric amounts of solvent. Some compounds have a tendency to trap a fixed molar ratio of solvent molecules in the crystalline solid state, thus forming a solvate. If the solvent is water the solvate formed is a hydrate; and if the solvent is alcohol, the solvate formed is an alcoholate. Hydrates are formed by the combination of one or more molecules of water with one molecule of the substance in which the water retains its molecular state as H<sub>2</sub>O.

[0438] As used herein, the term “analog” refers to a chemical compound that is structurally similar to another but differs slightly in composition (as in the replacement of one atom by an atom of a different element or in the presence of a particular functional group, or the replacement of one functional group by another functional group). Thus, an analog is a compound that is similar or comparable in function and appearance, but not in structure or origin to the reference compound.

[0439] As defined herein, the term “derivative” refers to compounds that have a common core structure, and are substituted with various groups as described herein. For example, all of the compounds represented by Formula (II) are substituted bi-heterocyclic compounds, and have Formula (II) as a common core.

[0440] The term “bioisostere” refers to a compound resulting from the exchange of an atom or of a group of atoms with another, broadly similar, atom or group of atoms. The objective of a bioisosteric replacement is to create a new compound with similar biological properties to the parent compound. The bioisosteric replacement may be physicochemically or topologically based. Examples of carboxylic acid bioisosteres include, but are not limited to, acyl sulfonimides, tetrazoles, sulfonates and phosphonates. See, *e.g.*, Patani and LaVoie, *Chem. Rev.* 96, 3147-3176, 1996.

[0441] The present disclosure is intended to include all isotopes of atoms occurring in the present compounds. Isotopes include those atoms having the same atomic number but different mass numbers. By way of general example and without limitation, isotopes of hydrogen include tritium and deuterium, and isotopes of carbon include C-13 and C-14.

[0442] As used herein, the expressions “one or more of A, B, or C,” “one or more A, B, or C,” “one or more of A, B, and C,” “one or more A, B, and C,” “selected from the group consisting of A, B, and C”, “selected from A, B, and C”, and the like are used interchangeably and all refer to a selection from a group consisting of A, B, and/or C, *i.e.*, one or more As, one or more Bs, one or more Cs, or any combination thereof, unless indicated otherwise.

[0443] The present disclosure provides methods for the synthesis of the compounds of any of the Formulae described herein. The present disclosure also provides detailed methods for the synthesis of various disclosed compounds of the present disclosure according to the following schemes as well as those shown in the Examples.

[0444] Throughout the description, where compositions are described as having, including, or comprising specific components, it is contemplated that compositions also consist essentially of, or consist of, the recited components. Similarly, where methods or processes are described as having, including, or comprising specific process steps, the processes also consist essentially of, or consist of, the recited processing steps. Further, it should be understood that the order of steps or order for performing certain actions is immaterial so long as the invention remains operable. Moreover, two or more steps or actions can be conducted simultaneously.

[0445] The synthetic processes of the disclosure can tolerate a wide variety of functional groups, therefore various substituted starting materials can be used. The processes generally provide the desired final compound at or near the end of the overall process, although it may be desirable in certain instances to further convert the compound to a pharmaceutically acceptable salt thereof.

[0446] Compounds of the present disclosure can be prepared in a variety of ways using commercially available starting materials, compounds known in the literature, or from readily prepared intermediates, by employing standard synthetic methods and procedures either known to those skilled in the art, or which will be apparent to the skilled artisan in light of the teachings herein. Standard synthetic methods and procedures for the preparation of organic molecules and functional group transformations and manipulations can be obtained from the relevant scientific literature or from standard textbooks in the field. Although not limited to any one or several sources, classic texts such as Smith, M. B., March, J., *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, 5<sup>th</sup> edition, John Wiley & Sons: New York, 2001; Greene, T.W., Wuts, P.G. M., *Protective Groups in Organic Synthesis*, 3<sup>rd</sup> edition, John Wiley & Sons: New York, 1999; R. Larock, *Comprehensive Organic Transformations*, VCH Publishers (1989); L. Fieser and M. Fieser, *Fieser and Fieser's Reagents for Organic Synthesis*, John Wiley and Sons (1994); and L. Paquette, ed., *Encyclopedia of Reagents for Organic Synthesis*, John Wiley and Sons (1995), incorporated by reference herein, are useful and recognized reference textbooks of organic synthesis known to those in the art. The following descriptions of synthetic methods are designed to illustrate, but not to limit, general procedures for the preparation of compounds of the present disclosure.

[0447] Compounds of the present disclosure can be conveniently prepared by a variety of methods familiar to those skilled in the art. The compounds of this disclosure having any of the Formulae described herein may be prepared according to the procedures illustrated in Schemes 1-4 below, from commercially available starting materials or starting materials which can be prepared using literature procedures. Certain variables (such as R<sup>6</sup> and R<sup>7</sup>) in Schemes 1-4 are as defined in any Formula described herein, unless otherwise specified.

[0448] One of ordinary skill in the art will note that, during the reaction sequences and synthetic schemes described herein, the order of certain steps may be changed, such as the introduction and removal of protecting groups.

[0449] One of ordinary skill in the art will recognize that certain groups may require protection from the reaction conditions via the use of protecting groups. Protecting groups may also be used

to differentiate similar functional groups in molecules. A list of protecting groups and how to introduce and remove these groups can be found in Greene, T.W., Wuts, P.G. M., *Protective Groups in Organic Synthesis*, 3<sup>rd</sup> edition, John Wiley & Sons: New York, 1999.

[0450] Preferred protecting groups include, but are not limited to:

[0451] For a hydroxyl moiety: TBS, benzyl, THP, Ac

[0452] For carboxylic acids: benzyl ester, methyl ester, ethyl ester, allyl ester

[0453] For amines: Cbz, BOC, DMB

[0454] For diols: Ac (x2) TBS (x2), or when taken together acetonides

[0455] For thiols: Ac

[0456] For benzimidazoles: SEM, benzyl, PMB, DMB

[0457] For aldehydes: di-alkyl acetals such as dimethoxy acetal or diethyl acetyl.

[0458] In the reaction schemes described herein, multiple stereoisomers may be produced. When no particular stereoisomer is indicated, it is understood to mean all possible stereoisomers that could be produced from the reaction. A person of ordinary skill in the art will recognize that the reactions can be optimized to give one isomer preferentially, or new schemes may be devised to produce a single isomer. If mixtures are produced, techniques such as preparative thin layer chromatography, preparative HPLC, preparative chiral HPLC, or preparative SFC may be used to separate the isomers.

[0459] The following abbreviations are used throughout the specification and are defined below:

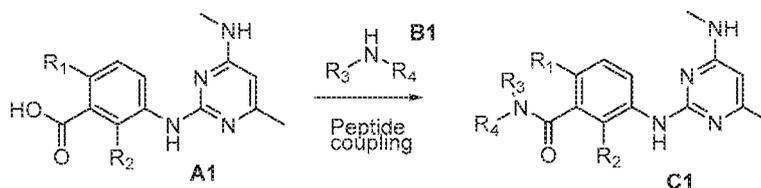
ACN	acetonitrile
Ac	acetyl
AcOH	acetic acid
AlCl <sub>3</sub>	aluminum chloride
BINAP	(2,2'-bis(diphenylphosphino)-1,1'-binaphthyl)
t-BuOK	potassium t-butoxide
tBuONa or t-BuONa	sodium t-butoxide
br	broad
BOC	tert-butoxy carbonyl
Cbz	benzyloxy carbonyl
CDCl <sub>3</sub> CHCl <sub>3</sub>	chloroform
CH <sub>2</sub> Cl <sub>2</sub>	dichloromethane
CH <sub>3</sub> CN	acetonitrile

CsCO <sub>3</sub>	cesium carbonate
CH <sub>3</sub> NO <sub>3</sub>	nitromethane
d	doublet
dd	doublet of doublets
dq	doublet of quartets
DCE	1,2 dichloroethane
DCM	dichloromethane
Δ	heat
δ	chemical shift
DIEA	N,N-diisopropylethylamine (Hunig's base)
DMB	2,4 dimethoxy benzyl
DMF	N,N-Dimethylformamide
DMSO	Dimethyl sulfoxide
DMSO- <i>d</i> <sub>6</sub>	deuterated dimethyl sulfoxide
EA or EtOAc	Ethyl acetate
ES	electrospray
Et <sub>3</sub> N	triethylamine
equiv	equivalents
g	grams
h	hours
H <sub>2</sub> O	water
HCl	hydrogen chloride or hydrochloric acid
HPLC	High performance liquid chromatography
Hz	Hertz
IPA	isopropyl alcohol
i-PrOH	isopropyl alcohol
J	NMR coupling constant
K <sub>2</sub> CO <sub>3</sub>	potassium carbonate
HI	potassium iodide
KCN	potassium cyanide
LCMS or LC-MS	Liquid chromatography mass spectrum
M	molar

m	multiplet
mg	milligram
MHz	megahertz
mL	milliliter
mm	millimeter
mmol	millimole
mol	mole
[M+1]	molecular ion plus one mass unit
m/z	mass/charge ratio
m-CPBA	meta-chloroperbenzoic acid
MeCN	Acetonitrile
MeOH	methanol
MeI	Methyl iodide
min	minutes
μm	micron
MsCl	Mesyl chloride
MW	microwave irradiation
N	normal
Na <sub>2</sub> SO <sub>4</sub>	sodium sulfate
NH <sub>3</sub>	ammonia
NaBH(AcO) <sub>3</sub>	sodium triacetoxyborohydride
NaI	sodium iodide
Na <sub>2</sub> SO <sub>4</sub>	sodium sulfate
NH <sub>4</sub> Cl	ammonium chloride
NH <sub>4</sub> HCO <sub>3</sub>	ammonium bicarbonate
nm	nanometer
NMP	N-methylpyrrolidinone
NMR	Nuclear Magnetic Resonance
Pd(OAc) <sub>2</sub>	palladium (II) acetate
Pd/C	Palladium on carbon
Pd <sub>2</sub> (dba) <sub>3</sub>	Tris(dibenzylideneacetone)dipalladium(0)
PMB	para methoxybenzyl

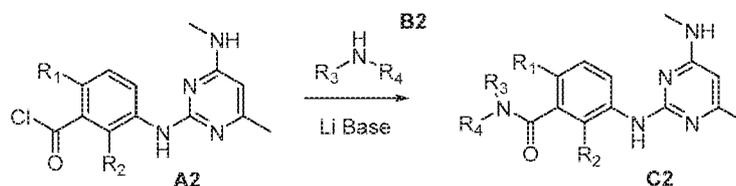
ppm	parts per million
POCl <sub>3</sub>	phosphoryl chloride
prep-HPLC	preparative High Performance Liquid Chromatography
PTSA	para-toluenesulfonic acid
p-TsOH	para-toluenesulfonic acid
RT	retention time
rt	room temperature
s	singlet
t	triplet
t-BuXPhos	2-Di- <i>tert</i> -butylphosphino-2', 4', 6'-triisopropylbiphenyl
TEA	Triethylamine
TFA	trifluoroacetic acid
TfO	triflate
THP	tetrahydropyran
TsOH	tosic acid
UV	ultraviolet

### Scheme 1



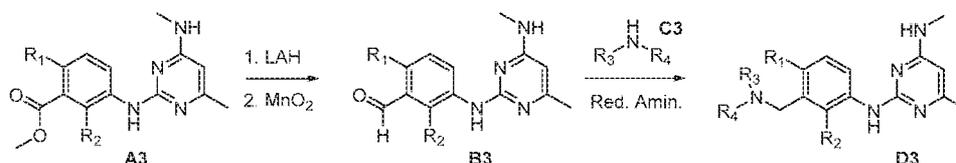
[0460] Scheme 1 shows the synthesis of 3-amino benzamide compounds **C1** following a general route. A substituted 3-aminobenzoic acid is combined in an organic solvent (*e.g.*, DMF) with a dialkylamine **B1** and a base (*e.g.*, DIEA) and a peptide coupling reagent (*e.g.*, HATU). The resulting reaction mixture is stirred at RT until completion to afford the 3-amino benzamide compounds **C1**.

### Scheme 2



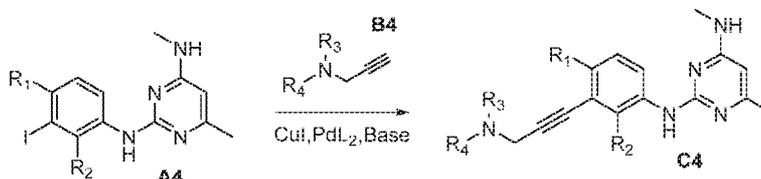
[0461] Scheme 2 shows the synthesis of 3-amino benzamide compounds **C1** following a general route. Dialkylamine **B2** is combined in an organic solvent (*e.g.*, THF) and treated with a strong base (*e.g.* LiHMDS). The resulting lithiated amine **B2** is cooled below 0 °C and then treated with an acid chloride **A2** in an organic solvent (*e.g.*, THF) to afford the desired 3-amino benzamide **C1**.

### Scheme 3



[0462] Scheme 3 shows the synthesis of 3-amino benzylamine compounds **C3** following a general route. Methyl benzoate derivative **A3** is combined in an organic solvent (*e.g.*, THF) and treated with LAH to afford the corresponding methyl alcohol. The resulting alcohol is treated with an oxidation reagent (*e.g.*, MnO<sub>2</sub>) to afford the benzaldehyde intermediate **B3**. Intermediate **B3** is taken up in an organic solvent (*e.g.*, THF) then treated with a dialkylamine **C3** in the presence of a reducing agent (*e.g.*, NaH(OAc)<sub>3</sub>) to afford the benzylamine compounds of type **D3**.

### Scheme 4



[0463] Scheme 4 shows the synthesis of 3-(3-aminoprop-1-yn-1-yl)aniline compounds **C4** following a general route. Propargylamine **B4** is combined in an organic solvent (*e.g.*, DMSO) with iodobenzene **A4** and treated with CuI, a Pd-coupling reagent (*e.g.*, Pd(PPh<sub>3</sub>)Cl<sub>2</sub>) and base (*e.g.*, TEA). After reaction completion, column chromatography affords the desired 3-(3-aminoprop-1-yn-1-yl)aniline compounds **C4**.

[0464] A person of ordinary skill in the art will recognize that in the above schemes the order of many of the steps are interchangeable.

[0465] Compounds of the present disclosure inhibit the histone methyltransferase activity of G9a, also known as KMT1C (lysine methyltransferase 1C) or EHMT2 (euchromatic histone methyltransferase 2), or a mutant thereof and, accordingly, in one aspect of the disclosure, certain compounds disclosed herein are candidates for treating, or preventing certain conditions, diseases,

and disorders in which EHMT2 plays a role. The present disclosure provides methods for treating conditions and diseases the course of which can be influenced by modulating the methylation status of histones or other proteins, wherein said methylation status is mediated at least in part by the activity of EHMT2. Modulation of the methylation status of histones can in turn influence the level of expression of target genes activated by methylation, and/or target genes suppressed by methylation. The method includes administering to a subject in need of such treatment, a therapeutically effective amount of a compound of the present disclosure, or a pharmaceutically acceptable salt, polymorph, solvate, or stereoisomer thereof.

[0466] Unless otherwise stated, any description of a method of treatment includes use of the compounds to provide such treatment or prophylaxis as is described herein, as well as use of the compounds to prepare a medicament to treat or prevent such condition. The treatment includes treatment of human or non-human animals including rodents and other disease models.

[0467] In still another aspect, this disclosure relates to a method of modulating the activity of EHMT2, which catalyzes the dimethylation of lysine 9 on histone H3 (H3K9) in a subject in need thereof. For example, the method comprises the step of administering to a subject having a cancer expressing a mutant EHMT2 a therapeutically effective amount of a compound described herein, wherein the compound(s) inhibits histone methyltransferase activity of EHMT2, thereby treating the cancer.

[0468] For example, the EHMT2-mediated cancer is selected from the group consisting of leukemia, prostate carcinoma, hepatocellular carcinoma, and lung cancer.

[0469] For example, the compounds disclosed herein can be used for treating cancer. For example, the cancer is a hematological cancer.

[0470] For example, the cancer is selected from the group consisting of brain and central nervous system (CNS) cancer, head and neck cancer, kidney cancer, ovarian cancer, pancreatic cancer, leukemia, lung cancer, lymphoma, myeloma, sarcoma, breast cancer, and prostate cancer.

Preferably, a subject in need thereof is one who had, is having or is predisposed to developing brain and CNS cancer, kidney cancer, ovarian cancer, pancreatic cancer, leukemia, lymphoma, myeloma, and/or sarcoma. Exemplary brain and central CNS cancer includes medulloblastoma, oligodendroglioma, atypical teratoid/rhabdoid tumor, choroid plexus carcinoma, choroid plexus papilloma, ependymoma, glioblastoma, meningioma, neuroglial tumor, oligoastrocytoma, oligodendroglioma, and pineoblastoma. Exemplary ovarian cancer includes ovarian clear cell adenocarcinoma, ovarian endometrioid adenocarcinoma, and ovarian serous adenocarcinoma.

Exemplary pancreatic cancer includes pancreatic ductal adenocarcinoma and pancreatic endocrine tumor. Exemplary sarcoma includes chondrosarcoma, clear cell sarcoma of soft tissue, ewing sarcoma, gastrointestinal stromal tumor, osteosarcoma, rhabdomyosarcoma, and not otherwise specified (NOS) sarcoma. Alternatively, cancers to be treated by the compounds of the disclosure are non-NHL cancers.

[0471] For example, the cancer is selected from the group consisting of acute myeloid leukemia (AML) or chronic lymphocytic leukemia (CLL), medulloblastoma, oligodendroglioma, ovarian clear cell adenocarcinoma, ovarian endometrioid adenocarcinoma, ovarian serous adenocarcinoma, pancreatic ductal adenocarcinoma, pancreatic endocrine tumor, malignant rhabdoid tumor, astrocytoma, atypical teratoid/rhabdoid tumor, choroid plexus carcinoma, choroid plexus papilloma, ependymoma, glioblastoma, meningioma, neuroglial tumor, oligoastrocytoma, oligodendroglioma, pineoblastoma, carcinosarcoma, chordoma, extragonadal germ cell tumor, extrarenal rhabdoid tumor, schwannoma, skin squamous cell carcinoma, chondrosarcoma, clear cell sarcoma of soft tissue, ewing sarcoma, gastrointestinal stromal tumor, osteosarcoma, rhabdomyosarcoma, and not otherwise specified (NOS) sarcoma. Preferably, the cancer is acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), medulloblastoma, ovarian clear cell adenocarcinoma, ovarian endometrioid adenocarcinoma, pancreatic ductal adenocarcinoma, malignant rhabdoid tumor, atypical teratoid/rhabdoid tumor, choroid plexus carcinoma, choroid plexus papilloma, glioblastoma, meningioma, pineoblastoma, carcinosarcoma, extrarenal rhabdoid tumor, schwannoma, skin squamous cell carcinoma, chondrosarcoma, ewing sarcoma, epithelioid sarcoma, renal medullary carcinoma, diffuse large B-cell lymphoma, follicular lymphoma and/or NOS sarcoma.

[0472] For example, the cancer is lymphoma, leukemia or melanoma. For example, the cancer is lymphoma selected from the group consisting of follicular lymphoma, diffuse large B-cell lymphoma (DLBCL), and Burkitt's lymphoma, and Non-Hodgkin's Lymphoma. Preferably, the lymphoma is non-Hodgkin's lymphoma (NHL), follicular lymphoma or diffuse large B-cell lymphoma. Alternatively, the leukemia is chronic myelogenous leukemia (CML), acute myeloid leukemia, acute lymphocytic leukemia or mixed lineage leukemia.

[0473] For example, the EHMT2-mediated disorder is a hematological disorder.

[0474] The compound(s) of the present disclosure inhibit the histone methyltransferase activity of EHMT2 or a mutant thereof and, accordingly, the present disclosure also provides methods for treating conditions and diseases the course of which can be influenced by modulating the

methylation status of histones or other proteins, wherein said methylation status is mediated at least in part by the activity of EHMT2. In one aspect of the disclosure, certain compounds disclosed herein are candidates for treating, or preventing certain conditions, diseases, and disorders. Modulation of the methylation status of histones can in turn influence the level of expression of target genes activated by methylation, and/or target genes suppressed by methylation. The method includes administering to a subject in need of such treatment, a therapeutically effective amount of a compound of the present disclosure.

[0475] As used herein, a “subject” is interchangeable with a “subject in need thereof”, both of which refer to a subject having a disorder in which EHMT2-mediated protein methylation plays a part, or a subject having an increased risk of developing such disorder relative to the population at large. A “subject” includes a mammal. The mammal can be *e.g.*, a human or appropriate non-human mammal, such as primate, mouse, rat, dog, cat, cow, horse, goat, camel, sheep or a pig. The subject can also be a bird or fowl. In one embodiment, the mammal is a human. A subject in need thereof can be one who has been previously diagnosed or identified as having cancer or a precancerous condition. A subject in need thereof can also be one who has (*e.g.*, is suffering from) cancer or a precancerous condition. Alternatively, a subject in need thereof can be one who has an increased risk of developing such disorder relative to the population at large (*i.e.*, a subject who is predisposed to developing such disorder relative to the population at large). A subject in need thereof can have a precancerous condition. A subject in need thereof can have refractory or resistant cancer (*i.e.*, cancer that does not respond or has not yet responded to treatment). The subject may be resistant at start of treatment or may become resistant during treatment. In some embodiments, the subject in need thereof has cancer recurrence following remission on most recent therapy. In some embodiments, the subject in need thereof received and failed all known effective therapies for cancer treatment. In some embodiments, the subject in need thereof received at least one prior therapy. In a preferred embodiment, the subject has cancer or a cancerous condition. For example, the cancer is leukemia, prostate carcinoma, hepatocellular carcinoma, and lung cancer.

[0476] As used herein, “candidate compound” refers to a compound of the present disclosure, or a pharmaceutically acceptable salt, polymorph or solvate thereof, that has been or will be tested in one or more *in vitro* or *in vivo* biological assays, in order to determine if that compound is likely to elicit a desired biological or medical response in a cell, tissue, system, animal or human that is being sought by a researcher or clinician. A candidate compound is a compound of the present

disclosure, or a pharmaceutically acceptable salt, polymorph or solvate thereof. The biological or medical response can be the treatment of cancer. The biological or medical response can be treatment or prevention of a cell proliferative disorder. The biological response or effect can also include a change in cell proliferation or growth that occurs *in vitro* or in an animal model, as well as other biological changes that are observable *in vitro*. *In vitro* or *in vivo* biological assays can include, but are not limited to, enzymatic activity assays, electrophoretic mobility shift assays, reporter gene assays, *in vitro* cell viability assays, and the assays described herein.

[0477] For example, an *in vitro* biological assay that can be used includes the steps of (1) mixing a histone substrate (*e.g.*, an isolated histone sample or an isolated histone peptide representative of human histone H3 residues 1-15) with recombinant EHMT2 enzymes; (2) adding a compound of the disclosure to this mixture; (3) adding non-radioactive and <sup>3</sup>H-labeled S-Adenosyl methionine (SAM) to start the reaction; (4) adding excessive amount of non-radioactive SAM to stop the reaction; (4) washing off the free non-incorporated <sup>3</sup>H-SAM; and (5) detecting the quantity of <sup>3</sup>H-labeled histone substrate by any methods known in the art (*e.g.*, by a PerkinElmer TopCount platereader).

[0478] For example, an *in vitro* study that can be used includes the steps of (1) treating cancer cells (*e.g.*, breast cancer cells) with a compound of this disclosure; (2) incubating the cells for a set period of time; (3) fixing the cells; (4) treating the cells with primary antibodies that bind to dimethylated histone substrates; (5) treating the cells with a secondary antibody (*e.g.* an antibody conjugated to an infrared dye); (6) detecting the quantity of bound antibody by any methods known in the art (*e.g.*, by a Licor Odyssey Infrared Scanner).

[0479] As used herein, “treating” or “treat” describes the management and care of a patient for the purpose of combating a disease, condition, or disorder and includes the administration of a compound of the present disclosure, or a pharmaceutically acceptable salt, polymorph or solvate thereof, to alleviate the symptoms or complications of a disease, condition or disorder, or to eliminate the disease, condition or disorder. The term “treat” can also include treatment of a cell *in vitro* or an animal model.

[0480] A compound of the present disclosure, or a pharmaceutically acceptable salt, polymorph or solvate thereof, can or may also be used to prevent a relevant disease, condition or disorder, or used to identify suitable candidates for such purposes. As used herein, “preventing,” “prevent,” or “protecting against” describes reducing or eliminating the onset of the symptoms or complications of such disease, condition or disorder.

[0481] One skilled in the art may refer to general reference texts for detailed descriptions of known techniques discussed herein or equivalent techniques. These texts include Ausubel *et al.*, *Current Protocols in Molecular Biology*, John Wiley and Sons, Inc. (2005); Sambrook *et al.*, *Molecular Cloning, A Laboratory Manual* (3<sup>rd</sup> edition), Cold Spring Harbor Press, Cold Spring Harbor, New York (2000); Coligan *et al.*, *Current Protocols in Immunology*, John Wiley & Sons, N.Y.; Enna *et al.*, *Current Protocols in Pharmacology*, John Wiley & Sons, N.Y.; Fingl *et al.*, *The Pharmacological Basis of Therapeutics* (1975), *Remington's Pharmaceutical Sciences*, Mack Publishing Co., Easton, PA, 18<sup>th</sup> edition (1990). These texts can, of course, also be referred to in making or using an aspect of the disclosure.

[0482] As used herein, "combination therapy" or "co-therapy" includes the administration of a compound of the present disclosure, or a pharmaceutically acceptable salt, polymorph or solvate thereof, and at least a second agent as part of a specific treatment regimen intended to provide the beneficial effect from the co-action of these therapeutic agents. The beneficial effect of the combination includes, but is not limited to, pharmacokinetic or pharmacodynamic co-action resulting from the combination of therapeutic agents.

[0483] The present disclosure also provides pharmaceutical compositions comprising a compound of any of the Formulae described herein in combination with at least one pharmaceutically acceptable excipient or carrier.

[0484] A "pharmaceutical composition" is a formulation containing the compounds of the present disclosure in a form suitable for administration to a subject. In one embodiment, the pharmaceutical composition is in bulk or in unit dosage form. The unit dosage form is any of a variety of forms, including, for example, a capsule, an IV bag, a tablet, a single pump on an aerosol inhaler or a vial. The quantity of active ingredient (*e.g.*, a formulation of the disclosed compound or salt, hydrate, solvate or isomer thereof) in a unit dose of composition is an effective amount and is varied according to the particular treatment involved. One skilled in the art will appreciate that it is sometimes necessary to make routine variations to the dosage depending on the age and condition of the patient. The dosage will also depend on the route of administration. A variety of routes are contemplated, including oral, pulmonary, rectal, parenteral, transdermal, subcutaneous, intravenous, intramuscular, intraperitoneal, inhalational, buccal, sublingual, intrapleural, intrathecal, intranasal, and the like. Dosage forms for the topical or transdermal administration of a compound of this disclosure include powders, sprays, ointments, pastes, creams, lotions, gels, solutions, patches and inhalants. In one embodiment, the active compound

is mixed under sterile conditions with a pharmaceutically acceptable carrier, and with any preservatives, buffers, or propellants that are required.

[0485] As used herein, the phrase “pharmaceutically acceptable” refers to those compounds, anions, cations, materials, compositions, carriers, and/or dosage forms which are, within the scope of sound medical judgment, suitable for use in contact with the tissues of human beings and animals without excessive toxicity, irritation, allergic response, or other problem or complication, commensurate with a reasonable benefit/risk ratio.

[0486] “Pharmaceutically acceptable excipient” means an excipient that is useful in preparing a pharmaceutical composition that is generally safe, non-toxic and neither biologically nor otherwise undesirable, and includes excipient that is acceptable for veterinary use as well as human pharmaceutical use. A “pharmaceutically acceptable excipient” as used in the specification and claims includes both one and more than one such excipient.

[0487] A pharmaceutical composition of the disclosure is formulated to be compatible with its intended route of administration. Examples of routes of administration include parenteral, *e.g.*, intravenous, intradermal, subcutaneous, oral (*e.g.*, inhalation), transdermal (topical), and transmucosal administration. Solutions or suspensions used for parenteral, intradermal, or subcutaneous application can include the following components: a sterile diluent such as water for injection, saline solution, fixed oils, polyethylene glycols, glycerine, propylene glycol or other synthetic solvents; antibacterial agents such as benzyl alcohol or methyl parabens; antioxidants such as ascorbic acid or sodium bisulfite; chelating agents such as ethylenediaminetetraacetic acid; buffers such as acetates, citrates or phosphates, and agents for the adjustment of tonicity such as sodium chloride or dextrose. The pH can be adjusted with acids or bases, such as hydrochloric acid or sodium hydroxide. The parenteral preparation can be enclosed in ampoules, disposable syringes or multiple dose vials made of glass or plastic.

[0488] A compound or pharmaceutical composition of the disclosure can be administered to a subject in many of the well-known methods currently used for chemotherapeutic treatment. For example, for treatment of cancers, a compound of the disclosure may be injected directly into tumors, injected into the blood stream or body cavities or taken orally or applied through the skin with patches. The dose chosen should be sufficient to constitute effective treatment but not so high as to cause unacceptable side effects. The state of the disease condition (*e.g.*, cancer, precancer, and the like) and the health of the patient should preferably be closely monitored during and for a reasonable period after treatment.

[0489] The term “therapeutically effective amount”, as used herein, refers to an amount of a pharmaceutical agent to treat, ameliorate, or prevent an identified disease or condition, or to exhibit a detectable therapeutic or inhibitory effect. The effect can be detected by any assay method known in the art. The precise effective amount for a subject will depend upon the subject’s body weight, size, and health; the nature and extent of the condition; and the therapeutic or combination of therapeutics selected for administration. Therapeutically effective amounts for a given situation can be determined by routine experimentation that is within the skill and judgment of the clinician. In a preferred aspect, the disease or condition to be treated is cancer. In another aspect, the disease or condition to be treated is a cell proliferative disorder.

[0490] For any compound, the therapeutically effective amount can be estimated initially either in cell culture assays, *e.g.*, of neoplastic cells, or in animal models, usually rats, mice, rabbits, dogs, or pigs. The animal model may also be used to determine the appropriate concentration range and route of administration. Such information can then be used to determine useful doses and routes for administration in humans. Therapeutic/prophylactic efficacy and toxicity may be determined by standard pharmaceutical procedures in cell cultures or experimental animals, *e.g.*, ED<sub>50</sub> (the dose therapeutically effective in 50% of the population) and LD<sub>50</sub> (the dose lethal to 50% of the population). The dose ratio between toxic and therapeutic effects is the therapeutic index, and it can be expressed as the ratio, LD<sub>50</sub>/ED<sub>50</sub>. Pharmaceutical compositions that exhibit large therapeutic indices are preferred. The dosage may vary within this range depending upon the dosage form employed, sensitivity of the patient, and the route of administration.

[0491] Dosage and administration are adjusted to provide sufficient levels of the active agent(s) or to maintain the desired effect. Factors which may be taken into account include the severity of the disease state, general health of the subject, age, weight, and gender of the subject, diet, time and frequency of administration, drug combination(s), reaction sensitivities, and tolerance/response to therapy. Long-acting pharmaceutical compositions may be administered every 3 to 4 days, every week, or once every two weeks depending on half-life and clearance rate of the particular formulation.

[0492] The pharmaceutical compositions containing active compounds of the present disclosure may be manufactured in a manner that is generally known, *e.g.*, by means of conventional mixing, dissolving, granulating, dragee-making, levigating, emulsifying, encapsulating, entrapping, or lyophilizing processes. Pharmaceutical compositions may be formulated in a conventional manner using one or more pharmaceutically acceptable carriers comprising excipients and/or auxiliaries

that facilitate processing of the active compounds into preparations that can be used pharmaceutically. Of course, the appropriate formulation is dependent upon the route of administration chosen.

[0493] Pharmaceutical compositions suitable for injectable use include sterile aqueous solutions (where water soluble) or dispersions and sterile powders for the extemporaneous preparation of sterile injectable solutions or dispersion. For intravenous administration, suitable carriers include physiological saline, bacteriostatic water, Cremophor EL™ (BASF, Parsippany, N.J.) or phosphate buffered saline (PBS). In all cases, the composition must be sterile and should be fluid to the extent that easy syringeability exists. It must be stable under the conditions of manufacture and storage and must be preserved against the contaminating action of microorganisms such as bacteria and fungi. The carrier can be a solvent or dispersion medium containing, for example, water, ethanol, polyol (for example, glycerol, propylene glycol, and liquid polyethylene glycol, and the like), and suitable mixtures thereof. The proper fluidity can be maintained, for example, by the use of a coating such as lecithin, by the maintenance of the required particle size in the case of dispersion and by the use of surfactants. Prevention of the action of microorganisms can be achieved by various antibacterial and antifungal agents, for example, parabens, chlorobutanol, phenol, ascorbic acid, thimerosal, and the like. In many cases, it will be preferable to include isotonic agents, for example, sugars, polyalcohols such as mannitol and sorbitol, and sodium chloride in the composition. Prolonged absorption of the injectable compositions can be brought about by including in the composition an agent which delays absorption, for example, aluminum monostearate and gelatin.

[0494] Sterile injectable solutions can be prepared by incorporating the active compound in the required amount in an appropriate solvent with one or a combination of ingredients enumerated above, as required, followed by filtered sterilization. Generally, dispersions are prepared by incorporating the active compound into a sterile vehicle that contains a basic dispersion medium and the required other ingredients from those enumerated above. In the case of sterile powders for the preparation of sterile injectable solutions, methods of preparation are vacuum drying and freeze-drying that yields a powder of the active ingredient plus any additional desired ingredient from a previously sterile-filtered solution thereof.

[0495] Oral compositions generally include an inert diluent or an edible pharmaceutically acceptable carrier. They can be enclosed in gelatin capsules or compressed into tablets. For the purpose of oral therapeutic administration, the active compound can be incorporated with

excipients and used in the form of tablets, troches, or capsules. Oral compositions can also be prepared using a fluid carrier for use as a mouthwash, wherein the compound in the fluid carrier is applied orally and swished and expectorated or swallowed. Pharmaceutically compatible binding agents, and/or adjuvant materials can be included as part of the composition. The tablets, pills, capsules, troches and the like can contain any of the following ingredients, or compounds of a similar nature: a binder such as microcrystalline cellulose, gum tragacanth or gelatin; an excipient such as starch or lactose, a disintegrating agent such as alginic acid, Primogel, or corn starch; a lubricant such as magnesium stearate or Sterotes; a glidant such as colloidal silicon dioxide; a sweetening agent such as sucrose or saccharin; or a flavoring agent such as peppermint, methyl salicylate, or orange flavoring.

[0496] For administration by inhalation, the compounds are delivered in the form of an aerosol spray from pressured container or dispenser, which contains a suitable propellant, *e.g.*, a gas such as carbon dioxide, or a nebulizer.

[0497] Systemic administration can also be by transmucosal or transdermal means. For transmucosal or transdermal administration, penetrants appropriate to the barrier to be permeated are used in the formulation. Such penetrants are generally known in the art, and include, for example, for transmucosal administration, detergents, bile salts, and fusidic acid derivatives. Transmucosal administration can be accomplished through the use of nasal sprays or suppositories. For transdermal administration, the active compounds are formulated into ointments, salves, gels, or creams as generally known in the art.

[0498] The active compounds can be prepared with pharmaceutically acceptable carriers that will protect the compound against rapid elimination from the body, such as a controlled release formulation, including implants and microencapsulated delivery systems. Biodegradable, biocompatible polymers can be used, such as ethylene vinyl acetate, polyanhydrides, polyglycolic acid, collagen, polyorthoesters, and polylactic acid. Methods for preparation of such formulations will be apparent to those skilled in the art. The materials can also be obtained commercially from Alza Corporation and Nova Pharmaceuticals, Inc. Liposomal suspensions (including liposomes targeted to infected cells with monoclonal antibodies to viral antigens) can also be used as pharmaceutically acceptable carriers. These can be prepared according to methods known to those skilled in the art, for example, as described in U.S. Pat. No. 4,522,811.

[0499] It is especially advantageous to formulate oral or parenteral compositions in dosage unit form for ease of administration and uniformity of dosage. Dosage unit form as used herein refers

to physically discrete units suited as unitary dosages for the subject to be treated, each unit containing a predetermined quantity of active compound calculated to produce the desired therapeutic effect in association with the required pharmaceutical carrier. The specification for the dosage unit forms of the disclosure are dictated by and directly dependent on the unique characteristics of the active compound and the particular therapeutic effect to be achieved.

[0500] In therapeutic applications, the dosages of the pharmaceutical compositions used in accordance with the disclosure vary depending on the agent, the age, weight, and clinical condition of the recipient patient, and the experience and judgment of the clinician or practitioner administering the therapy, among other factors affecting the selected dosage. Generally, the dose should be sufficient to result in slowing, and preferably regressing, the growth of the tumors and also preferably causing complete regression of the cancer. Dosages can range from about 0.01 mg/kg per day to about 5000 mg/kg per day. In preferred aspects, dosages can range from about 1 mg/kg per day to about 1000 mg/kg per day. In an aspect, the dose will be in the range of about 0.1 mg/day to about 50 g/day; about 0.1 mg/day to about 25 g/day; about 0.1 mg/day to about 10 g/day; about 0.1 mg to about 3 g/day; or about 0.1 mg to about 1 g/day, in single, divided, or continuous doses (which dose may be adjusted for the patient's weight in kg, body surface area in m<sup>2</sup>, and age in years). An effective amount of a pharmaceutical agent is that which provides an objectively identifiable improvement as noted by the clinician or other qualified observer. For example, regression of a tumor in a patient may be measured with reference to the diameter of a tumor. Decrease in the diameter of a tumor indicates regression. Regression is also indicated by failure of tumors to reoccur after treatment has stopped. As used herein, the term "dosage effective manner" refers to amount of an active compound to produce the desired biological effect in a subject or cell.

[0501] The pharmaceutical compositions can be included in a container, pack, or dispenser together with instructions for administration.

[0502] The compounds of the present disclosure are capable of further forming salts. All of these forms are also contemplated within the scope of the claimed disclosure.

[0503] As used herein, "pharmaceutically acceptable salts" refer to derivatives of the compounds of the present disclosure wherein the parent compound is modified by making acid or base salts thereof. Examples of pharmaceutically acceptable salts include, but are not limited to, mineral or organic acid salts of basic residues such as amines, alkali or organic salts of acidic residues such as carboxylic acids, and the like. The pharmaceutically acceptable salts include the conventional

non-toxic salts or the quaternary ammonium salts of the parent compound formed, for example, from non-toxic inorganic or organic acids. For example, such conventional non-toxic salts include, but are not limited to, those derived from inorganic and organic acids selected from 2-acetoxybenzoic, 2-hydroxyethane sulfonic, acetic, ascorbic, benzene sulfonic, benzoic, bicarbonic, carbonic, citric, edetic, ethane disulfonic, 1,2-ethane sulfonic, fumaric, glucoheptonic, gluconic, glutamic, glycolic, glycollyarsanilic, hexylresorcinic, hydrabamic, hydrobromic, hydrochloric, hydroiodic, hydroxymaleic, hydroxynaphthoic, isethionic, lactic, lactobionic, lauryl sulfonic, maleic, malic, mandelic, methane sulfonic, napsylic, nitric, oxalic, pamoic, pantothenic, phenylacetic, phosphoric, polygalacturonic, propionic, salicylic, stearic, subacetic, succinic, sulfamic, sulfanilic, sulfuric, tannic, tartaric, toluene sulfonic, and the commonly occurring amine acids, *e.g.*, glycine, alanine, phenylalanine, arginine, etc.

[0504] Other examples of pharmaceutically acceptable salts include hexanoic acid, cyclopentane propionic acid, pyruvic acid, malonic acid, 3-(4-hydroxybenzoyl)benzoic acid, cinnamic acid, 4-chlorobenzenesulfonic acid, 2-naphthalenesulfonic acid, 4-toluenesulfonic acid, camphorsulfonic acid, 4-methylbicyclo-[2.2.2]-oct-2-ene-1-carboxylic acid, 3-phenylpropionic acid, trimethylacetic acid, tertiary butylacetic acid, muconic acid, and the like. The present disclosure also encompasses salts formed when an acidic proton present in the parent compound either is replaced by a metal ion, *e.g.*, an alkali metal ion, an alkaline earth ion, or an aluminum ion; or coordinates with an organic base such as ethanolamine, diethanolamine, triethanolamine, tromethamine, N-methylglucamine, and the like. In the salt form, it is understood that the ratio of the compound to the cation or anion of the salt can be 1:1, or any ration other than 1:1, *e.g.*, 3:1, 2:1, 1:2, or 1:3.

[0505] It should be understood that all references to pharmaceutically acceptable salts include solvent addition forms (solvates) or crystal forms (polymorphs) as defined herein, of the same salt.

[0506] The compounds of the present disclosure can also be prepared as esters, for example, pharmaceutically acceptable esters. For example, a carboxylic acid function group in a compound can be converted to its corresponding ester, *e.g.*, a methyl, ethyl or other ester. Also, an alcohol group in a compound can be converted to its corresponding ester, *e.g.*, acetate, propionate or other ester.

[0507] The compounds, or pharmaceutically acceptable salts thereof, are administered orally, nasally, transdermally, pulmonary, inhalationally, buccally, sublingually, intraperitoneally, subcutaneously, intramuscularly, intravenously, rectally, intrapleurally, intrathecally and

parenterally. In one embodiment, the compound is administered orally. One skilled in the art will recognize the advantages of certain routes of administration.

[0508] The dosage regimen utilizing the compounds is selected in accordance with a variety of factors including type, species, age, weight, sex and medical condition of the patient; the severity of the condition to be treated; the route of administration; the renal and hepatic function of the patient; and the particular compound or salt thereof employed. An ordinarily skilled physician or veterinarian can readily determine and prescribe the effective amount of the drug required to prevent, counter, or arrest the progress of the condition.

[0509] Techniques for formulation and administration of the disclosed compounds of the disclosure can be found in *Remington: the Science and Practice of Pharmacy*, 19<sup>th</sup> edition, Mack Publishing Co., Easton, PA (1995). In an embodiment, the compounds described herein, and the pharmaceutically acceptable salts thereof, are used in pharmaceutical preparations in combination with a pharmaceutically acceptable carrier or diluent. Suitable pharmaceutically acceptable carriers include inert solid fillers or diluents and sterile aqueous or organic solutions. The compounds will be present in such pharmaceutical compositions in amounts sufficient to provide the desired dosage amount in the range described herein.

[0510] All percentages and ratios used herein, unless otherwise indicated, are by weight. Other features and advantages of the present disclosure are apparent from the different examples. The provided examples illustrate different components and methodology useful in practicing the present disclosure. The examples do not limit the claimed disclosure. Based on the present disclosure the skilled artisan can identify and employ other components and methodology useful for practicing the present disclosure.

[0511] In the synthetic schemes described herein, compounds may be drawn with one particular configuration for simplicity. Such particular configurations are not to be construed as limiting the disclosure to one or another isomer, tautomer, regioisomer or stereoisomer, nor does it exclude mixtures of isomers, tautomers, regioisomers or stereoisomers; however, it will be understood that a given isomer, tautomer, regioisomer or stereoisomer may have a higher level of activity than another isomer, tautomer, regioisomer or stereoisomer.

[0512] Compounds designed, selected and/or optimized by methods described above, once produced, can be characterized using a variety of assays known to those skilled in the art to determine whether the compounds have biological activity. For example, the molecules can be

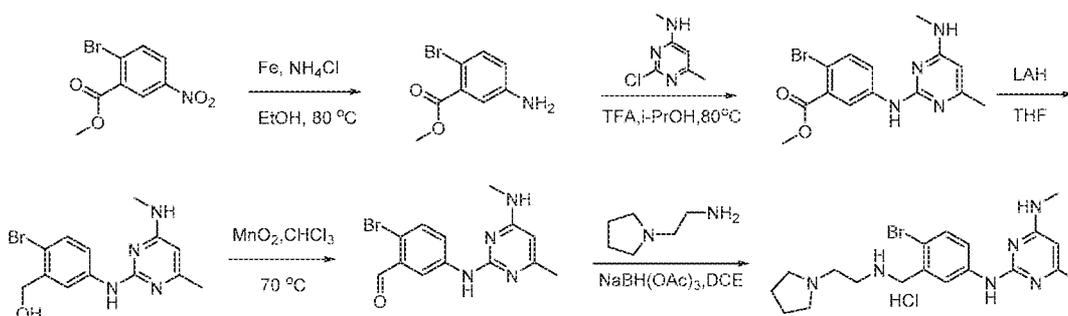
characterized by conventional assays, including but not limited to those assays described below, to determine whether they have a predicted activity, binding activity and/or binding specificity.

[0513] Furthermore, high-throughput screening can be used to speed up analysis using such assays. As a result, it can be possible to rapidly screen the molecules described herein for activity, using techniques known in the art. General methodologies for performing high-throughput screening are described, for example, in Devlin (1998) *High Throughput Screening*, Marcel Dekker; and U.S. Patent No. 5,763,263. High-throughput assays can use one or more different assay techniques including, but not limited to, those described below.

[0514] All publications and patent documents cited herein are incorporated herein by reference as if each such publication or document was specifically and individually indicated to be incorporated herein by reference. Citation of publications and patent documents is not intended as an admission that any is pertinent prior art, nor does it constitute any admission as to the contents or date of the same. The invention having now been described by way of written description, those of skill in the art will recognize that the invention can be practiced in a variety of embodiments and that the foregoing description and examples below are for purposes of illustration and not limitation of the claims that follow.

### Example 1: Synthesis of Compound 1

#### 2-N-[4-bromo-3-([(2-(pyrrolidin-1-yl)ethyl]amino)methyl)phenyl]-4-N,6-dimethylpyrimidine-2,4-diamine:



#### Step 1: Synthesis of methyl 5-amino-2-bromobenzoate:

[0515] Into a 100-mL round-bottom flask, was placed methyl 2-bromo-5-nitrobenzoate (2 g, 7.69 mmol, 1.00 equiv), ethanol (24 mL), water (8 mL), Fe (1.3 g, 3.00 equiv), NH<sub>4</sub>Cl (1.25 g, 23.37 mmol, 3.00 equiv). The resulting solution was stirred for 3 h at 80 °C. The solids were filtered out.

The resulting mixture was concentrated under vacuum. This resulted in 1.77 g (crude) of the title compound as a yellow solid.

Analytical Data: LC-MS: (ES,  $m/z$ ): RT = 0.806 min; LCMS53:  $m/z$  = 230 [M+1].

[0516] **Step 2: Synthesis of methyl 2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate:**

[0517] Into a 100-mL round-bottom flask, was placed methyl 5-amino-2-bromobenzoate (1.77 g, 7.69 mmol, 1.10 equiv), 2-chloro-N,6-dimethylpyrimidin-4-amine (1.1 g, 6.98 mmol, 1.00 equiv), trifluoroacetic acid (1.20 g, 10.62 mmol, 1.50 equiv), isopropanol (30 mL). The resulting solution was stirred for 3 h at 60 °C. The solids were collected by filtration. This resulted in 2.5 g (crude) of the title compound as a white solid.

[0518] Analytical Data: LC-MS: (ES,  $m/z$ ): RT = 1.039 min; LCMS53:  $m/z$  = 351 [M+1].

[0519] **Step 3: Synthesis of (2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)methanol:**

[0520] Into a 100-mL round-bottom flask, was placed a solution of methyl 2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate (1.28 g, 3.64 mmol, 1.00 equiv) in tetrahydrofuran (50 mL). This was followed by the addition of LAH (417 mg, 10.99 mmol, 3.00 equiv), in portions at 0 °C. The resulting solution was stirred for 3 h at 20 °C. The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 1 g (85%) of the title compound as an off-white solid.

LC-MS-PH-EPI-K-1122-3: (ES,  $m/z$ ): RT = 0.954 min; LCMS53:  $m/z$  = 325[m+1]<sup>+</sup>.

[0521] **Step 4: Synthesis of 2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzaldehyde:**

[0522] Into a 100-mL round-bottom flask, was placed (2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)methanol (960 mg, 2.97 mmol, 1.00 equiv), MnO<sub>2</sub> (1.162 g, 13.37 mmol, 5.00 equiv), chloroform (10 mL). The resulting solution was stirred for 12 h at 70 °C in an oil bath. The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 400 mg (42%) of the title compound as a yellow solid.

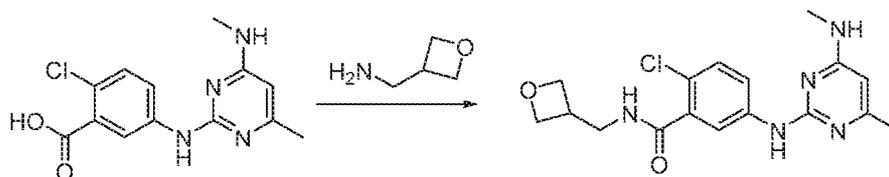
[0523] Analytical Data: LC-MS-PH-EPI-K-1122-4: (ES,  $m/z$ ): RT = 1.033 min; LCMS53:  $m/z$  = 321[m+1]<sup>+</sup>

[0524] **Step 5: Synthesis of 2-N-[4-bromo-3-([2-(pyrrolidin-1-yl)ethyl]amino)methyl]phenyl]-4-N,6-dimethylpyrimidine-2,4-diamine hydrochloride:**

[0525] Into a 25-mL round-bottom flask, was placed 2-bromo-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzaldehyde (400 mg, 1.25 mmol, 1.00 equiv), NaBH(OAc)<sub>3</sub> (5 mL), DCE (285 mg, 2.88 mmol, 2.00 equiv), 2-(pyrrolidin-1-yl)ethan-1-amine (1.06 g, 9.28 mmol, 4.00 equiv). The resulting solution was stirred for 30 min at 25 °C. The resulting solution was allowed to react, with stirring, for an additional 2 h at 25 °C. The crude product was purified by Prep-HPLC with the following conditions (2#-AnalyseHPLC-SHIMADZU(HPLC-10)): Column, X Select CSH Prep C18 OBD Column,, 5um,19\*150mm; mobile phase, Water (0.05%HCl ) and ACN (3.0% ACN up to 14.0% in 7 min); Detector, UV 254/220nm. This resulted in 233.4 mg (41%) of the title compound as an off-white solid.

### Example 2: Synthesis of Compound 2

[0526] **2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]-N-(oxetan-3-ylmethyl)benzamide:**

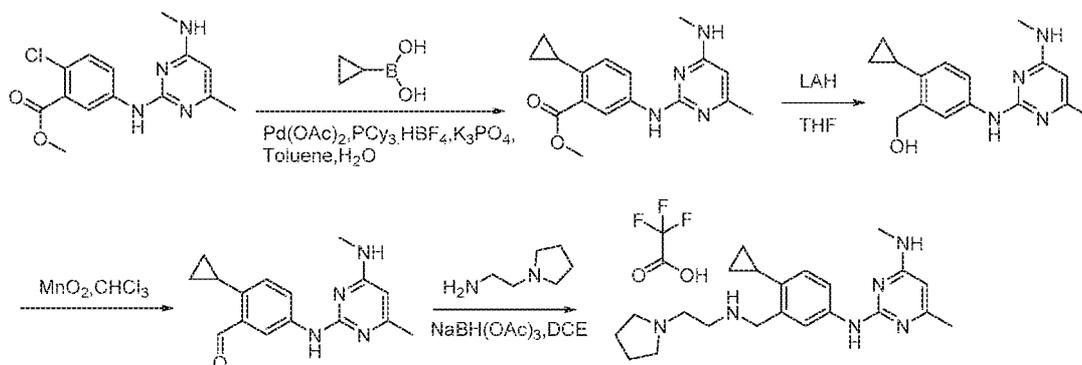


[0527] **Step 1: Synthesis of 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]-N-(oxetan-3-ylmethyl)benzamide:**

[0528] Into a 8-mL round-bottom flask, was placed 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoic acid (100 mg, 0.34 mmol, 1.00 equiv), oxetan-3-ylmethanamine (32 mg, 0.37 mmol, 1.30 equiv), N,N-dimethylformamide (1 g, 13.68 mmol, 40.05 equiv), DIEA (129 mg, 1.00 mmol, 1.30 equiv), HATU (175 mg, 0.46 mmol, 1.30 equiv). The resulting solution was stirred for 10 h at 25 °C. The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with H<sub>2</sub>O/ACN (2:1). This resulted in 56 mg (44%) of the title compound as a white solid.

### Example 3: Synthesis of Compound 11

[0529] **Synthesis of 2-N-[4-cyclopropyl-3-([2-(pyrrolidin-1-yl)ethyl]amino)methyl]phenyl]-4-N,6-dimethylpyrimidine-2,4-diamine**



[0530] **Step 1: Synthesis of methyl 2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate:**

[0531] Into a 30-mL sealed tube purged and maintained with an inert atmosphere of nitrogen, was placed methyl 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate (1 g, 3.26 mmol, 1.00 equiv), cyclopropylboronic acid (421 mg, 4.90 mmol, 1.50 equiv), Pd(OAc)<sub>2</sub> (36.6 mg, 0.16 mmol, 0.05 equiv), PCy<sub>3</sub>-HBF<sub>4</sub> (121 mg, 0.10 equiv), K<sub>3</sub>PO<sub>4</sub> (2.08 g, 9.80 mmol, 3.00 equiv), toluene (12 mL), water (1.2 mL). The resulting solution was stirred for 22 h at 80 °C. The solids were filtered out. The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with CH<sub>3</sub>CN/H<sub>2</sub>O (0.05%TFA) (1/1). This resulted in 0.66 g (65%) of the title compound as a white solid.

[0532] Analytical Data: LC-MS: (ES, *m/z*): RT = 1.061 min; *m/z* = 313[m+1]<sup>+</sup>.

[0533] **Step 2: Synthesis of (2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)methanol**

[0534] Into a 50-mL round-bottom flask, was placed a solution of methyl 2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate (610 mg, 1.95 mmol, 1.00 equiv) in tetrahydrofuran (15 mL). This was followed by the addition of LAH (223 mg, 5.88 mmol, 3.00 equiv), in portions at 0 °C. The resulting solution was stirred for 2 h at 20 °C. The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 0.5 g (90%) of the title compound as an off-white solid.

[0535] Data: LC-MS: (ES, *m/z*): RT = 0.964 min; *m/z* = 285 [M+1].

[0536] **Step 3: Synthesis of 2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzaldehyde:**

[0537] Into a 100-mL round-bottom flask, was placed (2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)methanol (500 mg, 1.76 mmol, 1.00 equiv), MnO<sub>2</sub> (765 mg, 8.80 mmol, 5.00 equiv), chloroform (8 mL). The resulting solution was stirred for 12 h at

70 °C in an oil bath. The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 300 mg (60%) of as a light yellow solid.

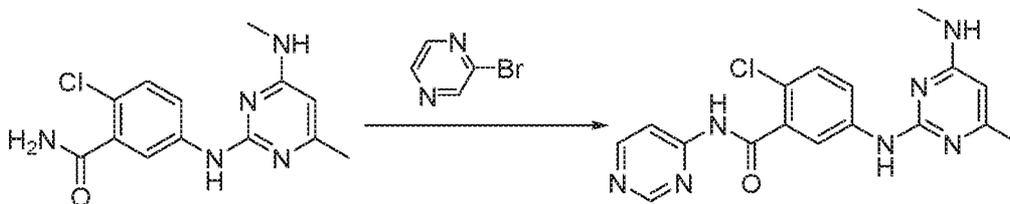
[0538] Analytical Data: LC-MS-PH-EPI-K-1154-3: (ES,  $m/z$ ): RT = 1.034 min; LCMS15:  $m/z$  = 283[ $m+1$ ]<sup>+</sup>

**[0539] Step 4: Synthesis of methyl 2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoate:**

[0540] Into a 25-mL round-bottom flask, was placed 2-cyclopropyl-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzaldehyde (300 mg, 1.06 mmol, 1.00 equiv), DCE (5 mL), 2-(pyrrolidin-1-yl)ethan-1-amine (242 mg, 2.12 mmol, 1.20 equiv), NaBH(OAc)<sub>3</sub> (902 mg, 4.00 equiv). The resulting solution was stirred for 30 min at 25 °C. The resulting solution was allowed to react, with stirring, for an additional 1 h at 25 °C. The solids were filtered out. The crude product was purified by Prep-HPLC with the following conditions (2#-Analyse HPLC-SHIMADZU(HPLC-10)): Column, XBridge Prep C18 OBD Column, 5 $\mu$ m, 19\*150mm; mobile phase, Water(0.05%TFA ) and ACN (10.0% ACN up to 25.0% in 8 min); Detector, UV 254/220nm. This resulted in 130.1 mg (25%) o the title compound as the trifluoroacetic acid as a white solid.

**Example 4: Synthesis of Compound 12**

**[0541] Synthesis of 2-N-(4-chloro-3-[[pyrazin-2-yl]amino]methyl]phenyl)-4-N,6-dimethylpyrimidine-2,4-diamine:**



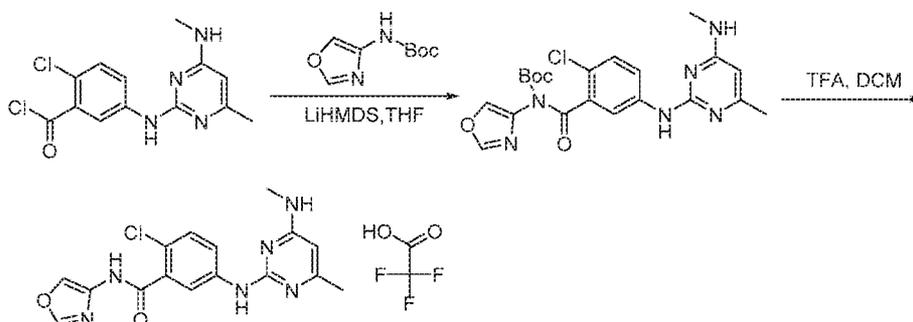
**[0542] Step 1: Synthesis of 2-N-(4-chloro-3-[[pyrazin-2-yl]amino]methyl]phenyl)-4-N,6-dimethylpyrimidine-2,4-diamine:**

[0543] Into a 25-mL round-bottom flask purged and maintained with an inert atmosphere of nitrogen, was placed 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzamide (100 mg, 0.34 mmol, 1.00 equiv), Xantphos (8 mg, 0.07 mmol, 0.20 equiv), Pd<sub>2</sub>(dba)<sub>3</sub> (7 mg, 0.03 mmol, 0.10 equiv), Cs<sub>2</sub>CO<sub>3</sub> (200 mg, 0.68 mmol, 2.00 equiv), DMSO (5 mL), 2-bromopyrazine (55 mg, 0.35 mmol, 1.00 equiv). The resulting solution was stirred for 8 h at 80 °C in an oil bath. The solids were filtered out. The crude product was purified by Prep-HPLC with the following

conditions (2#-AnalyseHPLC-SHIMADZU(HPLC-10)): Column, XBridge Shield RP18 OBD Column, 30\*150mm,5um; mobile phase, Water(10MMOL/L NH<sub>4</sub>HCO<sub>3</sub>) and ACN (25.0% ACN up to 45.0% in 7 min); Detector, UV 254220nm. This resulted in 15.2 mg (12%) of the title compound as a white solid.

#### Example 5: Synthesis of Compound 14

[0544] **Synthesis of 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]-N-(1,3-oxazol-4-yl)benzamide:**



[0545] **Step 1: Synthesis of tert-butyl N-[(2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)carbonyl]-N-(1,3-oxazol-4-yl)carbamate:**

[0546] Into a 20-mL vial, was placed 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzoyl chloride (50 mg, 0.16 mmol, 1.00 equiv), LiHMDS (0.3 mL), tetrahydrofuran (15 mL), tert-butyl N-(1,3-oxazol-4-yl)carbamate (60 mg, 0.33 mmol, 2.03 equiv). The resulting solution was stirred for 5 h at -78 °C. The reaction was then quenched by the addition of water. The resulting solution was extracted with of ethyl acetate and the organic layers combined and concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (80%). This resulted in 75 mg of the title compound as a yellow solid.

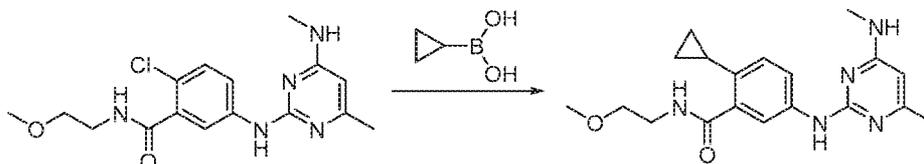
[0547] **Step 2: Synthesis of 2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]-N-(1,3-oxazol-4-yl)benzamide**

[0548] Into a 20-mL vial, was placed tert-butyl N-[(2-chloro-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)carbonyl]-N-(1,3-oxazol-4-yl)carbamate (60 mg, 0.13 mmol, 1.00 equiv), trifluoroacetic acid (4 mL), dichloromethane (4 mL). The resulting solution was stirred for 1 h at 25 °C. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#-AnalyseHPLC-SHIMADZU(HPLC-10)): Column, XBridge Prep C18 OBD Column, 19\*150mm, 5umC-0013 ; mobile phase, Water(0.05%TFA ) and ACN (5.0% ACN up to 16.0%) ; Detector, UV 254220nm.

This resulted in 12.3 mg (20%) of the title compound as the trifluoroacetyl fluoride as a white solid.

### Example 6: Synthesis of Compound 18

[0549] Synthesis of 2-cyclopropyl-N-(2-methoxyethyl)-5-((4-methyl-6-(methylamino)pyrimidin-2-yl)amino)benzamide:

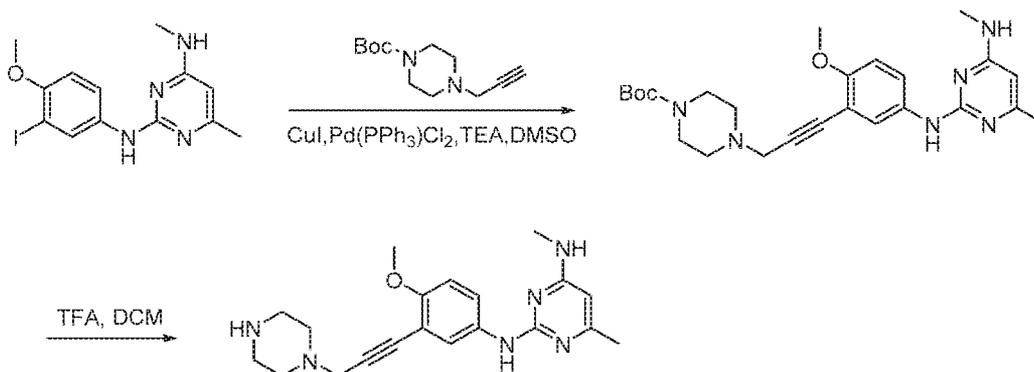


[0550] Step 1: Synthesis of 2-cyclopropyl-N-(2-methoxyethyl)-5-((4-methyl-6-(methylamino)pyrimidin-2-yl)amino)benzamide:

[0551] Into a 25-mL round-bottom flask, was placed 2-chloro-N-(2-methoxyethyl)-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]benzamide (216 mg, 0.62 mmol, 1.00 equiv), cyclopropylboronic acid (106 mg, 1.23 mmol, 2.00 equiv), K<sub>3</sub>PO<sub>4</sub> (460 mg, 2.17 mmol, 3.50 equiv), Toluene (4 mL), water(0.8 mL), PCy<sub>3</sub>-HBF<sub>4</sub> (91 mg, 0.40 equiv), Pd(OAc)<sub>2</sub> (28 mg, 0.12 mmol, 0.20 equiv). The resulting solution was stirred for 1.2 h at 115 °C under N<sub>2</sub>. The solids were filtered out. The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with H<sub>2</sub>O/ACN (2:1). This resulted in 31.1 mg (14%) of the title compound as a white solid.

### Example 7: Synthesis of Compound 28

[0552] Synthesis of 2-N-[4-methoxy-3-[3-(piperazin-1-yl)prop-1-yn-1-yl]phenyl]-4-N,6-dimethylpyrimidine-2,4-diamine:



[0553] **Step 1: Synthesis of tert-butyl 4-[3-(2-methoxy-5-[[4-methyl-6-**

**(methylamino)pyrimidin-2-yl]amino]phenyl)prop-2-yn-1-yl]piperazine-1-carboxylate:**

[0554] Into a 20-mL vial purged and maintained with an inert atmosphere of nitrogen, was placed 2-N-(3-iodo-4-methoxyphenyl)-4-N,6-dimethylpyrimidine-2,4-diamine (150 mg, 0.41 mmol, 1.00 equiv), tert-butyl 4-(prop-2-yn-1-yl)piperazine-1-carboxylate (80 mg, 0.36 mmol, 0.88 equiv), CuI (30 mg, 0.16 mmol, 0.39 equiv), Pd(PPh<sub>3</sub>)Cl<sub>2</sub> (161 mg), TEA (141 mg, 1.39 mmol, 3.44 equiv), DMSO (8 mL). The resulting solution was stirred overnight at 25°C. The solids were filtered out. The resulting solution was extracted with ethyl acetate and the organic layers combined. This resulted in 90 mg (48%) of the title compound as a white solid.

[0555] Analytical Data: LC-MS: (ES, *m/z*): RT=0.975 min, *m/z*=467 [M+1].

[0556] **Step 2: Synthesis of tert-butyl 4-[3-(2-methoxy-5-[[4-methyl-6-**

**(methylamino)pyrimidin-2-yl]amino]phenyl)prop-2-yn-1-yl]piperazine-1-carboxylate:**

[0557] Into a 20-mL vial, was placed tert-butyl 4-[3-(2-methoxy-5-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)prop-2-yn-1-yl]piperazine-1-carboxylate (70 mg, 0.15 mmol, 1.00 equiv), trifluoroacetic acid (3 mL), dichloromethane (3 mL). The resulting solution was stirred for 1 h at 25 °C. The crude product was purified by Prep-HPLC with the following conditions (2#-AnalyseHPLC-SHIMADZU(HPLC-10)): Column, XBridge Prep C18 OBD Column, 19\*150mm, 5umC-0013 ; mobile phase, Water(0.05%TFA ) and ACN (5.0% ACN up to 16.0%); Detector, UV 254220nm. This resulted in 27.5 mg (50%) of the title compound as a yellow solid.

[0558] Other compounds were synthesized in the similar manner and the characterization data are listed in Table 2 below.

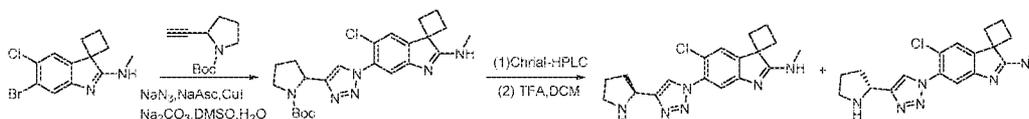
**Table 2**

Cpd #	Data
1	LC-MS: (ES, <i>m/z</i> ): RT = 0.899 min; <i>m/z</i> = 419 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.39 – 8.32 (m, 1H), 7.86 – 7.82 (m, 2H), 6.19 – 6.15 (m, 1H), 4.54 (d, <i>J</i> = 2.7 Hz, 2H), 3.72 – 3.68 (m, 6H), 3.26 (s, 2H), 3.03 (d, <i>J</i> = 3.0Hz, 3H), 2.40 – 2.35 (m, 3H), 2.17 (s, 4H).
2	LC-MS: (ES, <i>m/z</i> ): RT = 1.084 min; <i>m/z</i> = 362 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.08 (d, <i>J</i> = 4.0 Hz, 1H), 7.66 – 7.72 (m, 1H), 7.32 (d, <i>J</i> = 8.0 Hz, 1H), 5.87 (s, 1H), 4.85 – 4.81 (m, 2H), 4.56 (t, <i>J</i> = 6.0 Hz, 2H), 3.67 (d, <i>J</i> = 8.0 Hz, 2H), 3.30 (s, 1H), 2.92 (s, 3H), 2.21 (s, 3H).

3	LC-MS: (ES, m/z): RT = 1.405 min; m/z = 360 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 7.83 (d, J = 2.1 Hz, 1H), 7.74 – 7.57 (m, 1H), 7.50 (d, J = 4.2 Hz, 1H), 6.33 – 6.04 (m, 1H), 3.41 (d, J = 7.2 Hz, 2H), 3.00 (d, J = 3.3 Hz, 3H), 2.62 – 2.59 (m, 1H), 2.45 – 2.31 (m, 3H), 2.12 – 2.06 (m, 2H), 2.04 – 1.74 (m, 4H).
4	LC-MS: (ES, m/z): RT = 2.011 min; m/z = 346 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.09 (s, 1H), 7.46 – 7.70 (m, 1H), 7.32 (d, J = 8.8 Hz, 1H), 5.87 (s, 1H), 3.26 (d, J = 8.0 Hz, 2H), 2.93 (s, 3H), 2.21 (s, 3H), 1.16 – 1.05 (m, 1H), 0.61 – 0.53 (m, 2H), 0.28 – 0.34 (m, 2H).
5	LC-MS: (ES, m/z): RT = 1.183 min, m/z = 370 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 9.00 (dd, J = 4.8, 1.4 Hz, 1H), 8.66 – 8.58 (m, 1H), 8.16 (d, J = 2.6 Hz, 1H), 7.79 (dd, J = 9.1, 4.8 Hz, 1H), 7.71 (dd, J = 8.8, 2.7 Hz, 1H), 7.58 (d, J = 8.7 Hz, 1H), 6.07 (d, J = 1.1 Hz, 1H), 3.02 (s, 3H), 2.35 (d, J = 1.0 Hz, 3H).
6	LC-MS: (ES, m/z): RT = 1.181 min; m/z = 359 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.25 (s, 1H), 7.79 – 7.68 (m, 2H), 7.38 (d, J = 8.8 Hz, 1H), 7.15 (s, 1H), 5.88 (s, 1H), 2.92 (s, 3H), 2.21 (s, 3H).
7	LC-MS: (ES, m/z): RT = 0.918 min, m/z = 388.9 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.07 (s, 1H), 7.71 – 7.68 (m, 1H), 7.32 (d, J = 8.8 Hz, 1H), 5.87 (d, J = 0.8 Hz, 1H), 3.55 (t, J = 7.2 Hz, 2H), 2.92 (s, 3H), 2.80 – 2.71 (m, 2H), 2.71 – 2.62 (m, 4H), 2.21 (s, 3H), 1.91 – 1.79 (m, 4H).
8	LC-MS: (ES, m/z): RT = 0.946 min, m/z = 376 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 8.10 (s, 1H), 7.73 – 7.61 (m, 1H), 7.32 (d, J = 8.8 Hz, 1H), 5.88 (d, J = 0.8 Hz, 1H), 4.20 – 4.03 (m, 1H), 4.06 – 3.93 (m, 2H), 3.64 – 3.47 (m, 2H), 2.93 (s, 3H), 2.21 (s, 3H), 2.02 – 1.90 (m, 2H), 1.75 – 1.55 (m, 2H).
9	LC-MS: (ES, m/z): RT = 1.309 min, m/z = 347.9 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.06 (s, 1H), 7.69 – 7.66 (m, 1H), 7.31 (d, J = 8.8 Hz, 1H), 5.87 (d, J = 0.8 Hz, 1H), 3.38 (t, J = 7.0 Hz, 2H), 2.92 (s, 3H), 2.20 (s, 3H), 1.66 – 1.59 (m, 2H), 1.54 – 1.40 (m, 2H), 1.00 (t, J = 7.3 Hz, 3H).
10	LC-MS: (ES, m/z): RT = 1.274 min, m/z = 368 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 8.23 (s, 1H), 7.78 – 7.64 (m, 3H), 7.45 – 7.32 (m, 3H), 7.24 – 7.11 (m, 1H), 5.87 (d, J = 0.7 Hz, 1H), 2.91 (s, 3H), 2.21 (s, 3H).
11	LC-MS: (ES, m/z): RT = 1.255 min; m/z = 381 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 7.93 – 7.88 (m, 1H), 7.76 – 7.52 (m, 1H), 7.21 – 7.16 (m, 1H), 6.28 – 5.97 (m, 1H), 4.58 (s, 2H), 3.67 (s, 4H), 3.49 (s, 4H), 3.01 (d, J = 6.0 Hz, 3H), 2.53 – 2.30 (m, 3H), 2.21 – 2.04 (m, 5H), 1.17 – 1.04 (m, 2H), 0.84 – 0.72 (m, 2H).
12	LC-MS: (ES, m/z): RT = 1.04 min, LCMS 27: m/z = 369.9 [M+H]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 9.52 (d, J = 1.5 Hz, 1H), 8.47 – 8.35 (m, 2H), 8.29 – 8.22 (m, 1H), 7.77 (q, J = 2.7 Hz, 1H), 7.39 (d, J = 8.7 Hz, 1H), 5.88 (s, 1H), 2.90 (s, 3H), 2.21 (s, 3H).
13	LC-MS: (ES, m/z): RT = 1.36 min, m/z = 375 [M+1]. <sup>1</sup> H-NMR: (Methanol-d <sub>4</sub> , ppm): 8.86 (d, J = 2.3 Hz, 1H), 8.06 (d, J = 2.6 Hz, 1H), 7.85 (d, J = 2.2 Hz, 1H), 7.69 (dd, J = 8.8, 2.7 Hz, 1H), 7.57 (d, J = 8.8 Hz, 1H), 6.07 (d, J = 1.1 Hz, 1H), 3.01 (s, 3H), 2.34 (s, 3H).
14	LC-MS: (ES, m/z): RT = 2.424 min, m/z = 358.7 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.26 (d, J = 1.1 Hz, 1H), 8.05 (dd, J = 13.5, 1.9 Hz, 2H), 7.69 (dd, J = 8.8, 2.7 Hz, 1H), 7.56 (d, J = 8.7 Hz, 1H), 6.07 (s, 1H), 3.01 (s, 3H), 2.34 (s, 3H).
15	LC-MS: (ES, m/z): RT = 1.10 min, LCMS 28: m/z = 371 [M+1]. <sup>1</sup> H-NMR: (Methanol-d <sub>4</sub> , ppm): 8.68 (d, J = 1.7 Hz, 1H), 8.07 (d, J = 2.7 Hz, 1H), 7.98 – 7.85 (m, 1H), 7.60 –

	7.49 (m, 2H), 6.06 (d, J = 1.0 Hz, 1H), 3.96 (s, 3H), 3.01 (s, 3H), 2.35 (s, 3H).
19	LC-MS: (ES, m/z): RT=1.014 min, m/z =349.2 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 7.90 (d, J = 8.2 Hz, 2H), 7.51 (d, J = 8.6 Hz, 1H), 6.05 (s, 1H), 3.72 (t, J = 6.2 Hz, 2H), 3.28 (t, J = 6.2 Hz, 2H), 3.03 (s, 3H), 2.81 (s, 3H), 2.34 (s, 3H).
21	LC-MS: (ES, m/z): RT = 1.463 min, LCMS53: m/z = 375.3 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 8.04 (d, J = 2.7 Hz, 1H), 7.73 – 7.69 (m, 1H), 7.30 (d, J = 8.8 Hz, 1H), 5.86 (d, J = 0.7 Hz, 1H), 3.43 – 3.31 (m, 6H), 2.91 (s, 3H), 2.70 (t, J = 6.9 Hz, 2H), 2.23 – 2.07 (m, 5H).
22	LC-MS: (ES, m/z): RT = 1.190 min; m/z = 356 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 7.88 (s, 1H), 7.58 – 7.53 (m, J = 8.5, 2.4 Hz, 1H), 6.95 (d, J = 8.0 Hz, 1H), 5.84 (s, 1H), 3.65 – 3.54 (m, 4H), 3.40 (s, 3H), 2.92 (s, 3H), 2.20 (s, 3H), 2.16 – 2.09 (m, 1H), 0.96 – 0.88 (m, 2H), 0.69 – 0.62 (m, 2H).
23	LC-MS: (ES, m/z): RT = 0.91 min, m/z = 370 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 8.68 (d, J = 4.8 Hz, 2H), 8.25 (s, 1H), 7.74 (q, J = 2.7 Hz, 1H), 7.37 (d, J = 8.7 Hz, 1H), 7.23 (t, J = 4.9 Hz, 1H), 5.87 (d, J = 0.9 Hz, 1H), 2.90 (s, 3H), 2.21 (s, 3H).
24	LC-MS: (ES, m/z): RT=1.226 min, m/z =375.0 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 7.84 (d, J = 2.7 Hz, 1H), 7.67 (dd, J = 8.7, 2.7 Hz, 1H), 7.28 (d, J = 8.7 Hz, 1H), 5.85 (s, 1H), 3.87 (s, 2H), 2.93 (s, 3H), 2.80 – 2.75 (m, 2H), 2.69 – 2.64 (m, 2H), 2.55 – 2.50 (m, 4H), 2.21 (s, 3H), 1.85 – 1.72 (m, 4H).
26	LC-MS: (ES, m/z): RT = 1.02 min, m/z = 369.9 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol-d <sub>4</sub> ) δ 8.92 – 8.85 (m, 1H), 8.70 (q, J = 5.7 Hz, 1H), 8.33 (q, J = 5.7 Hz, 1H), 8.25 (s, 1H), 7.77 (q, J = 2.7 Hz, 1H), 7.39 (d, J = 8.7 Hz, 1H), 5.88 (d, J = 0.9 Hz, 1H), 2.90 (s, 3H), 2.21 (s, 3H).
27	LC-MS: (ES, m/z): RT=1.155 min, m/z =355.1 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 7.64 (d, J = 2.4 Hz, 1H), 7.51 (d, J = 8.1 Hz, 1H), 7.09 (d, J = 8.2 Hz, 1H), 5.82 (d, J = 0.8 Hz, 1H), 3.78 (s, 2H), 2.93 (s, 3H), 2.86 – 2.78 (m, 2H), 2.72 – 2.65 (m, 2H), 2.60 – 2.51 (m, 4H), 2.32 (s, 3H), 2.19 (s, 3H), 1.84 – 1.75 (m, 4H).
28	LC-MS: (ES, m/z): RT=0.936 min, LCMS 07, m/z=369 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.65 (d, 2H), 8.30 (s, 1H), 6.02 (s, 1H), 4.23 (s, 2H), 4.03 (d, 4H), 3.97 (d, 4H), 3.12 (d, J = 7.5 Hz, 5H), 2.86 (s, 3H), 2.16 (t, J = 6.3 Hz, 4H), 1.25 (d, 3H).
29	LC-MS: (ES, m/z): RT=2.2min, m/z=355.15 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ 8.85 (d, J = 2.2 Hz, 1H), 7.96 (d, J = 2.4 Hz, 1H), 7.85 (d, J = 2.3 Hz, 1H), 7.58 (dd, J = 8.3, 2.4 Hz, 1H), 7.37 (d, J = 8.4 Hz, 1H), 6.03 (d, J = 1.1 Hz, 1H), 3.002-2.98(m, 3H), 2.5-2.42 (m, 3H), 2.33 (s, 3H).

**Example 8: Synthesis of Compounds A2R and A2S: (S)-5'-chloro-N-methyl-6'-(4-(pyrrolidin-2-yl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine and (R)-5'-chloro-N-methyl-6'-(4-(pyrrolidin-2-yl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine:**



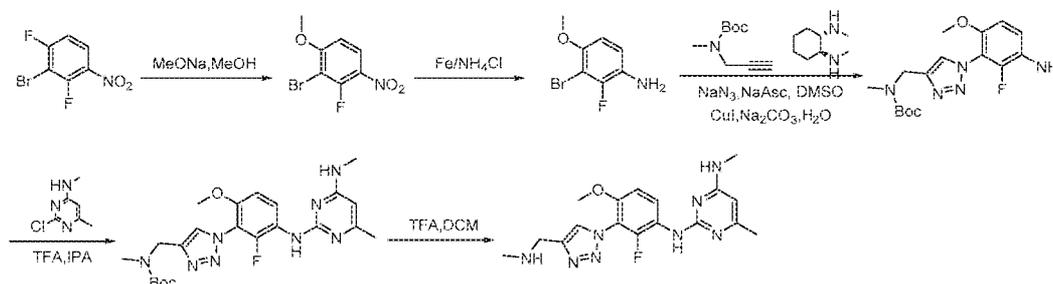
[0559] *Synthesis of tert-butyl 2-[1-[5-chloro-2-methylamino]spiro[cyclobutane-1,3-indol]-6-1]-1H-1,2,3-triazol-4-yl]pyrrolidine-1-carboxylate*: Into a 40-mL round-bottom flask purged and maintained with an inert atmosphere of nitrogen, was placed 6-bromo-5-chloro-N-methylspiro[cyclobutane-1,3-indol]-2-amine (300 mg, 1.00 mmol, 1.00 equiv), *tert*-butyl 2-ethynylpyrrolidine-1-carboxylate (393 mg, 2.01 mmol, 2.00 equiv), NaN<sub>3</sub> (131 mg, 2.02 mmol, 2.00 equiv), CuI (38 mg, 0.20 mmol, 0.20 equiv), NaAsc (60 mg, 0.30 equiv), sodium carbonate (205 mg, 1.93 mmol, 3.00 equiv), DMSO (20 mL), water(4 mL). The resulting solution was stirred for 48 h at 110 °C in an oil bath. The solids were filtered out. The resulting solution was diluted with 100 mL of H<sub>2</sub>O. The resulting solution was extracted with 3x100 mL of ethyl acetate and the organic layers combined, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, concentrated under vacuum. The crude product was purified by Flash-Prep-HPLC with the following conditions (IntelFlash-1): Reversed Column, C18; mobile phase, methanol: H<sub>2</sub>O=0 increasing to methanol: H<sub>2</sub>O = 80% within 30 min; Detector, UV 254 nm. The collected fractions were combined and concentrated under vacuum. This resulted in 150 mg (33%) of the title compound as yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT = 1.42min, *m/z* = 457.07 [M+1].

[0560] *Synthesis of tert-butyl (S)-2-(1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-1,2,3-triazol-4-yl)pyrrolidine-1-carboxylate and tert-butyl (R)-2-(1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-1,2,3-triazol-4-yl)pyrrolidine-1-carboxylate*: The *tert*-butyl 2-[1-[5-chloro-2-methylamino) spiro [cyclobutane-1,3-indol]-6-1]-1H-1,2,3-triazol-4-yl]pyrrolidine-1-carboxylate (trifluoroacetic salt, 40mg) was purified by Chiral-Prep-HPLC with the following conditions: Column,CHIRALPAK IG-3, 0.46\*5cm;3um; mobile phase, Hex(0.1%DEA): EtOH=70:30; Flow: 1.0ml/min ; Detector,254/220 nm. The collected fractions were combined and concentrated under vacuum. This resulted in 20 mg of the title compounds as an off-white solids.

[0561] *Synthesis of (S)-5'-chloro-N-methyl-6'-(4-(pyrrolidin-2-yl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine and (R)-5'-chloro-N-methyl-6'-(4-(pyrrolidin-2-yl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine*: Into a 25-mL round-bottom flask, was either placed *tert*-butyl (2S)-2-[1-[5-chloro-2-methylamino) spiro [cyclobutane-1, 3-indol]-6-1]-1H-1,2,3-triazol-4-yl]pyrrolidine-1-carboxylate or *tert*-butyl (R)-2-(1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-1,2,3-triazol-4-yl)pyrrolidine-1-carboxylate (20mg, 0.31mmol ,1 equiv), dichloromethane (5 mL), 2,2,2-trifluoroacetic acid (28 mg, 0.29 mmol, 3.00 equiv). The resulting solution was stirred for 1 h at 20 °C. The resulting mixture was

concentrated under vacuum. This resulted in 10.4 mg (81%) of the title compounds as off-white solids.

**Example 9: Synthesis of Compound A3: N2-(2-fluoro-4-methoxy-3-[4-[(methylamino)methyl]-1H-1,2,3-triazol-1-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt) :**



[0562] *Synthesis of 2-bromo-3-fluoro-1-methoxy-4-nitrobenzene:* Into a 100-mL round-bottom flask, was placed 2-bromo-1,3-difluoro-4-nitrobenzene (4 g, 16.81 mmol, 1.00 equiv), methanol (50 mL), 30% MeONa (2.34 g, MeOH solution). The resulting solution was stirred for 3 h at 0 °C. The reaction was then quenched by the addition of 200 mL of water. The resulting solution was extracted with 3x50 mL of ethyl acetate, the organic layers was combined, dried over anhydrous sodium sulfate and concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (1:5). The collected fractions were combined and concentrated under vacuum. This resulted in 1.57 g (37%) of the title compound as a light yellow solid.

Analytic Data: H-NMR: <sup>1</sup>H NMR (300 MHz, Chloroform-*d*) δ 8.15 (dd, *J* = 9.4, 8.3 Hz, 1H), 6.82 (dd, *J* = 9.4, 1.7 Hz, 1H), 4.05 (s, 3H).

[0563] *Synthesis of 3-bromo-2-fluoro-4-methoxyaniline:* Into a 100-mL round-bottom flask, was placed 2-bromo-3-fluoro-1-methoxy-4-nitrobenzene (1.57 g, 6.28 mmol, 1.00 equiv), Fe (1.76 g), NH<sub>4</sub>Cl (1.76 g, 32.90 mmol, 5.24 equiv), ethanol (50 mL), water(15 mL). The resulting solution was stirred for 3 h at 80 °C. The solids were filtered out. The reaction was then quenched by the addition of 100 mL of water. The resulting solution was extracted with 3x50 mL of ethyl acetate and the organic layers were combined, dried over anhydrous sodium sulfate and concentrated under vacuum. This resulted in 1.2 g (87%) of the title compound as a yellow solid. Analytic Data: LC-MS: (ES, *m/z*):RT = 0.856 min, *m/z* =373 [M+1].

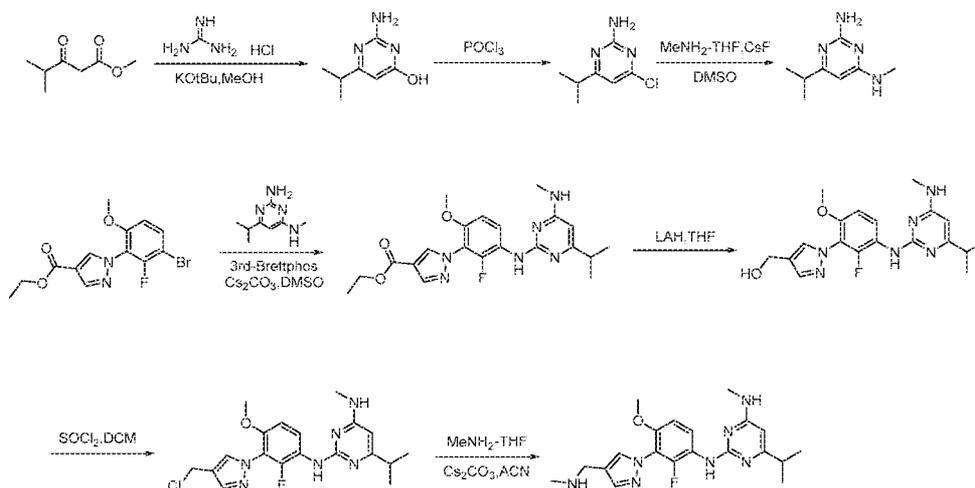
[0564] *Synthesis of tert-butyl N-[[1-(3-amino-2-fluoro-6-methoxyphenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylcarbamate:* Into a 40-mL round-bottom flask, was placed 3-bromo-2-fluoro-

4-methoxyaniline (300 mg, 1.36 mmol, 1.00 equiv), *tert*-butyl *N*-methyl-*N*-(prop-2-yn-1-yl)carbamate (360 mg, 2.13 mmol, 1.56 equiv), NaN<sub>3</sub> (177 mg, 2.72 mmol, 2.00 equiv), NaAsc (80 mg), DMSO (15 mL), CuI (52 mg, 0.27 mmol, 0.20 equiv), sodium carbonate (288 mg, 2.72 mmol, 1.99 equiv), water (3 mL). The resulting solution was stirred for 48 h at 100°C. The solids were filtered out. The resulting solution was extracted with 3x50 mL of ethyl acetate and the organic layers were combined. The solution was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, concentrated under vacuum. The crude product was purified by Flash-Prep-HPLC with the following conditions (IntelFlash-1): reverse Column, C18, mobile phase, H<sub>2</sub>O:CH<sub>3</sub>CN=1:1; Detector, UV 254 nm. The collected fractions were combined and concentrated under vacuum. This resulted in 200 mg (42%) of the title compound as a brown solid. Analytic Data: LC-MS: (ES, *m/z*): RT = 1.138 min, *m/z* = 352 [M+1].

[0565] *Synthesis of tert-butyl N-[[1-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-1H-pyrazol-4-yl]methyl]-N-methylcarbamate*: Into a 20-mL round-bottom flask, was placed *tert*-butyl *N*-[[1-(3-amino-2-fluoro-6-methoxyphenyl)-1H-pyrazol-4-yl]methyl]-*N*-methylcarbamate (200 mg, 0.57 mmol, 1.00 equiv), 2-chloro-*N*,6-dimethylpyrimidin-4-amine (90 mg, 0.57 mmol, 1.00 equiv), IPA (8 mL), trifluoroacetic acid (195 mg, 1.73 mmol, 3.02 equiv). The resulting solution was stirred for 3 h at 80°C. The resulting mixture was concentrated under vacuum. This resulted in 200 mg (74%) of the title compound as yellow oil. Analytic Data: LC-MS: (ES, *m/z*): RT = 1.12 min, *m/z* = 473 [M+1].

[0566] *Synthesis of N2-(2-fluoro-4-methoxy-3-[4-[(methylamino)methyl]-1H-1,2,3-triazol-1-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt)*: Into a 20-mL round-bottom flask, was placed *tert*-butyl *N*-[[1-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-1H-1,2,3-triazol-4-yl]methyl]-*N*-methylcarbamate (200 mg, 0.42 mmol, 1.00 equiv), dichloromethane (8 mL), trifluoroacetic acid (3 mL). The resulting solution was stirred for 3 h at 25 °C. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XSelect CSH Prep C18 OBD Column,, 5um,19\*150mm; mobile phase, Water (0.05%TFA ) and methanol- (6.0% methanol- up to 28.0% in 7 min); Detector, UV 254/220nm. This resulted in 74.7 mg (36%) of the title compound as a white solid.

**Example 10: Synthesis of Compound A8: N<sup>2</sup>-(2-fluoro-4-methoxy-3-[4-[(methylamino)methyl]-1H-pyrazol-1-yl]phenyl)-N<sup>4</sup>-methyl-6-(propan-2-yl)pyrimidine-2,4-diamine (trifluoroacetic acid salt):**



[0567] *Synthesis of 2-amino-6-isopropylpyrimidin-4-ol:* Into a 40 mL round-bottom flask was placed methyl 4-methyl-3-oxopentanoate (1 g, 6.94 mmol, 1.00 equiv), t-BuOK (4.3 g), guanidine hydrochloride (789 mg, 8.26 mmol, 1.19 equiv), methanol (20 mL). The resulting solution was stirred for 2 h at 60 °C. The solids were filtered out. The resulting mixture was concentrated under vacuum. The residual was diluted with water. The pH value of the solution was adjusted to 5 with 6 mol/L HCl (aq). The solids were collected by filtration. This resulted in 500 mg (89%) of the title compound as light brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.401 min, *m/z* =154 [M+1].

[0568] *Synthesis of 4-chloro-6-(propan-2-yl)pyrimidin-2-amine:* Into a 20 mL round-bottom flask was placed 2-amino-6-(propan-2-yl)pyrimidin-4-ol (300 mg, 1.96 mmol, 1.00 equiv), POCl<sub>3</sub> (5 mL). The resulting solution was stirred for 1 h at 100 °C. The resulting mixture was concentrated under vacuum. This resulted in 300 mg (89%) of the title compound as light brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT=1.042 min, *m/z* =172 [M+1].

[0569] *Synthesis of 6-isopropyl-N4-methylpyrimidine-2,4-diamine:* Into a 40 mL round-bottom flask was placed 4-chloro-6-(propan-2-yl)pyrimidin-2-amine (200 mg, 1.17 mmol, 1.00 equiv), CsF (500 mg), MeNH<sub>2</sub>-THF (3 mL), DMSO (1 mL). The resulting solution was stirred for overnight at 100 °C. The resulting solution was extracted with ethyl acetate and the organic layers combined. The resulting mixture was washed with water and brine. The mixture was dried over anhydrous sodium sulfate and concentrated under vacuum. This resulted in 130 mg (67%) of

N4-methyl-6-(propan-2-yl)pyrimidine-2,4-diamine as a off-white solid. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=0.781 min,  $m/z$  =167 [M+1].

[0570] *Synthesis of ethyl 1-(2-fluoro-6-methoxy-3-[[4-(methylamino)-6-(propan-2-yl)pyrimidin-2-yl]amino]phenyl)-1H-pyrazole-4-carboxylate*: Into a 40 mL round-bottom flask was placed ethyl 1-(3-bromo-2-fluoro-6-methoxyphenyl)-1H-pyrazole-4-carboxylate (134 mg, 0.39 mmol, 1.00 equiv), N4-methyl-2-(propan-2-yl)pyrimidine-4,6-diamine (130 mg, 0.78 mmol, 2.00 equiv), Cs<sub>2</sub>CO<sub>3</sub> (381 mg, 1.17 mmol, 2.99 equiv), 3rd-Brettphos (35 mg), DMSO (10 mL). The resulting solution was stirred for 2 h at 120 °C. The solids were filtered out. The resulting solution was extracted with of ethyl acetate and the organic layers combined. The resulting mixture was washed with water and brine. The mixture was dried over anhydrous sodium sulfate and concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (1/3). The collected fractions were combined and concentrated under vacuum. This resulted in 100 mg (60%) of the title compound as light yellow oil. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=1.063 min,  $m/z$  =429 [M+1].

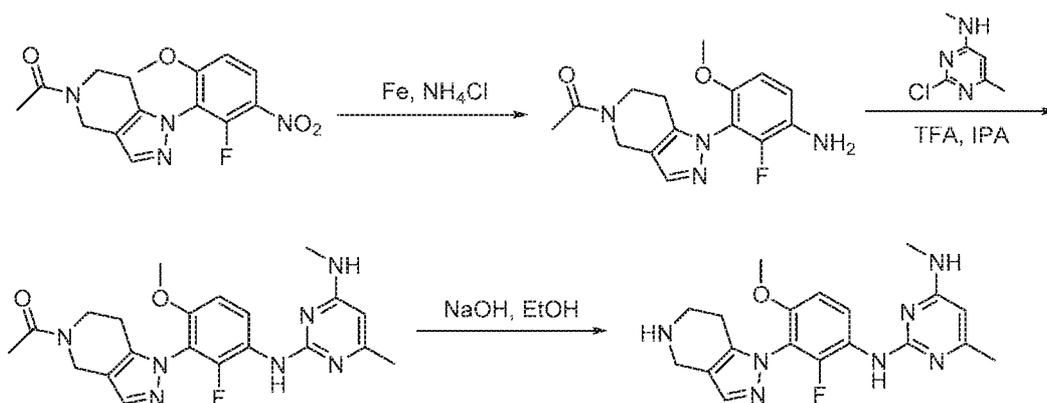
[0571] *Synthesis of [1-(2-fluoro-6-methoxy-3-[[4-(methylamino)-6-(propan-2-yl)pyrimidin-2-yl]amino]phenyl)-1H-pyrazol-4-yl]methanol*: Into a 40 mL round-bottom flask was placed ethyl 1-(2-fluoro-6-methoxy-3-[[4-(methylamino)-6-(propan-2-yl)pyrimidin-2-yl]amino]phenyl)-1H-pyrazole-4-carboxylate (90 mg, 0.21 mmol, 1.00 equiv), LiAlH<sub>4</sub> (24 mg, 0.63 mmol, 3.01 equiv), tetrahydrofuran (3 mL). The resulting solution was stirred for 1 h at 0 °C. The reaction was then quenched by the addition of sodium hydroxide (aq). The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 70 mg (86%) of the title compound as light yellow oil. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=0.648 min,  $m/z$  =387 [M+1].

[0572] *Synthesis of N2-[3-[4-(chloromethyl)-1H-pyrazol-1-yl]-2-fluoro-4-methoxyphenyl]-N4-methyl-6-(propan-2-yl)pyrimidine-2,4-diamine*: Into a 50 mL round-bottom flask was placed [1-(2-fluoro-6-methoxy-3-[[4-(methylamino)-6-(propan-2-yl)pyrimidin-2-yl]amino]phenyl)-1H-pyrazol-4-yl]methanol (70 mg, 0.18 mmol, 1.00 equiv), thionyl chloride (2 mL), dichloromethane (2 mL). The resulting solution was stirred for 1 h at 0 °C. The resulting mixture was concentrated under vacuum. This resulted in 75 mg of the title compound as yellow oil. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=1.067 min,  $m/z$  =405 [M+1].

[0573] *Synthesis of N2-(2-fluoro-4-methoxy-3-[4-[(methylamino)methyl]-1H-pyrazol-1-yl]phenyl)-N4-methyl-6-(propan-2-yl)pyrimidine-2,4-diamine (trifluoroacetic acid salt)*: Into a 20-mL round-bottom flask, was placed N<sup>2</sup>-[3-[4-(chloromethyl)-1H-pyrazol-1-yl]-2-fluoro-4-

methoxyphenyl]-N<sup>4</sup>-methyl-6-(propan-2-yl)pyrimidine-2,4-diamine (70 mg, 0.17 mmol, 1.00 equiv), potassium carbonate (75 mg, 0.54 mmol, 3.14 equiv), MeNH<sub>2</sub>-THF (2 mL), ACN (3 mL). The resulting solution was stirred for overnight at room temperature. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XSelect CSH Prep C18 OBD Column, 5 $\mu$ m, 19\*150mm; mobile phase, Water (0.05% TFA) and ACN (5.0% ACN up to 17.0% in 8 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 24.8 mg (28%) of the title compound as an off-white solid.

**Example 11: Synthesis of Compound A9: N2-(2-fluoro-4-methoxy-3-(4,5,6,7-tetrahydro-1H-pyrazolo[4,3-c]1,4,2,5,6-tetrahydropyridin-1-yl)phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt) :**



[0574] *Synthesis of 1-[1-(3-amino-2-fluoro-6-methoxyphenyl)-1H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one:* Into a 20-mL vial, was placed 1-[1-(2-fluoro-6-methoxy-3-nitrophenyl)-1H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (400 mg, 1.20 mmol, 1.00 equiv), Fe (390 mg), NH<sub>4</sub>Cl (398 mg, 7.44 mmol, 6.22 equiv), water (2 mL), ethanol (10 mL). The resulting solution was stirred for 1.5 h at 80 °C. The solids were filtered out.

The resulting mixture was concentrated under reduced pressure. The resulting solution was extracted with ethyl acetate and the organic layers combined. The solution was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, concentrated under vacuum. The resulting mixture was concentrated under reduced pressure. This resulted in 150 mg (41%) of the title compound as a yellow solid.

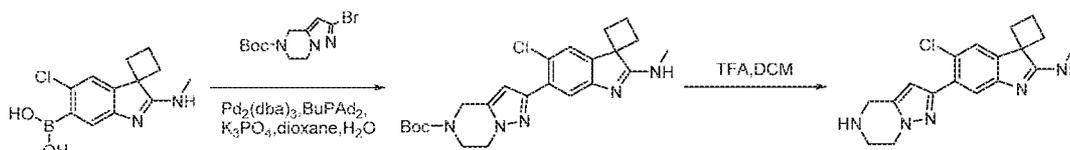
Analytical Data: LC-MS: (ES, *m/z*): RT=0.832 min, *m/z*=305 [M+1].

[0575] *Synthesis of 1-[2-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one:* Into a 20-mL vial,

was placed 1-[2-(3-amino-2-fluoro-6-methoxyphenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (150 mg, 0.49 mmol, 1.00 equiv), trifluoroacetic acid (163 mg, 1.44 mmol, 2.93 equiv), IPA (5 mL), 2-chloro-N,6-dimethylpyrimidin-4-amine (78 mg, 0.49 mmol, 1.00 equiv). The resulting solution was stirred for 1 h at 80 °C. The mixture was concentrated under vacuum. The residue was purified by reverse flash chromatography with the following conditions: column, C18; mobile phase, ACN/H<sub>2</sub>O (30%). The collected fractions were combined and concentrated under vacuum. This resulted in 105 mg (50%) of the title compound as a white solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.674 min, *m/z*=426 [M+1].

[0576] *Synthesis of N2-(2-fluoro-4-methoxy-3-[1H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-1-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt)*: Into a 20-mL vial, was placed 1-[1-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-1H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (108 mg, 0.25 mmol, 1.00 equiv), sodium hydroxide (54 mg, 1.35 mmol, 5.32 equiv), ethanol (5 mL). The resulting solution was stirred overnight at 80 °C. The mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XBridge Shield RP18 OBD Column, 30\*150mm,5um; mobile phase, Water(10mmol/L NH<sub>4</sub>HCO<sub>3</sub>) and ACN (8.0% ACN up to 28.0% in 10 min); Detector, UV 254/220nm. The collected fractions were combined and concentrated under vacuum and then trifluoroacetic acid (31mg, 0.27mmol, 1eq) was added. The resulting mixture was concentrated under reduced pressure. This resulted in 104.7 mg (83%) of the title compound as a white solid.

**Example 12: Synthesis of Compound A10: 5'-chloro-N-methyl-6'-(4,5,6,7-tetrahydropyrazolo[1,5-a]pyrazin-2-yl)spiro[cyclobutane-1,3'-indol]-2'-amine:**

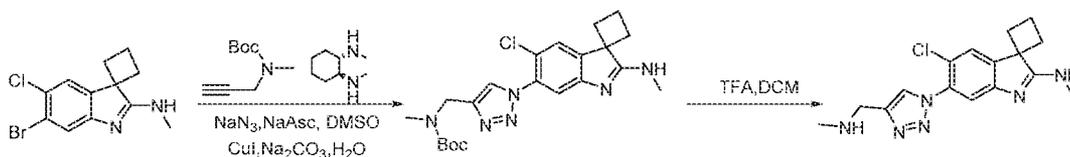


[0577] *Synthesis of tert-butyl 2-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-6,7-dihydropyrazolo[1,5-a]pyrazine-5(4H)-carboxylate*: Into a 20 mL round-bottom flask was placed (5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)boronic acid (200 mg, 0.76 mmol, 1.00 equiv), *tert*-butyl 2-bromo-4H,5H,6H,7H-pyrazolo[1,5-a]pyrazine-5-carboxylate (340 mg, 1.13 mmol, 1.49 equiv), Pd<sub>2</sub>(dba)<sub>3</sub> (80 mg, 0.09 mmol, 0.12 equiv), BuPAD<sub>2</sub> (80 mg), K<sub>3</sub>PO<sub>4</sub> (500 mg, 2.36 mmol, 3.12 equiv), dioxane (10 mL), water(2 mL). The resulting solution was

stirred for 2 h at 60 °C. The solids were filtered out. The filtrate was concentrated under vacuum. The crude product was purified by Flash-Prep-HPLC with the following conditions (IntelFlash-1): Column, C18 silica gel; mobile phase, H<sub>2</sub>O/CAN = 100/0 increasing to H<sub>2</sub>O/ACN=3/5 within 10 min; Detector, UV 254 nm. The collected fractions were combined and concentrated under vacuum. This resulted in 270 mg (81%) of *tert*-butyl 2-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-6,7-dihydropyrazolo[1,5-a]pyrazine-5(4H)-carboxylate as light yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT=1.131 min, *m/z* =442 [M+1].

[0578] *Synthesis of 5'-chloro-N-methyl-6'-(4,5,6,7-tetrahydropyrazolo[1,5-a]pyrazin-2-yl)spiro[cyclobutane-1,3'-indol]-2'-amine (trifluoroacetic acid salt)*: Into a 50 mL round-bottom flask was placed *tert*-butyl 2-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-6,7-dihydropyrazolo[1,5-a]pyrazine-5(4H)-carboxylate (250 mg, 0.57 mmol, 1.00 equiv), trifluoroacetic acid (2 mL), dichloromethane (5 mL). The resulting solution was stirred for 1 h at room temperature. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XSelect CSH Prep C18 OBD Column,, 5um,19\*150mm; mobile phase, Water(0.05%TFA ) and ACN (5.0% ACN up to 19.0% in 7 min); Detector, UV 254/220nm. The collected fractions were combined and concentrated under vacuum. This resulted in 52 mg (20%) of the title compound as an off-white solid.

**Example 13: Synthesis of Compound A11: 5'-chloro-N-methyl-6'-(4-((methylamino)methyl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine:**

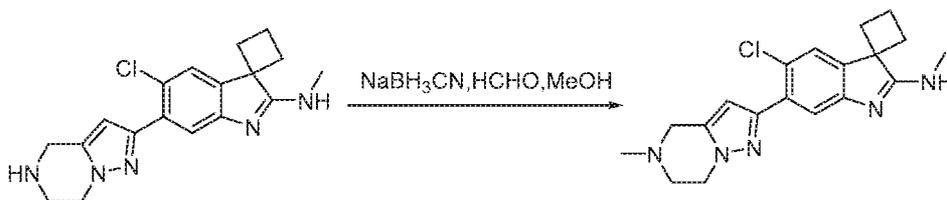


[0579] *Synthesis of tert-butyl ((1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-1,2,3-triazol-4-yl)methyl)(methyl)carbamate*: Into a 40-mL vial, was placed SM (400 mg, 1.34 mmol, 1.00 equiv), *tert*-butyl N-methyl-N-(prop-2-yn-1-yl)carbamate (476 mg, 2.81 mmol, 2.11 equiv), NaN<sub>3</sub> (183 mg, 2.81 mmol, 2.11 equiv), NaAsc (84 mg), CuI (54 mg, 0.28 mmol, 0.21 equiv), NaCO<sub>3</sub> (298 mg), DMSO (10 mL), water(2 mL). The resulting solution was stirred for 12 h at 100 °C in an oil bath. The solids were filtered out and the filtrate was concentrated under reduced pressure. The crude product was purified by Prep-HPLC with the following

conditions (2#SHIMADZU (HPLC-01)): Column, XBridge Prep C18 OBD Column, 19\*150mm 5um; mobile phase, Water(0.05%TFA) and ACN (5.0% ACN up to 23.0% in 10 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 70 mg (12%) of the title compound as a brown oil. Analytical Data: LC-MS: (ES,  $m/z$ ): RT= 1.10 min,  $m/z$  = 431 [M+1].

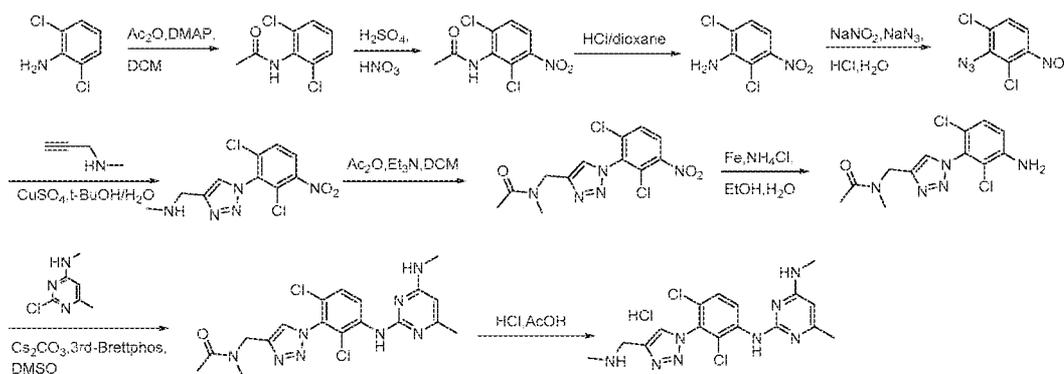
[0580] *Synthesis of 5'-chloro-N-methyl-6'-(4-((methylamino)methyl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine*: Into a 25-mL round-bottom flask, was placed SM (70 mg, 0.16 mmol, 1.00 equiv), trifluoroacetic acid (3 mL), dichloromethane (10 mL). The resulting solution was stirred for 2 h at 25 °C. The resulting mixture was concentrated under vacuum. This resulted in 48.5 mg (67%) of the title compound as a brown semi-solid.

**Example 14: Synthesis of Compound A12: 5'-chloro-N-methyl-6'-(5-methyl-4,5,6,7-tetrahydropyrazolo[1,5-a]145yrazine-2-yl)spiro[cyclobutane-1,3'-indol]-2'-amine(trifluoroacetic acid salt):**



[0581] *Synthesis of 5'-chloro-N-methyl-6'-(5-methyl-4,5,6,7-tetrahydropyrazolo[1,5-a]145yrazine-2-yl)spiro[cyclobutane-1,3'-indol]-2'-amine*: Into a 20 mL round-bottom flask was placed 5'-chloro-N-methyl-6'-(4,5,6,7-tetrahydropyrazolo[1,5-a]pyrazin-2-yl)spiro[cyclobutane-1,3'-indol]-2'-amine (40 mg, 0.12 mmol, 1.00 equiv), NaBH<sub>3</sub>CN (25 mg, 0.40 mmol, 3.40 equiv), HCHO (2 mL), methanol (2 mL). The resulting solution was stirred for 1 h at 0 °C. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XSelect CSH Prep C18 OBD Column, 5um,19\*150mm; mobile phase, Water(0.05%TFA ) and ACN (5.0% ACN up to 23.0% in 7 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 18 mg (33%) of the title compound as an off-white solid.

**Example 15: Synthesis of Compound A13: N2-(2,4-dichloro-3-(4-((methylamino)methyl)-1H-1,2,3-triazol-1-yl)phenyl)-N4,6-dimethylpyrimidine-2,4-diamine:**



[0582] *Synthesis of N-(2,6-dichlorophenyl)acetamide*: Into a 250 mL round-bottom flask was added 2,6-dichloroaniline (20 g, 123.45 mmol, 1 equiv), DMAP(3.0 g, 24.69 mmol, 0.20 equiv) and DCM (100 mL) at room temperature. Then the resulting mixture was cooled at 0 °C. To a stirred mixture was added Ac<sub>2</sub>O (37.8 g, 370.35 mmol, 3.00 equiv) in portions over 10 min at 0 °C. Then the resulting mixture was stirred for overnight at 40°C. The resulting mixture was extracted with EA. The organic layers were combined and washed with water and brine, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. After filtration, the filtrate was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography, eluted with PE/EtOAc (90/10) to afford the title compound (12g, 47.64%) as an off-white solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.839 min, *m/z* =204[M +H]

[0583] *Synthesis of N-(2,6-dichloro-3-nitrophenyl)acetamide*: Into a 250 mL round-bottom flask was added N-(2,6-dichlorophenyl)acetamide (12 g, 58.809 mmol, 1 equiv) and H<sub>2</sub>SO<sub>4</sub> (100 mL) at 0 °C. To the above mixture was added HNO<sub>3</sub> (11.12 g, 176.427 mmol, 3 equiv) dropwise over 30 min at 0 °C. The resulting mixture was stirred for 30 min at 0 °C. The resulting mixture was poured into water. The resulting mixture was extracted with EtOAc, the organic layers were combined and washed with water, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. After filtration, the filtrate was concentrated under reduced pressure. This resulted in the title compound (12 g, 81.93%) as an off-white solid. Analytic Data: LC-MS: (ES, *m/z*): RT=0.728 min, *m/z* =249 [M+1].

[0584] *Synthesis of 2,6-dichloro-3-nitroaniline*: Into a 20 mL sealed tube was added N-(2,6-dichloro-3-nitrophenyl)acetamide (6 g, 29.42 mmol, 1 equiv) and HCl/dioxane (8 mL) at room temperature. The resulting mixture was stirred for 48 h at 100 °C. The resulting mixture was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography, eluted with PE/EtOAc (90/10) to afford the title compound (4.8g, 96%) as a light yellow solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.939 min

[0585] *Synthesis of 2-azido-1,3-dichloro-4-nitrobenzene*: Into a 500 mL 3-necked round-bottom flask was added 2,6-dichloro-3-nitroaniline(4.3 g, 20.772 mmol, 1 equiv) and HCl/H<sub>2</sub>O(1:1, 60 mL) at room temperature. Then the resulting mixture was cooled at -5 °C. To the above mixture was added NaNO<sub>2</sub> (1.72 g, 24.926 mmol, 1.2 equiv) in portions over 15 min at -5 °C. Then the resulting mixture was added NaN<sub>3</sub> (1.62 g, 24.926 mmol, 1.2 equiv) in portions over 30 min at -5 °C. Then the resulting mixture was stirred for 1 h at -5 °C. The precipitated solids were collected by filtration and washed with water. This resulted in (4 g, 83%) as a light yellow solid. Analytical Data: LC-MS: (ES, *m/z*): RT=1.070 min.

[0586] *Synthesis of [[1-(2,6-dichloro-3-nitrophenyl)-1H-1,2,3-triazol-4-yl]methyl](methyl)amine*: Into a 40 mL round-bottom flask was added 2-azido-1,3-dichloro-4-nitrobenzene(600 mg, 2.575 mmol, 1 equiv), methyl(prop-2-yn-1-yl)amine(266.93 mg, 3.862 mmol, 1.5 equiv), CuSO<sub>4</sub>·5H<sub>2</sub>O (125 mg, 0.5 mmol, 0.2 equiv) and t-BuOH/H<sub>2</sub>O (5:1, 24 mL) at room temperature. Then the resulting mixture was stirred for 2 h at 80 °C. The resulting mixture was concentrated under reduced pressure. The crude product was washed with MeOH. After filtration, the filtrate was concentrated under reduced pressure. This resulted in the title compound (700mg, 90%) as a red solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.610 min, *m/z* =302 [M+1].

[0587] *Synthesis of in N-[[1-(2,6-dichloro-3-nitrophenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide*: Into a 50 mL round-bottom flask was added [[1-(2,6-dichloro-3-nitrophenyl)-1H-1,2,3-triazol-4-yl]methyl](methyl)amine(700 mg, 2.317 mmol, 1 equiv), Et<sub>3</sub>N(703.36 mg, 6.951 mmol, 3 equiv) and DCM(3 mL) at room temperature. Then the resulting mixture was cooled at 0 °C. To the above mixture was added Ac<sub>2</sub>O (473.07 mg, 4.634 mmol, 2 equiv) in portions over 15 min at 0 °C. The resulting mixture was stirred for additional 1 h at 0 °C. The resulting mixture was extracted with DCM, the organic layers were combined and washed with water and brine, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. After filtration, the filtrate was concentrated under reduced pressure. This resulted in the title compound (770 mg, 97%) as a light yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.829 min, *m/z* =344 [M+1].

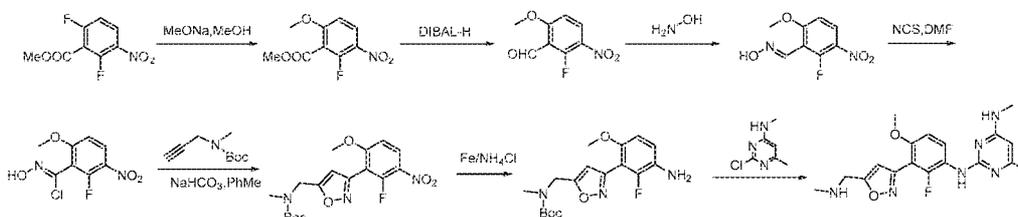
[0588] *Synthesis of N-[[1-(3-amino-2,6-dichlorophenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide*: Into a 40 mL round-bottom flask was added N-[[1-(2,6-dichloro-3-nitrophenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide (770 mg, 2.238 mmol, 1 equiv), Fe (624.74 mg, 11.187 mmol, 5 equiv), NH<sub>4</sub>Cl (46.63 mg, 0.872 mmol, 10 equiv) and EtOH/H<sub>2</sub>O (5:1, 20 mL) at room temperature. The resulting mixture was stirred for 30 min at 80 °C. The resulting mixture was filtered and the filter cake was washed with EtOH. The filtrate was

concentrated under reduced pressure. This resulted in the title compound (700 mg, 100%) as a red oil. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=1.004 min,  $m/z$  =314 [M+1].

[0589] *Synthesis of N-[[1-(2,6-dichloro-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide*: Into a 40 mL round-bottom flask was added N-[[1-(3-amino-2,6-dichlorophenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide (360 mg, 1.146 mmol, 1 equiv), 2-chloro-N,6-dimethylpyrimidin-4-amine (541.77 mg, 3.438 mmol, 3 equiv), Cs<sub>2</sub>CO<sub>3</sub> (1.12 g, 3.438 mmol, 3 equiv), 3rd-BrettPhos (207.75 mg, 0.229 mmol, 0.2 equiv) and DMSO (10 mL) at room temperature. Then the resulting mixture was stirred for 2 h at 80 °C. The resulting mixture was extracted with EA. The organic layers were combined and washed with water and brine, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. After filtration, the filtrate was concentrated under reduced pressure. The residue was purified by silica gel column chromatography, eluted with PE/EtOAc (60:40) to afford the title compound (400mg, 80%) as a brown solid. Analytical Data: LC-MS: (ES,  $m/z$ ): RT=0.905 min,  $m/z$  =435 [M+1].

[0590] *Synthesis of N2-(2,4-dichloro-3-[4-[(methylamino)methyl]-1H-1,2,3-triazol-1-yl]phenyl)-N,6-dimethylpyrimidine-2,4-diamine (HCl salt)*: Into a 40 mL round-bottom flask was added N-[[1-(2,6-dichloro-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-1H-1,2,3-triazol-4-yl]methyl]-N-methylacetamide (200 mg, 0.459 mmol, 1 equiv), HCl (5 mL) and AcOH (5 mL) at room temperature. The resulting solution was stirred for 8 h at 100 °C. The resulting mixture was concentrated. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XBridge Shield RP18 OBD Column, 30\*150mm,5um ; mobile phase, Water(10MMOL/L NH<sub>4</sub>HCO<sub>3</sub>) and ACN (17% PhaseB up to 45% in 7 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 30.0 mg (15%) of the title compound as a light brown solid.

**Example 16: Synthesis of Compound A14: N2-(2-fluoro-4-methoxy-3-[5-[(methylamino)methyl]-1,2-oxazol-3-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt):**



[0591] *Synthesis of methyl 2-fluoro-6-methoxy-3-nitrobenzoate*: Into a 250-mL round-bottom flask, was placed methyl 2, 6-difluoro-3-nitrobenzoate (2 g, 9.21 mmol, 1.00 equiv), methanol (100 mL), MeONa-MeOH (1.7 g). The resulting solution was stirred for 30 min at 0 °C in a water/ice bath. The solids were filtered out, The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (1:5). The collected fractions were combined and concentrated under vacuum. This resulted in 920 mg (44%) of the title compound as an off-white solid. Analytical Data: LC-MS: (ES,  $m/z$ ): RT = 1.23min,  $m/z$  = 230.21 [M+1].

[0592] *Synthesis of 2-fluoro-6-methoxy-3-nitrobenzaldehyde*: Into a 250-mL 3-necked round-bottom flask purged and maintained with an inert atmosphere of nitrogen, was placed methyl 2-fluoro-6-methoxy-3-nitrobenzoate (1.3 g, 5.67 mmol, 1.00 equiv), dichloromethane (100 mL), DIBAL-H (25 mL, 5.00 equiv). The resulting solution was stirred for 1 h at -78 °C in a liquid nitrogen bath. The reaction was then quenched by the addition of 35 mL of NH<sub>4</sub>Cl (aq). The resulting solution was extracted with 3x500 mL of ethyl acetate and the organic layers combined. The resulting mixture was washed with 3x500 mL of H<sub>2</sub>O. The mixture was dried over anhydrous sodium sulfate. The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (1:1). The collected fractions were combined and concentrated under vacuum. This resulted in 500mg (44%) of the title compound as an off-white solid. Analytical Data: LC-MS: (ES,  $m/z$ ): RT = 0.80min,  $m/z$  = 200.01 [M+1].

[0593] *Synthesis of (E)-N-[(2-fluoro-6-methoxy-3-nitrophenyl)methylidene] hydroxylamine*: Into a 100-mL round-bottom flask, was placed 2-fluoro-6-methoxy-3-nitrobenzaldehyde (600 mg, 3.01 mmol, 1.00 equiv), sodium carbonate (384 mg, 3.62 mmol, 1.20 equiv), ethanol (5 mL), water (25 mL), hydroxylamine (250 mg, 7.57 mmol, 1.20 equiv). The resulting solution was stirred for 12 h at 20 °C. The solids were collected by filtration. This resulted in 500 mg (77%) of the title compound as a yellow solid. Analytical Data: LC-MS: (ES,  $m/z$ ): RT = 1.12min,  $m/z$  = 215.00 [M+1].

[0594] *Synthesis of (Z)-2-fluoro-N-hydroxy-6-methoxy-3-nitrobenzene-1-carbonimidoyl chloride*: Into a 50-mL round-bottom flask, was placed (E)-N-[(2-fluoro-6-methoxy-3-nitrophenyl)methylidene] hydroxylamine (500 mg, 2.33 mmol, 1.00 equiv), N, N-dimethylformamide (10 mL), NCS (404 mg, 3.03 mmol, 1.00 equiv). The resulting solution was stirred for 2 h at 40 °C in an oil bath. The resulting solution was diluted with 100 mL of H<sub>2</sub>O. The resulting solution was extracted with 3x100 mL of ethyl acetate and the organic layers combined. The resulting mixture

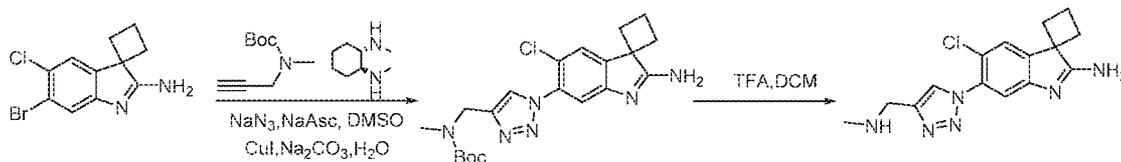
was washed with 2x100 mL of H<sub>2</sub>O. The mixture was dried over anhydrous sodium sulfate. The resulting mixture was concentrated under vacuum. This resulted in 300 mg (52%) of the title compound as a yellow solid. Analytical Data: LC-MS: (ES, *m/z*): RT = 0.80min, *m/z* = 200.01 [M+1].

[0595] *Synthesis of tert-butyl N-[[3-(2-fluoro-6-methoxy-3-nitrophenyl)-1,2-oxazol-5-yl]methyl]-N-methylcarbamate*: Into a 20-mL round-bottom flask, was placed (Z)-2-fluoro-N-hydroxy-6-methoxy-3-nitrobenzene-1-carbonimidoyl chloride (300 mg, 1.21 mmol, 1.00 equiv), sodium bicarbonate (305 mg, 3.63 mmol, 3.00 equiv), tert-butyl N-methyl-N-(prop-2-yn-1-yl)carbamate (204 mg, 1.21 mmol, 1.00 equiv), PhMe (10 mL). The resulting solution was stirred for 12 h at 20 °C. The resulting mixture was concentrated under vacuum. The residue was applied onto a silica gel column with ethyl acetate/petroleum ether (1:1). The collected fractions were combined and concentrated under vacuum. This resulted in 100 mg (22%) of the title compound as yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT = 1.36min, *m/z* = 382.10 [M+1].

[0596] *Synthesis of N-[[3-(3-amino-2-fluoro-6-methoxyphenyl)-1,2-oxazol-5-yl]methyl]-N-methylcarbamate*: Into a 20-mL round-bottom flask, was placed *tert*-butyl N-[[3-(2-fluoro-6-methoxy-3-nitrophenyl)-1,2-oxazol-5-yl]methyl]-N-methylcarbamate (80 mg, 0.21 mmol, 1.00 equiv), Fe (80 mg, 5.00 equiv), NH<sub>4</sub>Cl (157 mg, 2.94 mmol, 10.00 equiv), ethanol (5 mL), water (0.5 mL). The resulting solution was stirred for 10 min at 80 °C in an oil bath. The solids were filtered out. The resulting mixture was concentrated under vacuum. This resulted in 40mg of title compound (54%) as yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT = 0.79min, *m/z* = 352.20 [M+1].

[0597] *Synthesis of N2-(2-fluoro-4-methoxy-3-[5-[(methylamino)methyl]-1,2-oxazol-3-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt)*: Into a 40-mL vial, was placed *tert*-butyl N-[[3-(3-amino-2-fluoro-6-methoxyphenyl)-1,2-oxazol-5-yl]methyl]-N-methylcarbamate (40 mg, 0.11 mmol, 1.00 equiv), trifluoroacetic acid (38.6 mg, 0.34 mmol, 3.00 equiv), IPA (2 mL), 2-chloro-N,6-dimethylpyrimidin-4-amine (11 mg, 0.07 mmol, 0.60 equiv). The resulting solution was stirred for 2 h at 80 °C in an oil bath. The resulting mixture was concentrated under vacuum. The crude product (40 mg) was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XSelect CSH Prep C18 OBD Column, 5µm, 19\*150mm; mobile phase, Water (0.05%TFA ) and ACN (5.0% ACN up to 18.0% in 7 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 12.8 mg (23%) of the title compound as an off-white solid.

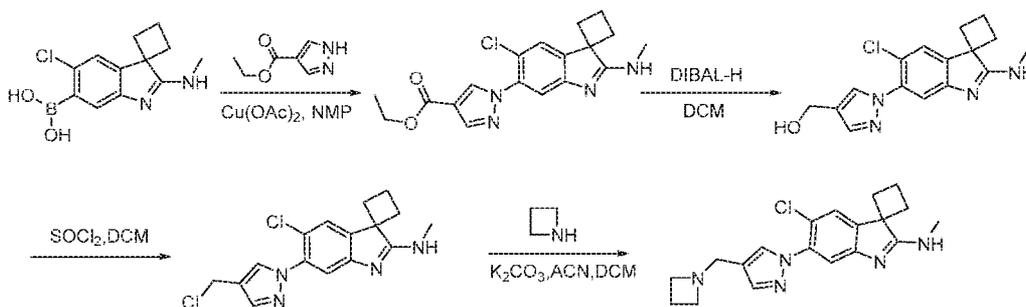
**Example 17: Synthesis of Compound A15: 5'-chloro-6'-(4-((methylamino)methyl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine:**



[0598] *Synthesis of tert-butyl ((1-(2'-amino-5'-chlorospiro[cyclobutane-1,3'-indol]-6'-yl)-1H-1,2,3-triazol-4-yl)methyl)(methyl)carbamate:* Into a 40-mL vial, was placed SM (400 mg, 1.40 mmol, 1.00 equiv), tert-butyl N-methyl-N-(prop-2-yn-1-yl)carbamate (476 mg, 2.81 mmol, 2.01 equiv), NaN<sub>3</sub> (183 mg, 2.81 mmol, 2.01 equiv), NaAsc (84 mg), NaCO<sub>3</sub> (298 mg), CuI (54 mg, 0.28 mmol, 0.20 equiv), DMSO (10 mL), water(2 mL). The resulting solution was stirred for 72 h at 100°C in an oil bath. The solids were filtered out and the filtrate was concentrated under reduced pressure. The crude product was purified by Flash-Prep-HPLC with the mobile phase: methanol/H<sub>2</sub>O = 1/1. The collected fractions were combined and concentrated under vacuum. This resulted in 60 mg (10%) of the title compound as brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT= 0.85 min, *m/z* = 417 [M+1].

[0599] *Synthesis of 5'-chloro-6'-(4-((methylamino)methyl)-1H-1,2,3-triazol-1-yl)spiro[cyclobutane-1,3'-indol]-2'-amine:* Into a 50-mL round-bottom flask, was placed SM (60 mg, 0.14 mmol, 1.00 equiv), trifluoroacetic acid (3 mL), dichloromethane (10 mL). The resulting solution was stirred for 2 h at 25°C. The resulting mixture was concentrated under vacuum. This resulted in 32.5 mg (52%) of the title compound (trifluoroacetic acid salt) as brown oil.

**Example 18: Synthesis of Compound A17: 6'-(4-(azetidinemethyl)-1H-pyrazol-1-yl)-5'-chloro-N-methylspiro[cyclobutane-1,3'-indol]-2'-amine (trifluoroacetic acid salt):**



[0600] *Synthesis of ethyl 1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-pyrazole-4-carboxylate:* Into a 40-mL round-bottom flask, was placed SM (800 mg, 3.02 mmol,

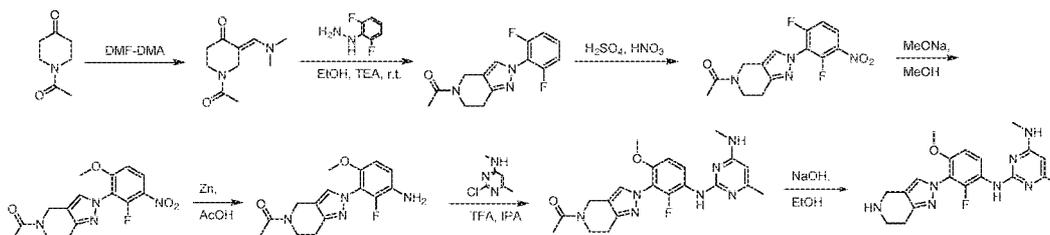
1.00 equiv), ethyl 1H-pyrazole-4-carboxylate (507 mg, 3.62 mmol, 1.20 equiv), Cu(OAc)<sub>2</sub> (181 mg, 1.00 mmol, 0.33 equiv), TEA (915 mg, 9.04 mmol, 2.99 equiv), NMP (8 mL). The resulting solution was stirred for 6 h at 80 °C in an oil bath. The resulting mixture was concentrated under vacuum. The crude product was purified by Flash-Prep-HPLC with the mobile phase, methanol/H<sub>2</sub>O = 1:1. The collected fractions were combined and concentrated under vacuum. This resulted in 100 mg (9%) of the title compound as brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.83 min, *m/z* = 359 [M+1].

[0601] *Synthesis of (1-(5'-chloro-2'-(methylamino)spiro[cyclobutane-1,3'-indol]-6'-yl)-1H-pyrazol-4-yl)methanol*: Into a 50-mL round-bottom flask, was placed SM (80 mg, 0.22 mmol, 1.00 equiv), DIBAL-H (1.1 mL), dichloromethane (10 mL). The resulting solution was stirred for 1 h at -78 °C in a liquid nitrogen bath. The reaction was then quenched by the addition of MeOH. The resulting solution was extracted with of dichloromethane and the organic layers combined, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, concentrated under vacuum. The crude product was purified by Flash-Prep-HPLC with mobile phase, methanol/H<sub>2</sub>O = 1:1. The collected fractions were combined and concentrated under vacuum. This resulted in 50 mg (71%) of the title compound as brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.86 min, *m/z* = 317 [M+1].

[0602] *Synthesis of 5'-chloro-6'-(4-(chloromethyl)-1H-pyrazol-1-yl)-N-methylspiro[cyclobutane-1,3'-indol]-2'-amine*: Into a 50-mL round-bottom flask, was placed SM (50 mg, 0.16 mmol, 1.00 equiv), thionyl chloride (94 mg), dichloromethane (10 mL). The resulting solution was stirred for 2 h at 25 °C. The resulting mixture was concentrated under vacuum. This resulted in 30 mg (57%) of the target compound as a brown oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.81 min, *m/z* = 335 [M+1].

[0603] *Synthesis of 6'-(4-(azetidin-1-ylmethyl)-1H-pyrazol-1-yl)-5'-chloro-N-methylspiro[cyclobutane-1,3'-indol]-2'-amine (trifluoroacetic acid salt)*: Into a 50-mL round-bottom flask, was placed SM (50 mg, 0.15 mmol, 1.00 equiv), azetidine (43 mg, 0.75 mmol, 5.05 equiv), potassium methaneperoxoate potassium (103 mg, 0.74 mmol, 4.96 equiv), ACN (10 mL), dichloromethane (5 mL). The resulting solution was stirred for 2 h at 25 °C. The resulting mixture was concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XBridge Prep C18 OBD Column, 19\*150mm 5um; mobile phase, Water (0.05%TFA) and ACN (5.0% ACN up to 23.0% in 10 min); Detector, UV 220/254nm. The collected fractions were combined and concentrated under vacuum. This resulted in 25.9 mg (37%) of the title compound as a brown oil

**Example 19: Synthesis of Compound A19: N2-(2-fluoro-4-methoxy-3-(4,5,6,7-tetrahydro-2H-pyrazolo[4,3-c]pyridin-2-yl)phenyl)-N4,6-dimethylpyrimidine-2,4-diamine:**



[0604] *Synthesis of (3E)-1-acetyl-3-[(dimethylamino)methylidene]piperidin-4-one:* Into a 40-mL vial, was placed 1-acetylpiperidin-4-one 2g (14.17 mmol, 1.00 equiv), N,N-dimethylformamide (30 mL), DMF-DMA (1.5 g). The resulting solution was stirred for 6 h at 80 °C. The resulting mixture was concentrated under reduced pressure. The residue was applied onto a C18 column with ACN/H<sub>2</sub>O (10%). The collected fractions were combined and concentrated under vacuum. This resulted in 5 g (crude) of the title compound as yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.392 min, *m/z*=197 [M+1].

[0605] *Synthesis of 1-[2-(2,6-difluorophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one:* Into a 100-mL round-bottom flask, was placed (2,6-difluorophenyl)hydrazine (1.1 g, 7.63 mmol, 1.50 equiv), (3E)-1-acetyl-3-[(dimethylamino)methylidene]piperidin-4-one (1 g, 5.10 mmol, 1.00 equiv), TEA (1.5 g, 14.82 mmol, 2.91 equiv), methanol (20 mL). The resulting solution was stirred overnight at 25 °C. The resulting mixture was concentrated under reduced pressure. The residue was applied onto a C<sub>18</sub> column with ACN/H<sub>2</sub>O (30%). The collected fractions were combined and concentrated under vacuum. This resulted in 1.5 g (crude) of the title compound as yellow oil. Analytical Data: LC-MS: (ES, *m/z*): RT=0.725 min, *m/z*=278 [M+1].

[0606] *Synthesis of 1-[2-(2,6-difluoro-3-nitrophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one:* Into a 25-mL round-bottom flask, was placed 1-[2-(2,6-difluorophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (380 mg, 1.37 mmol, 1.00 equiv), sulfuric acid (8 mL), HNO<sub>3</sub> (190 mg). The resulting solution was stirred overnight at 25 °C. The resulting solution was extracted with of ethyl acetate and the organic layers were combined, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub> and concentrated under vacuum. This resulted in 350 mg (79%) of the title compound as a yellow solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.858 min, *m/z*=323 [M+1].

[0607] *Synthesis of 1-[2-(2-fluoro-6-methoxy-3-nitrophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one*: Into a 25-mL round-bottom flask, was placed 1-[2-(2,6-difluoro-3-nitrophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (350 mg, 1.09 mmol, 1.00 equiv), MeONa (175 mg), methanol (10 mL). The resulting solution was stirred for 1 h at 0 °C and then quenched with ice water. The aqueous layer was extracted with EtOEt, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. After filtration, the filtrate was concentrated under reduced pressure. The residue was applied onto a silica gel column with dichloromethane/methanol (5%). The collected fractions were combined and concentrated under vacuum. This resulted in 105 mg (29%) of as a yellow solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.848 min, *m/z*=335 [M+1].

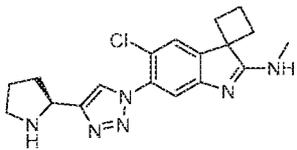
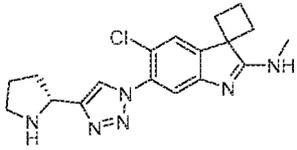
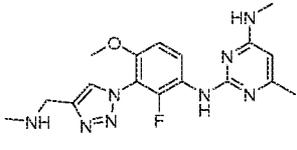
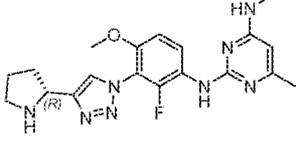
[0608] *Synthesis of 1-[2-(3-amino-2-fluoro-6-methoxyphenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one*: Into a 8-mL vial, was placed 1-[2-(2-fluoro-6-methoxy-3-nitrophenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (110 mg, 0.33 mmol, 1.00 equiv), Zn (110 mg), AcOH (3 mL). The resulting solution was stirred for 1 h at 25 °C. The solids were filtered out. The filtrate was concentrated under reduced pressure. This resulted in 130 mg of the title compound as a yellow solid that was used without further purification. Analytical Data: LC-MS: (ES, *m/z*): RT=0.832 min, *m/z*=305 [M+1].

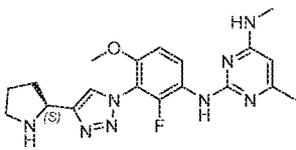
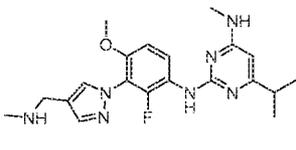
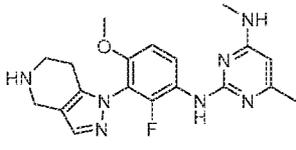
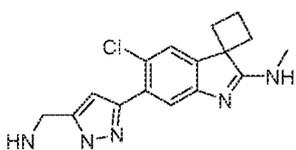
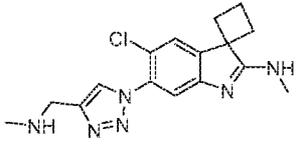
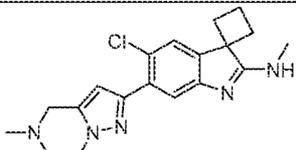
[0609] *Synthesis of 1-[2-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one*: Into a 8-mL vial, was placed 1-[2-(3-amino-2-fluoro-6-methoxyphenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (80 mg, 0.26 mmol, 1.00 equiv), trifluoroacetic acid (105 mg, 0.93 mmol, 3.53 equiv), IPA (3 mL), 2-chloro-N,6-dimethylpyrimidin-4-amine (55 mg, 0.35 mmol, 1.33 equiv). The resulting solution was stirred for 1 h at 80 °C. The solution was concentrated under vacuum. The residue was purified by reverse flash chromatography with the following conditions: column, C18 silica gel; mobile phase, ACN/H<sub>2</sub>O (30%). The collected fractions were combined and concentrated under vacuum. This resulted in 54 mg (48%) of the title compound as a white solid. Analytical Data: LC-MS: (ES, *m/z*): RT=0.674 min, *m/z*=426 [M+1].

[0610] *Synthesis of N2-(2-fluoro-4-methoxy-3-[2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-2-yl]phenyl)-N4,6-dimethylpyrimidine-2,4-diamine (trifluoroacetic acid salt)*: Into a 20mL vial were added 1-[2-(2-fluoro-6-methoxy-3-[[4-methyl-6-(methylamino)pyrimidin-2-yl]amino]phenyl)-2H,4H,5H,6H,7H-pyrazolo[4,3-c]pyridin-5-yl]ethan-1-one (150 mg, 0.353 mmol, 1 equiv) and NaOH (110 mg, 2.750 mmol, 7.80 equiv) EtOH (3 mL, 0.065 mmol, 0.18 equiv) and H<sub>2</sub>O (0.6 mL, 0.033 mmol, 0.09 equiv) at room temperature. The resulting mixture was

stirred for overnight at 80 °C under air atmosphere. The filtrate was collected after filtration and concentrated under vacuum. The crude product was purified by Prep-HPLC with the following conditions (2#SHIMADZU (HPLC-01)): Column, XBridge Shield RP18 OBD Column, 30\*150mm,5um; mobile phase, Water(10MMOL/L NH<sub>4</sub>HCO<sub>3</sub>) and ACN (8.0% ACN up to 28.0% in 10 min); Detector, UV 254/220nm. The collected fractions were combined and concentrated under vacuum and trifluoroacetic acid (31mg, 0.27mmol, 1eq) was added to this compound. After stirring for 1h, the solution was concentrated under vacuum. This resulted in 47.7 mg (27.20%) of the title compound as a white solid.

#### Analytical Data of Synthesized Compounds.

Compound No.	Structure	Data
A2S		LC-MS: (ES, <i>m/z</i> ): RT = 0.93min, <i>m/z</i> = 357.20 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.58 (s, 1H), 8.19 (s, 1H), 7.39 (s, 1H), 5.01 (t, <i>J</i> = 7.8 Hz, 1H), 3.63 – 3.45 (m, 2H), 3.27 (s, 3H), 2.93 – 2.81 (m, 2H), 2.74 – 2.54 (m, 4H), 2.48 – 2.30 (m, 3H), 2.31 – 2.21 (m, 1H).
A2R		LC-MS: (ES, <i>m/z</i> ): RT = 1.77min, <i>m/z</i> = 357.21 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.58 (s, 1H), 8.19 (s, 1H), 7.39 (s, 1H), 5.01 (t, <i>J</i> = 7.8 Hz, 1H), 3.58 – 3.47 (m, 2H), 3.27 (s, 3H), 2.93 – 2.81 (m, 2H), 2.74 – 2.54 (m, 4H), 2.48 – 2.30 (m, 3H), 2.31 – 2.21 (m, 1H).
A3		LC-MS: (ES, <i>m/z</i> ): RT = 1.764 min, <i>m/z</i> = 373 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.36 (s, 1H), 7.85 (t, <i>J</i> = 8.9 Hz, 1H), 7.18 (dd, <i>J</i> = 9.2, 1.8 Hz, 1H), 6.02 (d, <i>J</i> = 1.0 Hz, 1H), 4.44 (s, 2H), 3.87 (s, 3H), 2.89 (s, 3H), 2.81 (s, 3H), 2.31 (d, <i>J</i> = 0.9 Hz, 3H).
A4R		LC-MS: (ES, <i>m/z</i> ): RT = 1.019 min, <i>m/z</i> = 399.3 [M+1]. <sup>1</sup> H NMR (300 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.46 – 8.19 (m, 2H), 7.08 (dd, <i>J</i> = 9.4, 1.9 Hz, 1H), 5.88 (d, <i>J</i> = 0.7 Hz, 1H),

		4.81 (t, $J = 7.5$ Hz, 1H), 3.87 (s, 3H), 3.48 – 3.35 (m, 2H), 2.89 (s, 3H), 2.61 – 2.41 (m, 1H), 2.39 – 2.04 (m, 6H).
A4S		LC-MS: (ES, $m/z$ ): RT = 1.023 min, $m/z = 399.3$ [M+1]. $^1\text{H NMR}$ (300 MHz, Methanol- $d_4$ ) $\delta$ 8.42 – 8.23 (m, 2H), 7.08 (dd, $J = 9.4$ , 1.9 Hz, 1H), 5.88 (d, $J = 0.8$ Hz, 1H), 4.82 (t, $J = 7.5$ Hz, 1H), 3.85 (s, 3H), 3.49 – 3.35 (m, 2H), 2.89 (s, 3H), 2.60 – 2.43 (m, 1H), 2.40 – 2.06 (m, 6H).
A8		LC-MS: (ES, $m/z$ ): RT=0.980 min, $m/z = 399.9$ [M+1]. $^1\text{H NMR}$ (400 MHz, Methanol- $d_4$ ) $\delta$ 8.01 (s, 1H), 7.92 – 7.85 (m, 2H), 7.15 – 7.02 (m, 1H), 6.17 – 6.01 (m, 1H), 4.21 (s, 2H), 3.85 (s, 3H), 2.97 – 2.80 (m, 4H), 2.74 (s, 3H), 1.36 – 1.27 (m, 6H).
A9		LC-MS: (ES, $m/z$ ): RT=0.853 min, $m/z = 384$ [M+1]. $^1\text{H NMR}$ (400 MHz, Methanol- $d_4$ ) $\delta$ 7.85 (t, $J = 8.8$ Hz, 1H), 7.71 (s, 1H), 7.15 – 7.06 (m, 1H), 6.19 – 5.99 (m, 1H), 4.35 (s, 2H), 3.86 (d, $J = 3.7$ Hz, 3H), 3.60 – 3.51 (m, 2H), 2.96 – 2.82 (m, 5H), 2.40 – 2.30 (m, 3H).
A10		LC-MS: (ES, $m/z$ ): RT=1.638 min, $m/z = 342.3$ [M+1]. $^1\text{H NMR}$ (400 MHz, Methanol- $d_4$ ) $\delta$ 7.94 (d, $J = 1.3$ Hz, 1H), 7.52 (s, 1H), 6.86 – 6.83 (m, 1H), 4.60 (s, 2H), 4.51 (t, $J = 5.9$ Hz, 2H), 3.85 (t, $J = 5.9$ Hz, 2H), 3.22 (s, 3H), 2.86 – 2.76 (m, 2H), 2.69 – 2.53 (m, 3H), 2.37 – 2.24 (m, 1H).
A11		LC-MS: (ES, $m/z$ ): RT= 0.87 min, $m/z = 331$ [M+1]. $^1\text{H NMR}$ : (Methanol- $d_4$ , ppm) $\delta$ 8.57 (s, 1H), 8.21 (s, 1H), 7.44 (s, 1H), 4.48 (s, 2H), 3.27 (s, 3H), 2.93 – 2.81 (m, 5H), 2.84 (s, 3H), 2.67 – 2.35 (m, 4H).
A12		LC-MS: (ES, $m/z$ ): RT=1.522 min, $m/z = 356.2$ [M+1]. $^1\text{H NMR}$ (400 MHz, Methanol- $d_4$ ) $\delta$ 7.94 (d, $J = 1.6$ Hz, 1H), 7.52 (d, $J =$

		1.3 Hz, 1H), 6.83 (s, 1H), 4.67 – 4.61 (m, 2H), 4.59 – 4.52 (m, 2H), 3.93 – 3.86 (m, 1H), 3.22 (s, 2H), 3.15 – 3.08 (m, 2H), 2.84 – 2.76 (m, 2H), 2.65 – 2.52 (m, 3H), 2.35 – 2.24 (m, 1H).
A13		LC-MS: (ES, <i>m/z</i> ): RT=1.481 min, <i>m/z</i> = 393.1 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 8.97 (d, <i>J</i> = 9.3 Hz, 1H), 8.17 (s, 1H), 7.58 (d, <i>J</i> = 9.3 Hz, 1H), 5.96 (s, 1H), 4.00 (s, 2H), 2.93 (s, 3H), 2.48 (s, 3H), 2.23 (s, 3H).
A14		LC-MS: (ES, <i>m/z</i> ): RT = 1.52min, <i>m/z</i> = 373.20 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 7.76 (t, <i>J</i> = 8.8 Hz, 1H), 7.18 – 7.04 (m, 1H), 6.93 (s, 1H), 6.25 – 5.94 (m, 1H), 4.54 (s, 2H), 3.95 – 3.91 (m, 3H), 2.95 – 2.78 (m, 6H), 2.49 – 2.24 (m, 3H).
A15		LC-MS: (ES, <i>m/z</i> ): RT= 0.86 min, <i>m/z</i> = 317 [M+1]. <sup>1</sup> H NMR: (Methanol- <i>d</i> <sub>4</sub> , ppm): δ 8.55 (s, 1H), 8.20 (s, 1H), 7.44 (s, 1H), 4.48 (s, 2H), 2.90 – 2.85 (m, 2H), 2.84 (s, 3H), 2.78 – 2.62 (m, 3H), 2.51 – 2.35 (m, 1H).
A17		LC-MS: (ES, <i>m/z</i> ): RT= 1.34 min, LCMS15: <i>m/z</i> = 356 [M+1]. <sup>1</sup> H NMR: (Methanol- <i>d</i> <sub>4</sub> , ppm): δ 8.31 (s, 1H), 8.10 (s, 1H), 7.90 (s, 1H), 7.35 (s, 1H), 4.39 (s, 2H), 4.20 (t, <i>J</i> = 8.3 Hz, 4H), 3.23 (s, 3H), 2.84 (s, 2H), 2.65 – 2.26 (m, 6H).
A19		LC-MS: (ES, <i>m/z</i> ): RT=0.768 min, <i>m/z</i> =384 [M+1]. <sup>1</sup> H NMR (400 MHz, Methanol- <i>d</i> <sub>4</sub> ) δ 7.87 – 7.76 (m, 1H), 7.73 (d, <i>J</i> = 2.5 Hz, 1H), 7.16 – 7.09 (m, 1H), 6.12 (dd, <i>J</i> = 70.4, 1.0 Hz, 1H), 4.36 (s, 2H), 3.88 (d, <i>J</i> = 3.7 Hz, 3H), 3.65 – 3.49 (m, 2H), 2.95 – 2.90 (m, 4H), 2.86 – 2.79 (m, 1H), 2.41 – 2.32 (m, 3H).

## Example 20: Bioactivity Assays

### *Materials and Equipments*

[0611] Recombinant purified human EHMT2 913-1193 (55  $\mu$ M) synthesized by Viva was used for all experiments. Biotinylated histone peptides were synthesized by Biopeptide and HPLC-purified to > 95% purity. Streptavidin Flashplates and seals were purchased from PerkinElmer and 384 Well V-bottom Polypropylene Plates were from Greiner.  $^3$ H-labeled *S*-adenosylmethionine ( $^3$ H-SAM) was obtained from American Radiolabeled Chemicals with a specific activity of 80 Ci/mmol. Unlabeled SAM and *S*-adenosylhomocysteine (SAH) were obtained from American Radiolabeled Chemicals and Sigma-Aldrich respectively. Flashplates were washed in a Biotek ELx-405 with 0.1% Tween. 384-well Flashplates and 96-well filter binding plates were read on a TopCount microplate reader (PerkinElmer). Compound serial dilutions were performed on a Freedom EVO (Tecan) and spotted into assay plates using a Thermo Scientific Matrix PlateMate (Thermo Scientific). Reagent cocktails were added by Multidrop Combi (Thermo Scientific).

[0612] MDA-MB-231 cell line was purchased from ATCC (Manassas, VA, USA). RPMI/Glutamax medium, Penicillin-Streptomycin, Heat Inactivated Fetal Bovine Serum, and D-PBS were purchased from Life Technologies (Grand Island, NY, USA). Odyssey blocking buffer, 800CW goat anti-mouse IgG (H+L) antibody, and Licor Odyssey Infrared Scanner were purchased from Licor Biosciences, Lincoln, NE, USA. H3K9me2 mouse monoclonal antibody (Cat #1220) was purchased from Abcam (Cambridge, MA, USA). 16% Paraformaldehyde was purchased from Electron Microscopy Sciences, Hatfield, PA, USA). MDA-MB-231 cells were maintained in complete growth medium (RPMI supplemented with 10% v/v heat inactivated fetal bovine serum) and cultured at 37 °C under 5% CO<sub>2</sub>. UNC0638 was purchased from Sigma-Aldrich (St. Louis, MO, USA).

### *General Procedure for EHMT2 Enzyme Assay on Histone Peptide Substrate.*

[0613] 10-point curves of test compounds were made on a Freedom EVO (Tecan) using serial 3-fold dilutions in DMSO, beginning at 2.5 mM (final top concentration of compound was 50  $\mu$ M and the DMSO was 2%). A 1  $\mu$ L aliquot of the inhibitor dilution series was spotted in a polypropylene 384-well V-bottom plate (Greiner) using a Thermo Scientific Matrix PlateMate (Thermo Scientific). The 100% inhibition control consisted of 1 mM final concentration of the product inhibitor *S*-adenosylhomocysteine (SAH, Sigma-Aldrich). Compounds were incubated for 30 minutes with 40  $\mu$ L per well of 0.031 nM EHMT2 (recombinant purified human EHMT2 913-1193, Viva) in 1X assay buffer (20 mM Bicine [pH 7.5], 0.002% Tween 20, 0.005% Bovine Skin

Gelatin and 1 mM TCEP). 10  $\mu$ L per well of substrate mix comprising assay buffer,  $^3\text{H}$ -SAM ( $^3\text{H}$ -labeled *S*-adenosylmethionine, American Radiolabeled Chemicals, specific activity of 80 Ci/mmol), unlabeled SAM (American Radiolabeled Chemicals), and peptide representing histone H3 residues 1-15 containing C-terminal biotin (appended to a C-terminal amide-capped lysine, synthesized by Biopeptide and HPLC-purified to greater than 95% purity) were added to initiate the reaction (both substrates were present in the final reaction mixture at their respective  $K_m$  values, an assay format referred to as “balanced conditions”). Reactions were incubated for 60 minutes at room temperature and quenched with 10  $\mu$ L per well of 400  $\mu$ M unlabeled SAM, then transferred to a 384-well streptavidin Flashplate (PerkinElmer) and washed in a Biotek ELx-405 well washer with 0.1% Tween after 60 minutes. 384-well Flashplates were read on a TopCount microplate reader (PerkinElmer).

***General Procedure for MDA-MB-231 HEK9me2 in-cell Western Assay.***

[0614] Compound (100 nL) was added directly to 384-well cell plate. MDA-MB-231 cells (ATCC) were seeded in assay medium (RPMI/Glutamax supplemented with 10% v/v heat inactivated fetal bovine serum and 1% Penicillin/Streptomycin, Life Technologies) at a concentration of 3,000 cells per well to a Poly-D-Lysine coated 384-well cell culture plate with 50  $\mu$ L per well. Plates were incubated at 37°C, 5% CO<sub>2</sub> for 48 hours (BD Biosciences 356697). Plates were incubated at room temperature for 30 minutes and then incubated at 37°C, 5% CO<sub>2</sub> for additional 48 hours. After the incubation, 50  $\mu$ L per well of 8% paraformaldehyde (Electron Microscopy Sciences) in PBS was added to the plates and incubated at room temperature for 20 minutes. Plates were transferred to a Biotek 406 plate washer and washed 2 times with 100  $\mu$ L per well of wash buffer (1X PBS containing 0.3% Triton X-100 (v/v)). Next, 60  $\mu$ L per well of Odyssey blocking buffer (Licor Biosciences) was added to each plate and incubated for 1 hour at room temperature. Blocking buffer was removed and 20  $\mu$ L of monoclonal primary antibody  $\alpha$ -H3K9me2 (Abcam) diluted 1:800 in Odyssey buffer with 0.1% Tween 20 (v/v) were added and plates were incubated overnight (16 hours) at 4 °C. Plates were washed 5 times with 100  $\mu$ L per well of wash buffer. Next 20  $\mu$ L per well of secondary antibody was added (1:500 800CW donkey anti-mouse IgG (H+L) antibody (Licor Biosciences), 1:1000 DRAQ5 (Cell Signaling Technology) in Odyssey buffer with 0.1% Tween 20 (v/v)) and incubated for 1 hour at room temperature. The plates were washed 5 times with 100  $\mu$ L per well wash buffer then 2 times with 100  $\mu$ L per well of water. Plates were allowed to dry at room temperature then imaged on a Licor

Odyssey Infrared Scanner (Licor Biosciences) which measured integrated intensity at 700 nm and 800 nm wavelengths. Both 700 and 800 channels were scanned.

**% Inhibition Calculation.**

[0615] First, the ratio for each well was determined by:  $\left( \frac{H3K9me2\ 800nm\ value}{DRAQ5\ 700nm\ value} \right)$ .

[0616] Each plate included fourteen control wells of DMSO only treatment (Minimum Inhibition) as well as fourteen control wells (background wells) for maximum inhibition treated with control compound UNC0638 (Background wells).

[0617] The average of the ratio values for each well was calculated and used to determine the percent inhibition for each test well in the plate. Control compound was serially diluted three-fold in DMSO for a total of 10 test concentrations beginning at 1  $\mu$ M. Percent inhibition was calculated

as: Percent Inhibition = 100 -  $\left( \left( \frac{(\text{Individual Test Sample Ratio}) - (\text{Background Avg Ratio})}{(\text{Minimum Inhibition Ratio}) - (\text{Background Average Ratio})} \right) * 100 \right)$

[0618] IC<sub>50</sub> curves were generated using triplicate wells per concentration of compound. The IC<sub>50</sub> is the concentration of compound at which measured methylation is inhibited by 50% as interpolated from the dose response curves. IC<sub>50</sub> values were calculated using a non-linear regression (variable slope–four parameter fit model) with by the following formula:

$\% inhibition = Bottom + \left( \frac{Top - Bottom}{1 + (IC_{50}/I)^n} \right)$ , where *Top* is fixed at 100% and *Bottom* is fixed to 0%, [I] = concentration of inhibitor, IC<sub>50</sub> = half maximal inhibitory concentration and *n* = Hill Slope.

[0619] The IC<sub>50</sub> values are listed in Table 3 below (in which “A” means IC<sub>50</sub> <100 nM; “B” means IC<sub>50</sub> ranging between 100 nM and 1  $\mu$ M; “C” means IC<sub>50</sub> ranging between >1  $\mu$ M and 10  $\mu$ M; “D” means IC<sub>50</sub> >10  $\mu$ M) and Table 3A below (in which “A” means IC<sub>50</sub> <10 nM; “B” means IC<sub>50</sub> ranging between 10 nM and 100 nM; “C” means IC<sub>50</sub> ranging between >100 nM and 1  $\mu$ M; “D” means IC<sub>50</sub> >1  $\mu$ M).

**Table 3**

Compound No.	EHMT2 PEP (IC <sub>50</sub> $\mu$ M)	EHMT1 PEP (IC <sub>50</sub> $\mu$ M)	EHMT2 ICW (IC <sub>50</sub> $\mu$ M)
1	B	A	C
2	D	C	D
3	C	B	D
4	D	C	D

Compound No.	EHMT2 PEP (IC50 $\mu$ M)	EHMT1 PEP (IC50 $\mu$ M)	EHMT2 ICW (IC50 $\mu$ M)
5	D	C	D
6	C	C	C
7	B	A	C
8	D	D	D
9	C	B	C
10	D	C	D
11	B	A	C
12	C	B	C
13	C	B	C
14	D	C	D
15	D	D	D
19	B	A	C
21	A	A	B
22	D	D	D
23	C	B	C
24	B	A	C
26	D	C	D
27	C	B	C
28	B	A	C
30	D	C	D
31	B	A	C
32	D	B	C
33	D	C	D
35	D	D	D
36	D	D	D
37	C	C	D
38	C	B	D
39	B	B	C
40	D	D	D
41	D	D	D
42	B	B	C
43	D	D	D
45	D	D	D
47	B	B	C
48	C	B	C
49	C	B	C

Table 3A

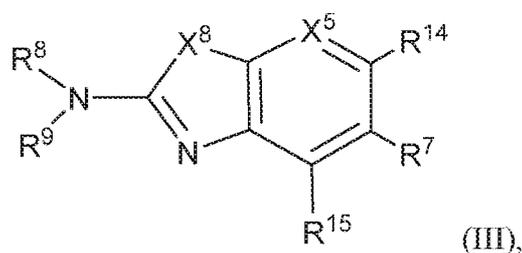
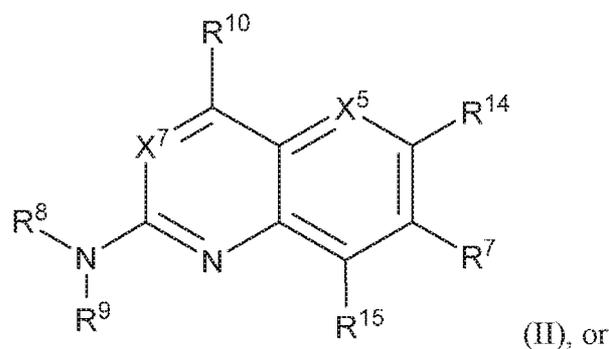
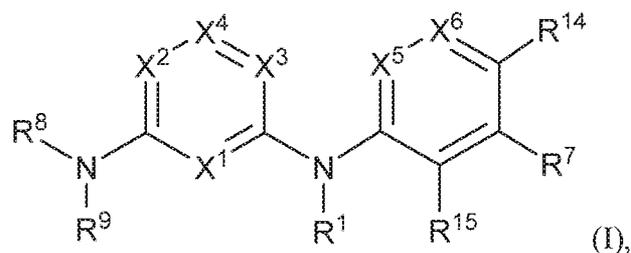
Compound No.	EHMT2 (IC50 $\mu$ M)	EHMT1 (IC50 $\mu$ M)	ICW (IC50 $\mu$ M)
A1	A	A	B
A2	B	A	C
A2S	C	B	D

Compound No.	EHMT2 (IC50 $\mu$ M)	EHMT1 (IC50 $\mu$ M)	ICW (IC50 $\mu$ M)
A2R	A	A	B
A3	B	A	B
A4	B	A	B
A4S	C	B	C
A4R	B	A	B
A5	C	C	D
A6	A	A	B
A7	C	B	C
A8	B	A	B
A9	C	C	C
A10	C	B	D
A11	B	A	C
A12	D	C	D
A13	A	A	B
A14	B	A	C
A15	B	B	C
A17	B	B	C
A19	C	C	C
A21	B	B	C
A22	B	B	C
A44	B		C
A45	A		B
A47	B		C
A48	D		D
A51	A		A
A52R	B		B
A59R	A		C
A62	A		B
A63	D		
A66	A		
A68	A		A
A69	A		B
A70	A		A

[0620] The invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The foregoing embodiments are therefore to be considered in all respects illustrative rather than limiting on the invention described herein. Scope of the invention is thus indicated by the appended claims rather than by the foregoing description, and all changes that come within the meaning and range of equivalency of the claims are intended to be embraced therein.

## What is claimed is:

1. A compound of Formula (I), (II), or (III):



or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer, wherein

$X^1$  is N or  $CR^2$ ;

$X^2$  is N or  $CR^3$ ;

$X^3$  is N or  $CR^4$ ;

$X^4$  is N or  $CR^5$ ;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$X^8$  is  $NR^{13}$  or  $CR^{11}R^{12}$ ;

$R^1$  is H or  $C_1$ - $C_4$  alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano,  $C_1$ - $C_6$  alkoxy,  $C_6$ - $C_{10}$  aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,

OC(O)NR<sup>a</sup>R<sup>b</sup>, NR<sup>a</sup>C(O)OR<sup>b</sup>, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, wherein the C<sub>6</sub>-C<sub>10</sub> aryl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, are each optionally substituted with one or more of halo, OR<sup>a</sup>, or NR<sup>a</sup>R<sup>b</sup>, in which each of R<sup>a</sup> and R<sup>b</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>6</sup> is -Q<sup>1</sup>-T<sup>1</sup>, in which Q<sup>1</sup> is a bond, or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>1</sup> is H, halo, cyano, or R<sup>S1</sup>, in which R<sup>S1</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and R<sup>S1</sup> is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, -C(O)R<sup>c</sup>, -C(O)OR<sup>c</sup>, -SO<sub>2</sub>R<sup>c</sup>, -SO<sub>2</sub>N(R<sup>c</sup>)<sub>2</sub>, -NR<sup>c</sup>C(O)R<sup>d</sup>, -C(O)NR<sup>c</sup>R<sup>d</sup>, -NR<sup>c</sup>C(O)OR<sup>d</sup>, -OC(O)NR<sup>c</sup>R<sup>d</sup>, NR<sup>c</sup>R<sup>d</sup>, or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of R<sup>c</sup> and R<sup>d</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>7</sup> is -Q<sup>2</sup>-T<sup>2</sup>, in which Q<sup>2</sup> is a bond, C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, and T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl is optionally substituted with one or more -Q<sup>3</sup>-T<sup>3</sup>, wherein each Q<sup>3</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>3</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6- membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, C(O)OR<sup>f</sup>, OC(O)R<sup>f</sup>, S(O)<sub>2</sub>R<sup>f</sup>, NR<sup>f</sup>R<sup>g</sup>, OC(O)NR<sup>f</sup>R<sup>g</sup>, NR<sup>f</sup>C(O)OR<sup>g</sup>, C(O)NR<sup>f</sup>R<sup>g</sup>, and NR<sup>f</sup>C(O)R<sup>g</sup>; or -Q<sup>3</sup>-T<sup>3</sup> is oxo;

each R<sup>e</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of R<sup>f</sup> and R<sup>g</sup>, independently, is -Q<sup>6</sup>-T<sup>6</sup>, in which Q<sup>6</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>6</sup> is H, halo, OR<sup>m1</sup>, NR<sup>m1</sup>R<sup>m2</sup>, NR<sup>m1</sup>C(O)R<sup>m2</sup>, C(O)NR<sup>m1</sup>R<sup>m2</sup>, C(O)R<sup>m1</sup>, C(O)OR<sup>m1</sup>, NR<sup>m1</sup>C(O)OR<sup>m2</sup>, OC(O)NR<sup>m1</sup>R<sup>m2</sup>, S(O)<sub>2</sub>R<sup>m1</sup>, S(O)<sub>2</sub>NR<sup>m1</sup>R<sup>m2</sup>, or R<sup>S3</sup>, in which each of R<sup>m1</sup> and R<sup>m2</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S3</sup> is

C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S3</sup> is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>, wherein each Q<sup>7</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>7</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>n1</sup>, C(O)R<sup>n1</sup>, C(O)OR<sup>n1</sup>, OC(O)R<sup>n1</sup>, S(O)<sub>2</sub>R<sup>n1</sup>, NR<sup>n1</sup>R<sup>n2</sup>, OC(O)NR<sup>n1</sup>R<sup>n2</sup>, NR<sup>n1</sup>C(O)OR<sup>n2</sup>, C(O)NR<sup>n1</sup>R<sup>n2</sup>, and NR<sup>n1</sup>C(O)R<sup>n2</sup>, each of R<sup>n1</sup> and R<sup>n2</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or -Q<sup>7</sup>-T<sup>7</sup> is oxo;

R<sup>8</sup> is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>9</sup> is -Q<sup>4</sup>-T<sup>4</sup>, in which Q<sup>4</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>4</sup> is H, halo, OR<sup>h</sup>, NR<sup>h</sup>R<sup>i</sup>, NR<sup>h</sup>C(O)R<sup>i</sup>, C(O)NR<sup>h</sup>R<sup>i</sup>, C(O)R<sup>h</sup>, C(O)OR<sup>h</sup>, NR<sup>h</sup>C(O)OR<sup>i</sup>, OC(O)NR<sup>h</sup>R<sup>i</sup>, S(O)<sub>2</sub>R<sup>h</sup>, S(O)<sub>2</sub>NR<sup>h</sup>R<sup>i</sup>, or R<sup>S2</sup>, in which each of R<sup>h</sup> and R<sup>i</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and R<sup>S2</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and R<sup>S2</sup> is optionally substituted with one or more -Q<sup>5</sup>-T<sup>5</sup>, wherein each Q<sup>5</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>5</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl, OR<sup>j</sup>, C(O)R<sup>j</sup>, C(O)OR<sup>j</sup>, OC(O)R<sup>j</sup>, S(O)<sub>2</sub>R<sup>j</sup>, NR<sup>j</sup>R<sup>k</sup>, OC(O)NR<sup>j</sup>R<sup>k</sup>, NR<sup>j</sup>C(O)OR<sup>k</sup>, C(O)NR<sup>j</sup>R<sup>k</sup>, and NR<sup>j</sup>C(O)R<sup>k</sup>, each of R<sup>j</sup> and R<sup>k</sup> independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or -Q<sup>5</sup>-T<sup>5</sup> is oxo;

R<sup>10</sup> is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di- alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C(O)NR<sup>j</sup>R<sup>k</sup>, or NR<sup>j</sup>C(O)R<sup>k</sup>;

R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N,

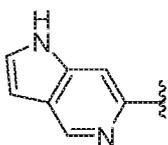
O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

R<sup>13</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S; and

each of R<sup>14</sup> and R<sup>15</sup>, independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

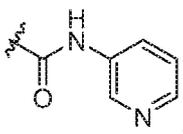
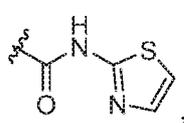
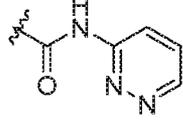
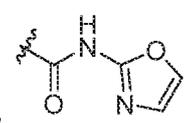
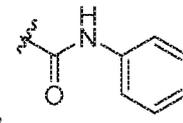
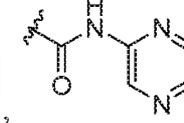
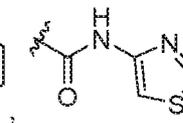
2. The compound of claim 1, being of Formula (I) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

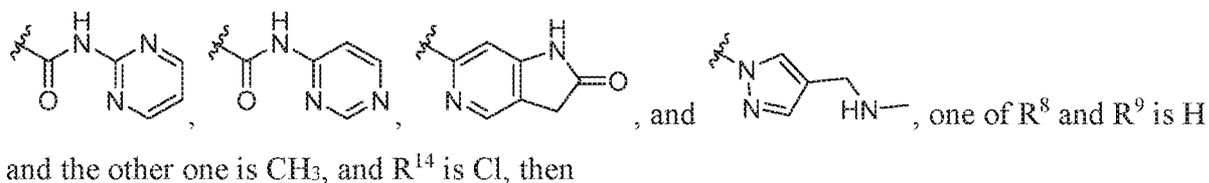
3. The compound of claim 1, wherein when X<sup>1</sup> is N, X<sup>2</sup> is CH, X<sup>3</sup> is N, X<sup>4</sup> is CCH<sub>3</sub>, X<sup>5</sup> is

CH, X<sup>6</sup> is CH, R<sup>1</sup> is H, R<sup>7</sup> is , one of R<sup>8</sup> and R<sup>9</sup> is H and the other one is CH<sub>3</sub>, and R<sup>14</sup> is OCH<sub>3</sub>, then

R<sup>15</sup> is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

4. The compound of claim 1, wherein when X<sup>1</sup> is N, X<sup>2</sup> is CH, X<sup>3</sup> is N, X<sup>4</sup> is CCH<sub>3</sub>, X<sup>5</sup> is

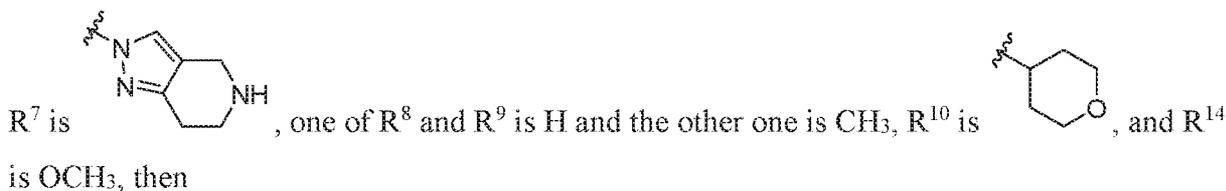
CH, X<sup>6</sup> is CH, R<sup>1</sup> is H, R<sup>7</sup> is selected from the group consisting of , , , , , , ,



R<sup>15</sup> is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

5. The compound of any one of the preceding claims, being of Formula (II) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

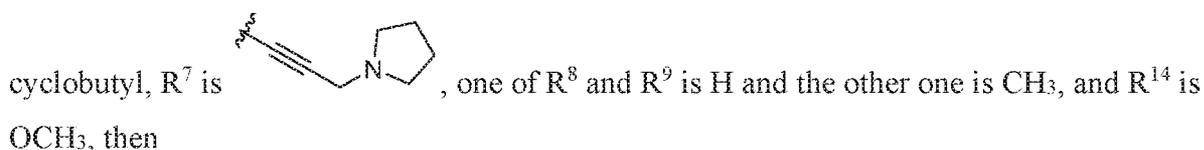
6. The compound of any one of the preceding claims, wherein when X<sup>5</sup> is CH, X<sup>7</sup> is CH,



R<sup>15</sup> is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

7. The compound of any one of the preceding claims, being of Formula (III) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

8. The compound of any one of the preceding claims, wherein when X<sup>5</sup> is CH, X<sup>8</sup> is CR<sup>11</sup>R<sup>12</sup>, in which R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a



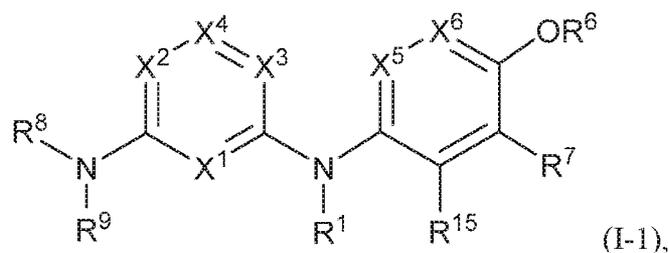
R<sup>15</sup> is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl

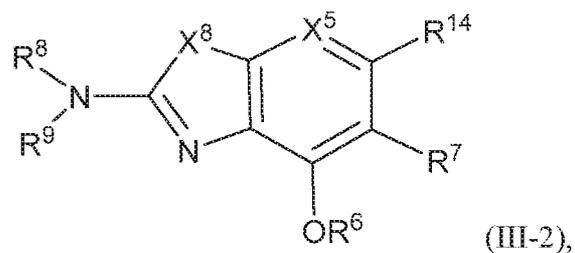
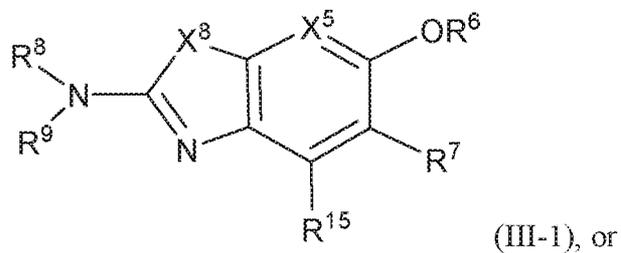
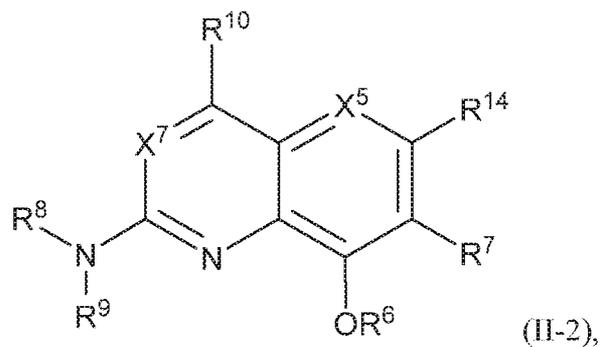
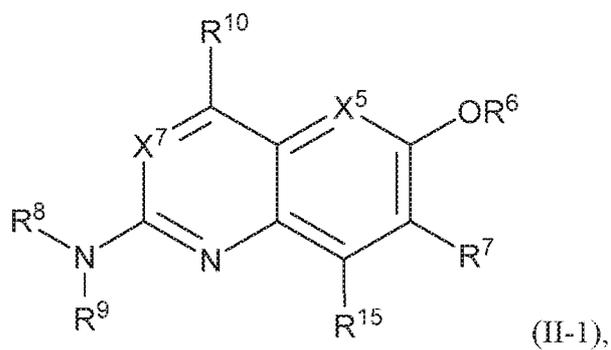
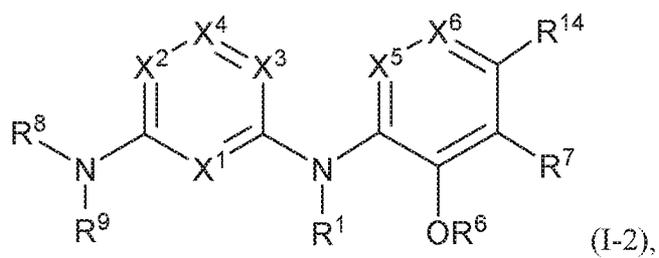
optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.

9. The compound of any one of the preceding claims, wherein at least one of R<sup>14</sup> and R<sup>15</sup> is halo.
10. The compound of any one of the preceding claims, wherein at least one of R<sup>14</sup> and R<sup>15</sup> is F.
11. The compound of any one of the preceding claims, wherein at least one of R<sup>14</sup> and R<sup>15</sup> is Cl.
12. The compound of any one of the preceding claims, wherein at least one of R<sup>14</sup> and R<sup>15</sup> is Br.
13. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is halo.
14. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is F.
15. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is Cl.
16. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is Br.
17. The compound of any one of the preceding claims, wherein R<sup>14</sup> is halo.
18. The compound of any one of the preceding claims, wherein R<sup>14</sup> is F.
19. The compound of any one of the preceding claims, wherein R<sup>14</sup> is Cl.
20. The compound of any one of the preceding claims, wherein R<sup>14</sup> is Br.
21. The compound of any one of the preceding claims, wherein R<sup>15</sup> is halo.

22. The compound of any one of the preceding claims, wherein R<sup>15</sup> is F.
23. The compound of any one of the preceding claims, wherein R<sup>15</sup> is Cl.
24. The compound of any one of the preceding claims, wherein R<sup>15</sup> is Br.
25. The compound of any one of the preceding claims, wherein both of R<sup>14</sup> and R<sup>15</sup> are halo.
26. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>.
27. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano.
28. The compound of any one of the preceding claims, wherein one of R<sup>14</sup> and R<sup>15</sup> is halo, and the other one is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl.
29. The compound of any one of the preceding claims, wherein R<sup>14</sup> is halo, and R<sup>15</sup> is H, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or -OR<sup>6</sup>, in which R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl.
30. The compound of any one of the preceding claims, wherein R<sup>14</sup> is halo, and R<sup>15</sup> is H.
31. The compound of any one of the preceding claims, wherein R<sup>14</sup> is halo, and R<sup>15</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl.
32. The compound of any one of the preceding claims, wherein R<sup>14</sup> is halo, and R<sup>15</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl.

33. The compound of any one of the preceding claims, wherein  $R^{14}$  is halo, and  $R^{15}$  is  $-OR^6$ , in which  $R^6$  is  $C_1-C_6$  alkyl.
34. The compound of any one of the preceding claims, wherein  $R^{15}$  is halo, and  $R^{14}$  is H,  $C_1-C_6$  alkyl,  $C_3-C_8$  cycloalkyl, or  $-OR^6$ , in which  $R^6$  is  $C_1-C_6$  alkyl.
35. The compound of any one of the preceding claims, wherein  $R^{15}$  is halo, and  $R^{14}$  is H.
36. The compound of any one of the preceding claims, wherein  $R^{15}$  is halo, and  $R^{14}$  is  $C_1-C_6$  alkyl.
37. The compound of any one of the preceding claims, wherein  $R^{15}$  is halo, and  $R^{14}$  is  $C_3-C_8$  cycloalkyl.
38. The compound of any one of the preceding claims, wherein  $R^{15}$  is halo, and  $R^{14}$  is  $-OR^6$ , in which  $R^6$  is  $C_1-C_6$  alkyl.
39. The compound of any one of the preceding claims, wherein one of  $R^{14}$  and  $R^{15}$  is halo, and the other one is H,  $-CH_3$ , cyclopropyl, or  $-OCH_3$ .
40. The compound of any one of the preceding claims, being of Formula (I-1), (I-2), (II-1), (II-2), (III-1), or (III-2):





or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer, wherein

X<sup>1</sup> is N or CR<sup>2</sup>;

X<sup>2</sup> is N or CR<sup>3</sup>;

$X^3$  is N or  $CR^4$ ;

$X^4$  is N or  $CR^5$ ;

each of  $X^5$ ,  $X^6$  and  $X^7$  is independently N or CH;

$R^1$  is H or C<sub>1</sub>-C<sub>4</sub> alkyl;

each of  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^5$ , independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>6</sub>-C<sub>10</sub> aryl, OH,  $NR^aR^b$ ,  $C(O)NR^aR^b$ ,  $NR^aC(O)R^b$ ,  $C(O)OR^a$ ,  $OC(O)R^a$ ,  $OC(O)NR^aR^b$ ,  $NR^aC(O)OR^b$ , C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, wherein the C<sub>6</sub>-C<sub>10</sub> aryl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, 4- to 7- membered heterocycloalkyl, 5- to 6- membered heteroaryl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, and C<sub>2</sub>-C<sub>6</sub> alkynyl, are each optionally substituted with one or more of halo, OR<sup>a</sup>, or  $NR^aR^b$ , in which each of R<sup>a</sup> and R<sup>b</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^6$  is  $-Q^1-T^1$ , in which  $Q^1$  is a bond, or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, oxo, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^1$  is H, halo, cyano, or  $R^{S1}$ , in which  $R^{S1}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6- membered heteroaryl and  $R^{S1}$  is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo,  $-C(O)R^c$ ,  $-C(O)OR^c$ ,  $-SO_2R^c$ ,  $-SO_2N(R^c)_2$ ,  $-NR^cC(O)R^d$ ,  $-C(O)NR^cR^d$ ,  $-NR^cC(O)OR^d$ ,  $-OC(O)NR^cR^d$ ,  $NR^cR^d$ , or C<sub>1</sub>-C<sub>6</sub> alkoxy, in which each of R<sup>c</sup> and R<sup>d</sup> independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^7$  is  $-Q^2-T^2$ , in which  $Q^2$  is a bond, a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di- alkylamino, and  $T^2$  is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>,  $C(O)R^f$ ,  $NR^eR^f$ ,  $C(O)NR^eR^f$ ,  $NR^eC(O)R^f$ , C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10- membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12- membered heterocycloalkyl is optionally substituted with one or more  $-Q^3-T^3$ , wherein each  $Q^3$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^3$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7- membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6- membered heteroaryl, OR<sup>e</sup>, OR<sup>f</sup>,  $C(O)R^f$ ,  $C(O)OR^f$ ,  $OC(O)R^f$ ,  $S(O)_2R^f$ ,  $NR^fR^g$ ,  $OC(O)NR^fR^g$ ,  $NR^fC(O)OR^g$ ,  $C(O)NR^fR^g$ , and  $NR^fC(O)R^g$ ; or  $-Q^3-T^3$  is oxo;

each  $R^e$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy;

each of  $R^f$  and  $R^g$ , independently, is  $-Q^6-T^6$ , in which  $Q^6$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^6$  is H, halo,  $OR^{m1}$ ,  $NR^{m1}R^{m2}$ ,  $NR^{m1}C(O)R^{m2}$ ,  $C(O)NR^{m1}R^{m2}$ ,  $C(O)R^{m1}$ ,  $C(O)OR^{m1}$ ,  $NR^{m1}C(O)OR^{m2}$ ,  $OC(O)NR^{m1}R^{m2}$ ,  $S(O)_2R^{m1}$ ,  $S(O)_2NR^{m1}R^{m2}$ , or  $R^{S3}$ , in which each of  $R^{m1}$  and  $R^{m2}$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and  $R^{S3}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $R^{S3}$  is optionally substituted with one or more  $-Q^7-T^7$ , wherein each  $Q^7$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^7$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^{n1}$ ,  $C(O)R^{n1}$ ,  $C(O)OR^{n1}$ ,  $OC(O)R^{n1}$ ,  $S(O)_2R^{n1}$ ,  $NR^{n1}R^{n2}$ ,  $OC(O)NR^{n1}R^{n2}$ ,  $NR^{n1}C(O)OR^{n2}$ ,  $C(O)NR^{n1}R^{n2}$ , and  $NR^{n1}C(O)R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^7-T^7$  is oxo;  $R^8$  is H or C<sub>1</sub>-C<sub>6</sub> alkyl;

$R^9$  is  $-Q^4-T^4$ , in which  $Q^4$  is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and  $T^4$  is H, halo,  $OR^h$ ,  $NR^hR^i$ ,  $NR^hC(O)R^i$ ,  $C(O)NR^hR^i$ ,  $C(O)R^h$ ,  $C(O)OR^h$ ,  $NR^hC(O)OR^i$ ,  $OC(O)NR^hR^i$ ,  $S(O)_2R^h$ ,  $S(O)_2NR^hR^i$ , or  $R^{S2}$ , in which each of  $R^h$  and  $R^i$  independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, and  $R^{S2}$  is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- to 10-membered heteroaryl, and  $R^{S2}$  is optionally substituted with one or more  $-Q^5-T^5$ , wherein each  $Q^5$  independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each  $T^5$  independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, C<sub>6</sub>-C<sub>10</sub> aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^j$ ,  $C(O)R^j$ ,  $C(O)OR^j$ ,  $OC(O)R^j$ ,  $S(O)_2R^j$ ,  $NR^jR^k$ ,  $OC(O)NR^jR^k$ ,  $NR^jC(O)OR^k$ ,  $C(O)NR^jR^k$ , and  $NR^jC(O)R^k$ , each of  $R^j$  and  $R^k$  independently being H or C<sub>1</sub>-C<sub>6</sub> alkyl; or  $-Q^5-T^5$  is oxo;

$R^{10}$  is halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein each

of the C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>3</sub>-C<sub>8</sub> cycloalkyl, and 4- to 12-membered heterocycloalkyl is optionally substituted with one or more halo, cyano, hydroxyl, oxo, amino, mono- or di- alkylamino, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, C<sub>1</sub>-C<sub>6</sub> alkoxy, C(O)NR<sup>j</sup>R<sup>k</sup>, or NR<sup>l</sup>C(O)R<sup>k</sup>; and

R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl, hydroxyl, oxo, amino, mono- or di- alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy

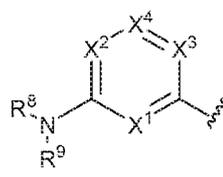
each of R<sup>14</sup> and R<sup>15</sup>, independently, is H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkenyl optionally substituted with one or more of halo or cyano, C<sub>2</sub>-C<sub>6</sub> alkynyl optionally substituted with one or more of halo or cyano, or C<sub>3</sub>-C<sub>8</sub> cycloalkyl optionally substituted with one or more of halo or cyano.

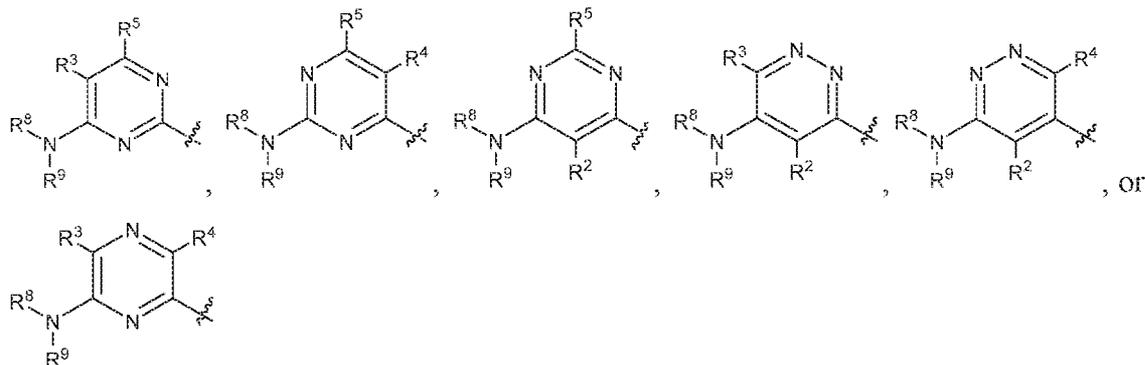
41. The compound of claim 40, wherein the compound is of Formula (I-1) or (I-2), or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

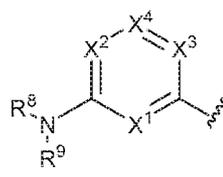
42. The compound of any one of the preceding claims, wherein at least one of X<sup>1</sup>, X<sup>2</sup>, X<sup>3</sup> and X<sup>4</sup> is N.

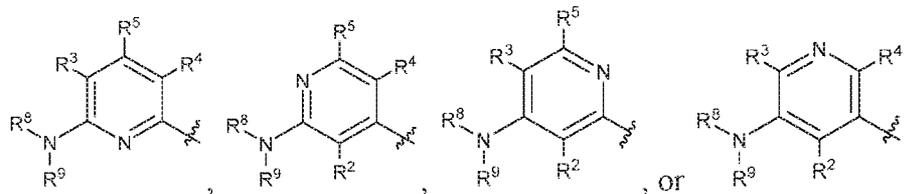
43. The compound of any one of the preceding claims, wherein X<sup>1</sup> and X<sup>3</sup> are N.

44. The compound of any one of the preceding claims, wherein X<sup>1</sup> and X<sup>3</sup> are N, X<sup>2</sup> is CR<sup>3</sup> and X<sup>4</sup> is CR<sup>5</sup>.

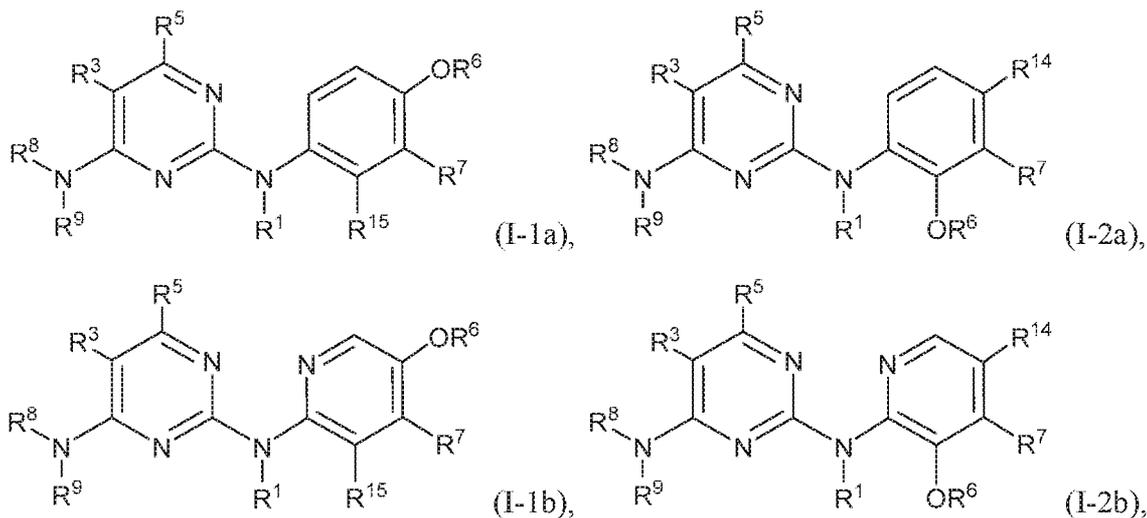
45. The compound of any one of the preceding claims, wherein  is

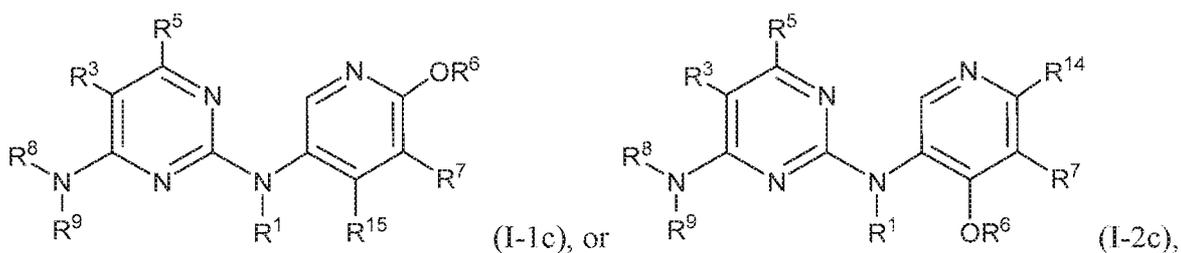


46. The compound of any one of the preceding claims, wherein  is



47. The compound of any one of the preceding claims, being of Formula (I-1a), (I-2a), (I-1b), (I-2b), (I-1c), or (I-2c):





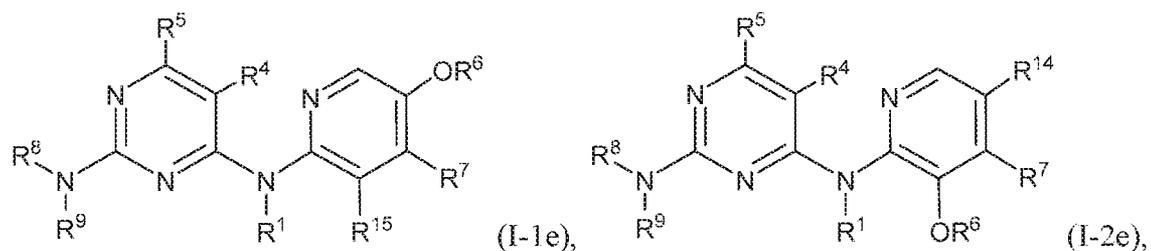
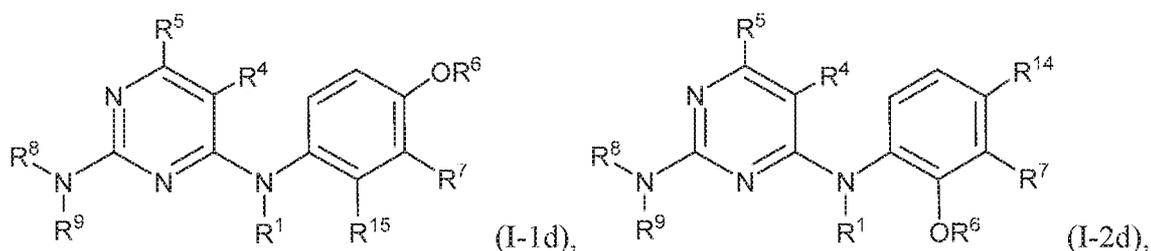
or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

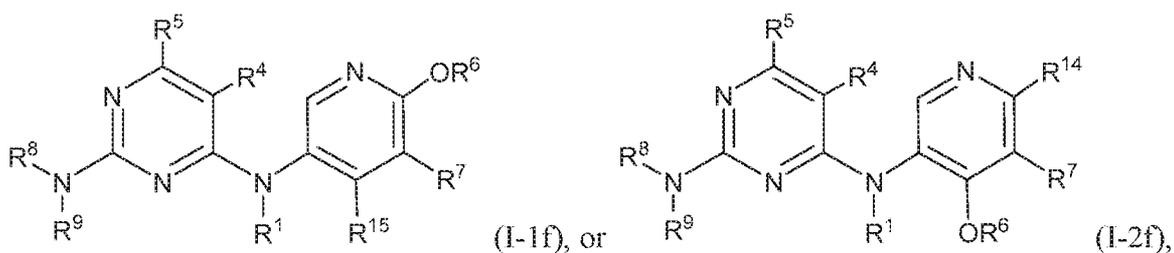
48. The compound of any one of the preceding claims, wherein at most one of  $R^3$  and  $R^5$  is not H.

49. The compound of any one of the preceding claims, wherein at least one of  $R^3$  and  $R^5$  is not H.

50. The compound of any one of the preceding claims, wherein  $R^3$  is H or halo.

51. The compound of any one of the preceding claims, being of Formula (I-1d), (I-2d), (I-1e), (I-2e), (I-1f), or (I-2f) :





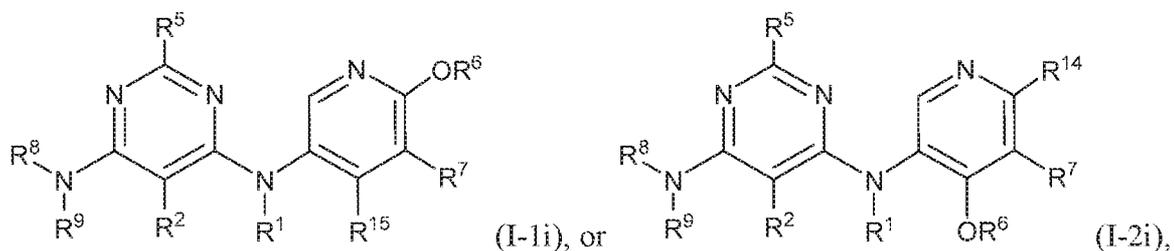
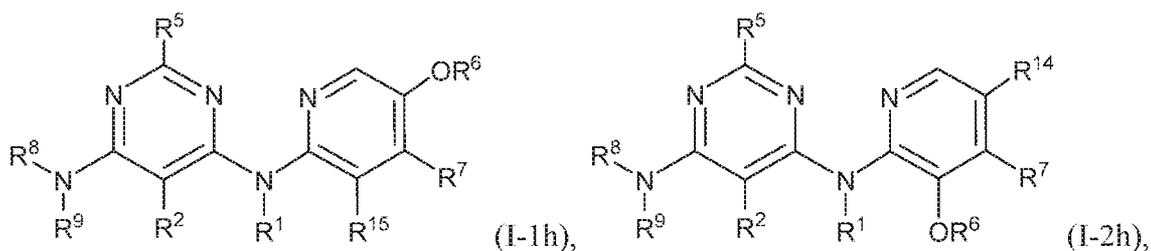
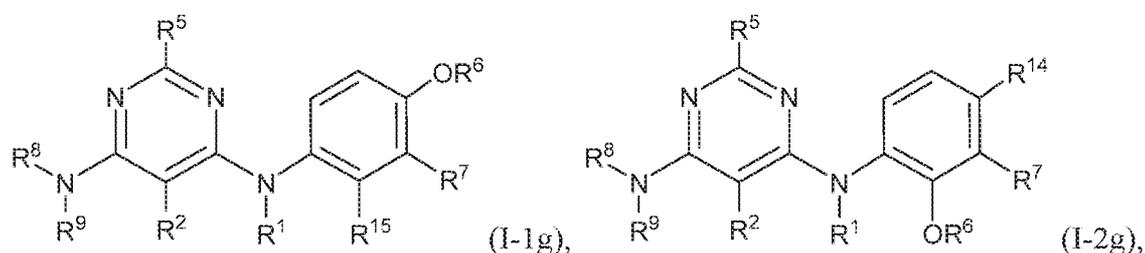
or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

52. The compound of any one of the preceding claims, wherein at most one of  $R^4$  and  $R^5$  is not H.

53. The compound of any one of the preceding claims, wherein at least one of  $R^4$  and  $R^5$  is not H.

54. The compound of any one of the preceding claims, wherein  $R^4$  is H,  $C_1$ - $C_6$  alkyl, or halo.

55. The compound of any one of the preceding claims, being of Formula (I-1g), (I-2g), (I-1h), (I-2h), (I-1i), or (I-2i):

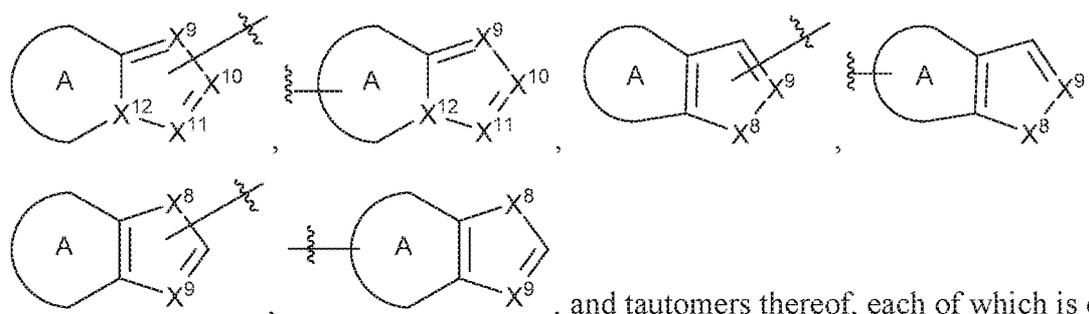


or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.

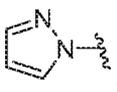
56. The compound of any one of the preceding claims, wherein at most one of  $R^2$  and  $R^5$  is not H.
57. The compound of any one of the preceding claims, wherein at least one of  $R^2$  and  $R^5$  is not H.
58. The compound of any one of the preceding claims, wherein  $R^2$  is H, C<sub>1</sub>-C<sub>6</sub> alkyl, or halo.
59. The compound of any one of the preceding claims, wherein  $R^5$  is C<sub>1</sub>-C<sub>6</sub> alkyl.
60. The compound of claim 40, wherein the compound is of Formula (II-1) or (II-2), or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.
61. The compound of any one of the preceding claims, wherein each of  $X^5$ ,  $X^6$  and  $X^7$  is CH.
62. The compound of any one of the preceding claims, wherein at least one of  $X^5$ ,  $X^6$  and  $X^7$  is N.
63. The compound of any one of the preceding claims, wherein at most one of  $X^5$ ,  $X^6$  and  $X^7$  is N.
64. The compound of any one of the preceding claims, wherein  $R^{10}$  is optionally substituted 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S.
65. The compound of any one of the preceding claims, wherein  $R^{10}$  is connected to the bicyclic group of Formula (II-1) or (II-2) via a carbon-carbon bond.
66. The compound of any one of the preceding claims, wherein  $R^{10}$  is connected to the bicyclic group of Formula (II-1) or (II-2) via a carbon-nitrogen bond.

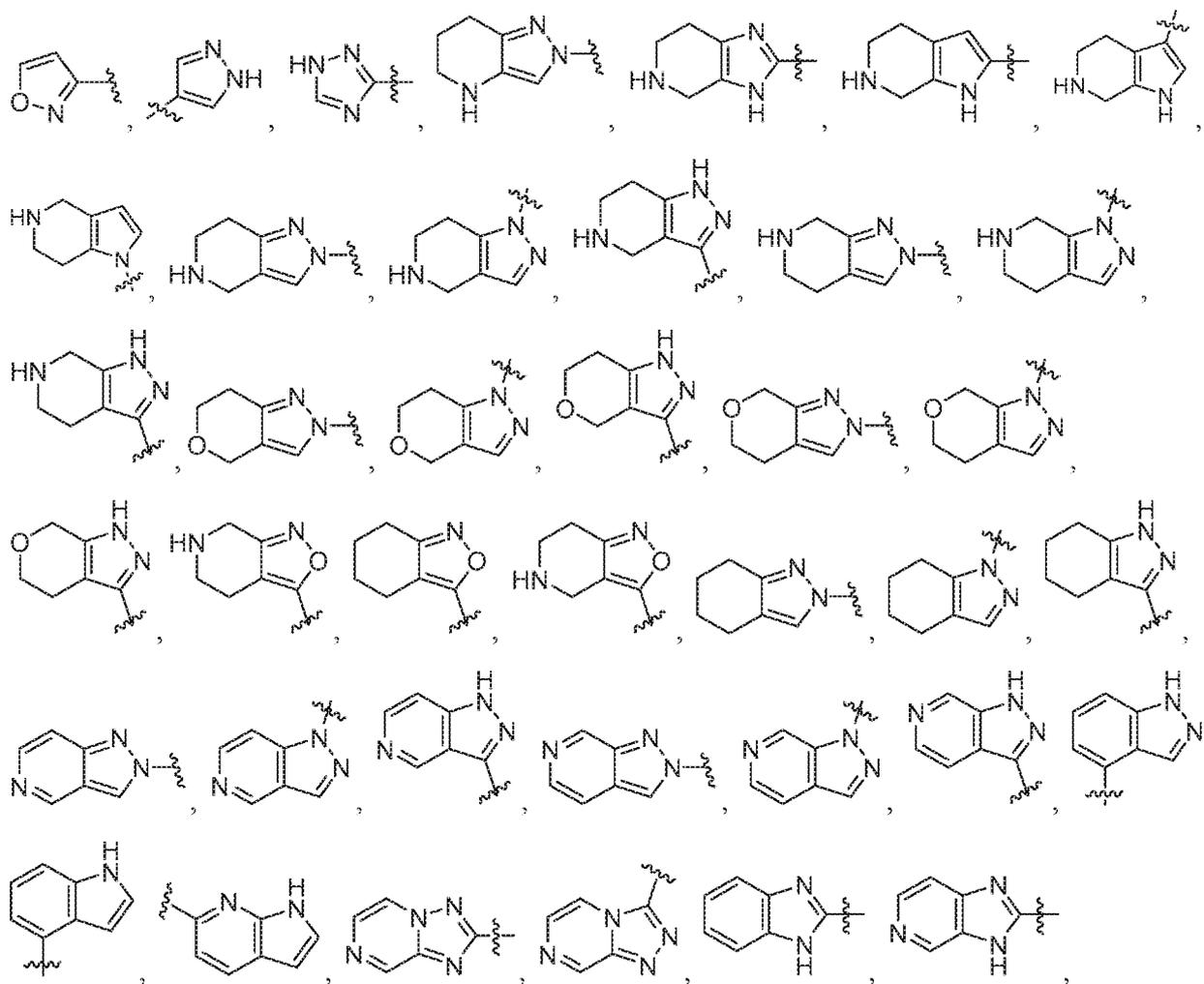
67. The compound of claim 40, wherein the compound is of Formula (III-1) or (III-2), or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or the tautomer.
68. The compound of any one of the preceding claims, wherein R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 4- to 7-membered heterocycloalkyl is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy.
69. The compound of any one of the preceding claims, wherein R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form a C<sub>4</sub>-C<sub>8</sub> cycloalkyl which is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy.
70. The compound of any one of the preceding claims, wherein each of X<sup>5</sup> and X<sup>6</sup> is CH.
71. The compound of any one of the preceding claims, wherein each of X<sup>5</sup> and X<sup>6</sup> is N.
72. The compound of any one of the preceding claims, wherein one of X<sup>5</sup> and X<sup>6</sup> is CH and the other is CH.
73. The compound of any one of the preceding claims, wherein R<sup>6</sup> is -Q<sup>1</sup>-T<sup>1</sup>, in which Q<sup>1</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene linker optionally substituted with one or more of halo, and T<sup>1</sup> is H, halo, cyano, or R<sup>S1</sup>, in which R<sup>S1</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl, phenyl, 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, or a 5- or 6-membered heteroaryl and R<sup>S1</sup> is optionally substituted with one or more of halo, C<sub>1</sub>-C<sub>6</sub> alkyl, hydroxyl, oxo, NR<sup>c</sup>R<sup>d</sup>, or C<sub>1</sub>-C<sub>6</sub> alkoxy.
74. The compound of any one of the preceding claims, wherein R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy.
75. The compound of any one of the preceding claims, wherein R<sup>6</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl.

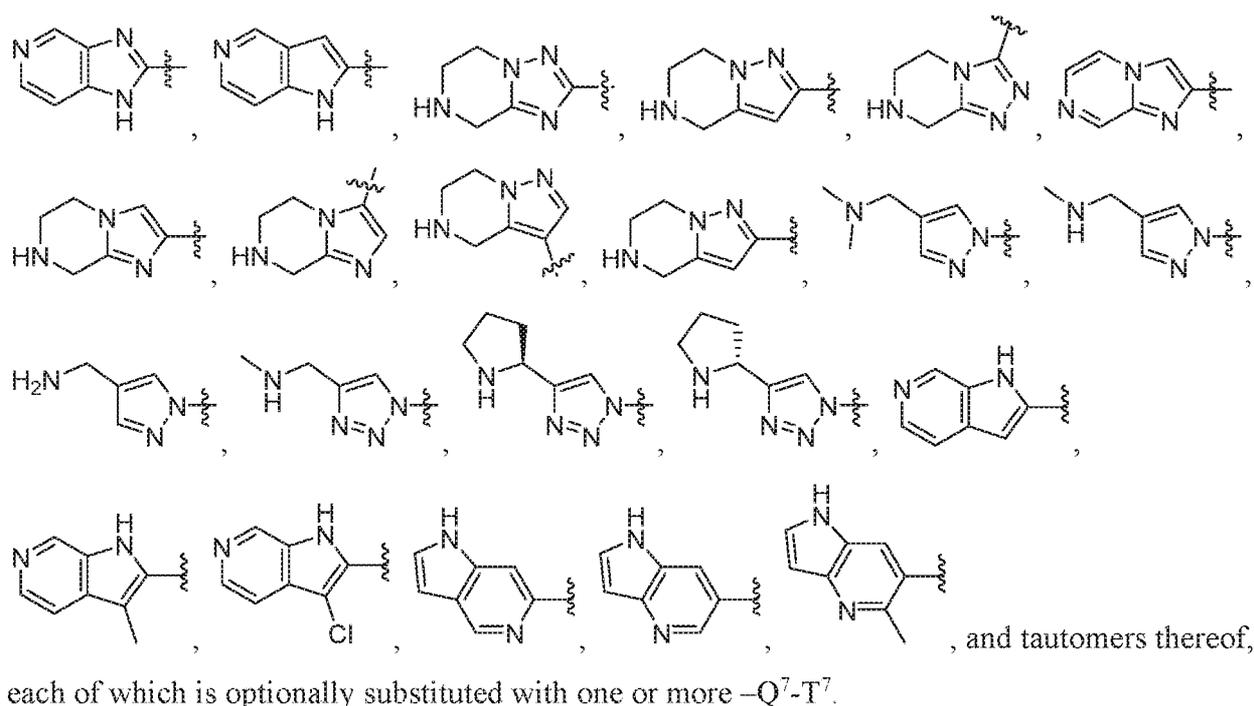




, and tautomers thereof, each of which is optionally substituted with one or more -Q<sup>7</sup>-T<sup>7</sup>, wherein X<sup>8</sup> is NH, O, or S, each of X<sup>9</sup>, X<sup>10</sup>, X<sup>11</sup>, and X<sup>12</sup> is independently CH or N, and at least one of X<sup>9</sup>, X<sup>10</sup>, X<sup>11</sup>, and X<sup>12</sup> is N, and ring A is a C<sub>5</sub>-C<sub>8</sub> cycloalkyl, phenyl, 6-membered heteroaryl, or 4- to 8-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S.

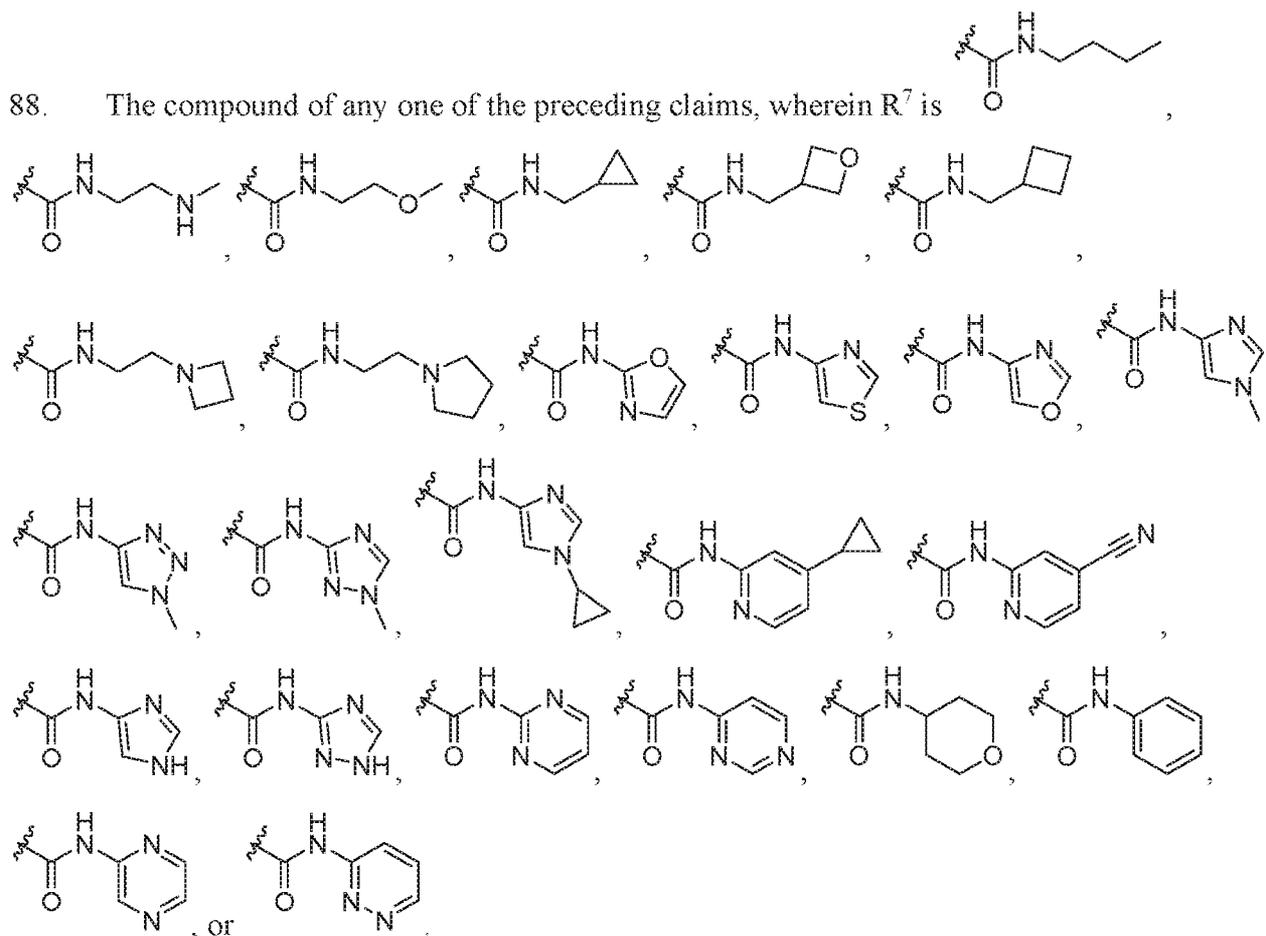
85. The compound of any one of the preceding claims, wherein T<sup>6</sup> is selected from 





86. The compound of any one of the preceding claims, wherein each  $Q^7$  independently is a bond or  $C_1-C_3$  alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and each  $T^7$  independently is selected the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl,  $C_3-C_8$  cycloalkyl,  $C_6-C_{10}$  aryl, 4- to 7-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, 5- to 6-membered heteroaryl,  $OR^{n1}$ ,  $C(O)R^{n1}$ ,  $C(O)OR^{n1}$ ,  $OC(O)R^{n1}$ ,  $S(O)_2R^{n1}$ ,  $NR^{n1}R^{n2}$ ,  $OC(O)NR^{n1}R^{n2}$ ,  $NR^{n1}C(O)OR^{n2}$ ,  $C(O)NR^{n1}R^{n2}$ , and  $NR^{n1}C(O)R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or  $C_1-C_6$  alkyl; or  $-Q^7-T^7$  is oxo.

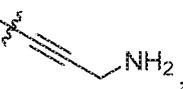
87. The compound of any one of the preceding claims, wherein each  $Q^7$  independently is a bond or  $C_1-C_3$  alkylene linker each optionally substituted with one or more of halo, cyano, hydroxyl, or  $C_1-C_6$  alkoxy, and each  $T^7$  independently is selected from the group consisting of H, halo, cyano,  $C_1-C_6$  alkyl, and  $NR^{n1}R^{n2}$ , each of  $R^{n1}$  and  $R^{n2}$  independently being H or  $C_1-C_6$  alkyl.

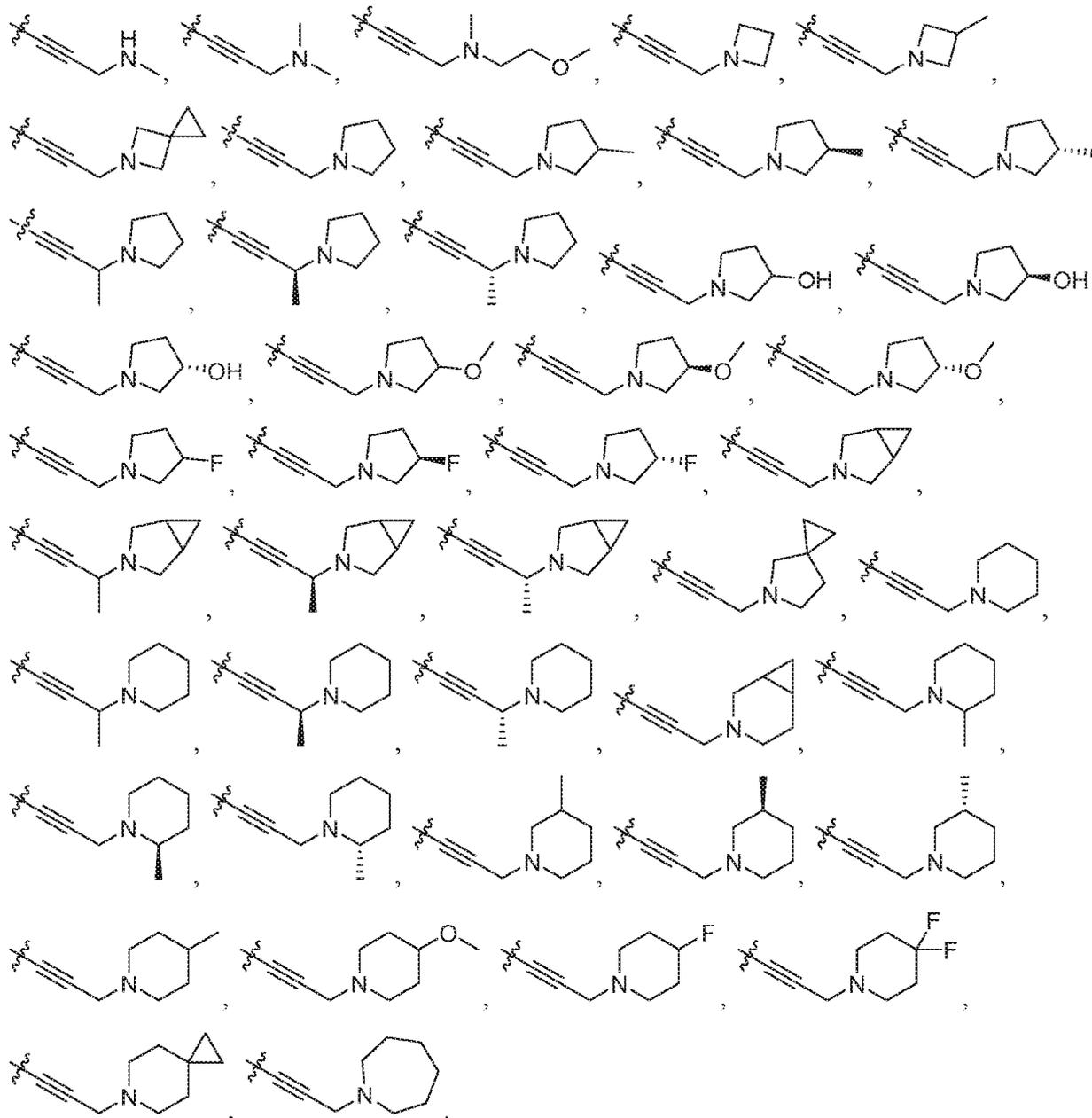


89. The compound of any one of the preceding claims, wherein R<sup>7</sup> is -Q<sup>2</sup>-T<sup>2</sup>, in which Q<sup>2</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene, C<sub>2</sub>-C<sub>6</sub> alkenylene, or C<sub>2</sub>-C<sub>6</sub> alkynylene linker optionally substituted with one or more of halo, cyano, hydroxyl, amino, mono- or di-alkylamino, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and each T<sup>2</sup> independently is H, OR<sup>e</sup>, OR<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl.

90. The compound of any one of the preceding claims, wherein R<sup>7</sup> is , wherein T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>e</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, hydroxyl, cyano, C<sub>1</sub>-C<sub>6</sub> haloalkyl, -SO<sub>2</sub>R<sup>c</sup>, C<sub>1</sub>-C<sub>6</sub> alkoxy or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of NR<sup>c</sup>R<sup>d</sup>.

91. The compound of any one of the preceding claims, wherein R<sup>7</sup> is , wherein T<sup>2</sup> is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl optionally substituted with one or more of halo, hydroxyl, C<sub>1</sub>-C<sub>6</sub> alkoxy or C<sub>1</sub>-C<sub>6</sub> alkyl.

92. The compound of any one of the preceding claims, wherein R<sup>7</sup> is ,



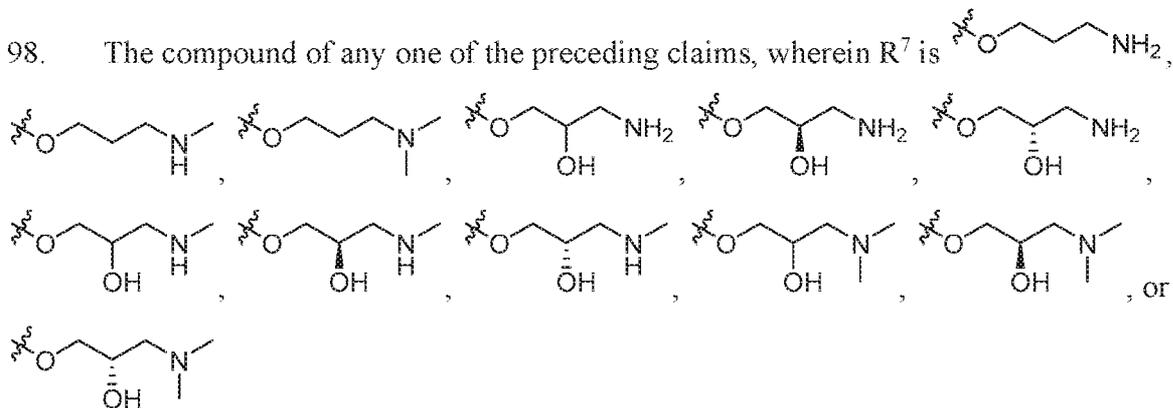
93. The compound of any one of the preceding claims, wherein R<sup>7</sup> is OR<sup>c</sup>.

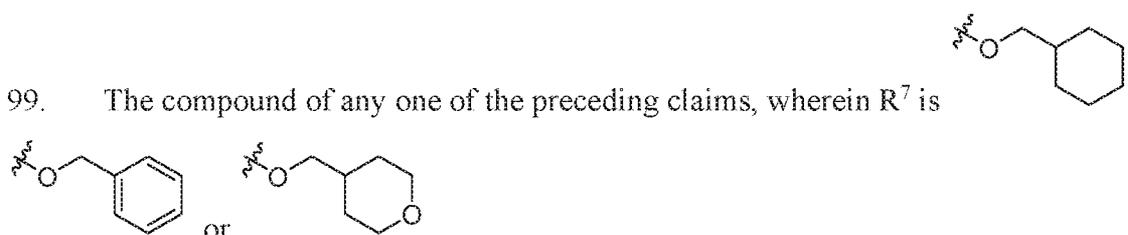
94. The compound of any one of the preceding claims, wherein R<sup>7</sup> is OR<sup>f</sup>.

95. The compound of any one of the preceding claims, wherein R<sup>7</sup> is -CH<sub>2</sub>-T<sup>2</sup>, wherein T<sup>2</sup> is H, halo, cyano, OR<sup>e</sup>, OR<sup>f</sup>, C(O)R<sup>f</sup>, NR<sup>7</sup>R<sup>f</sup>, C(O)NR<sup>e</sup>R<sup>f</sup>, NR<sup>e</sup>C(O)R<sup>f</sup>, C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl, or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, and wherein the C<sub>6</sub>-C<sub>10</sub> aryl, 5- to 10-membered heteroaryl, C<sub>3</sub>-C<sub>12</sub> cycloalkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of halo, hydroxyl, cyano, C<sub>1</sub>-C<sub>6</sub> haloalkyl, -SO<sub>2</sub>R<sup>e</sup>, C<sub>1</sub>-C<sub>6</sub> alkoxy or C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more of NR<sup>e</sup>R<sup>d</sup>.

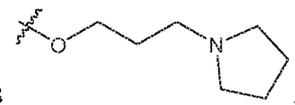
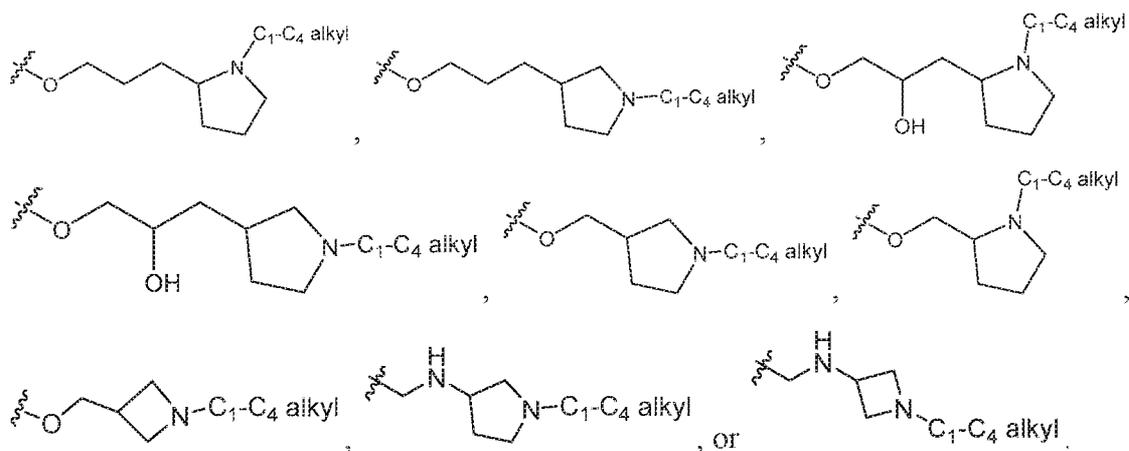
96. The compound of any one of the preceding claims, wherein R<sup>7</sup> is -CH<sub>2</sub>-OR<sub>8</sub>.

97. The compound of any one of the preceding claims, wherein R<sup>7</sup> is -CH<sub>2</sub>-NR<sub>7</sub>R<sub>8</sub>.

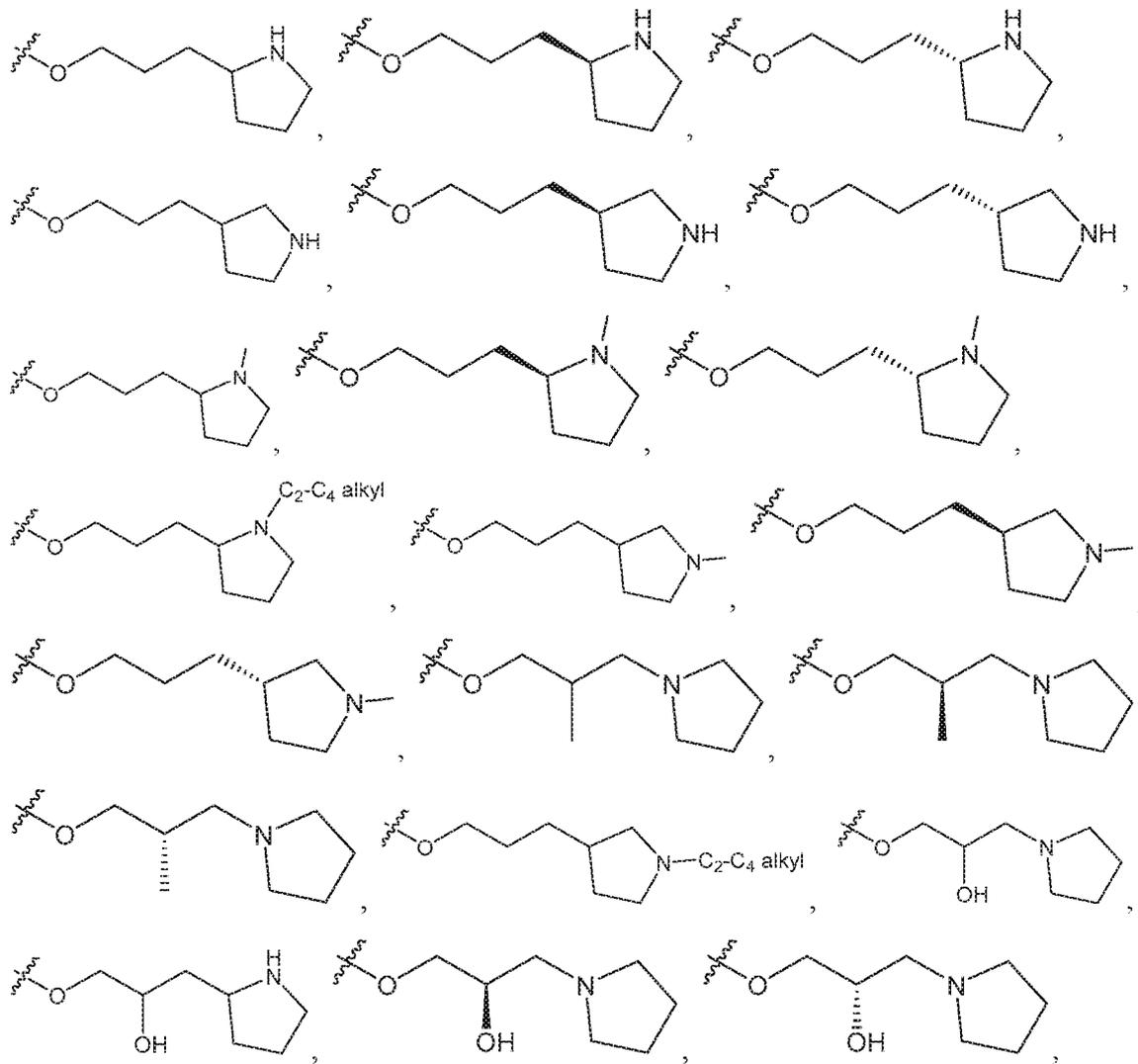


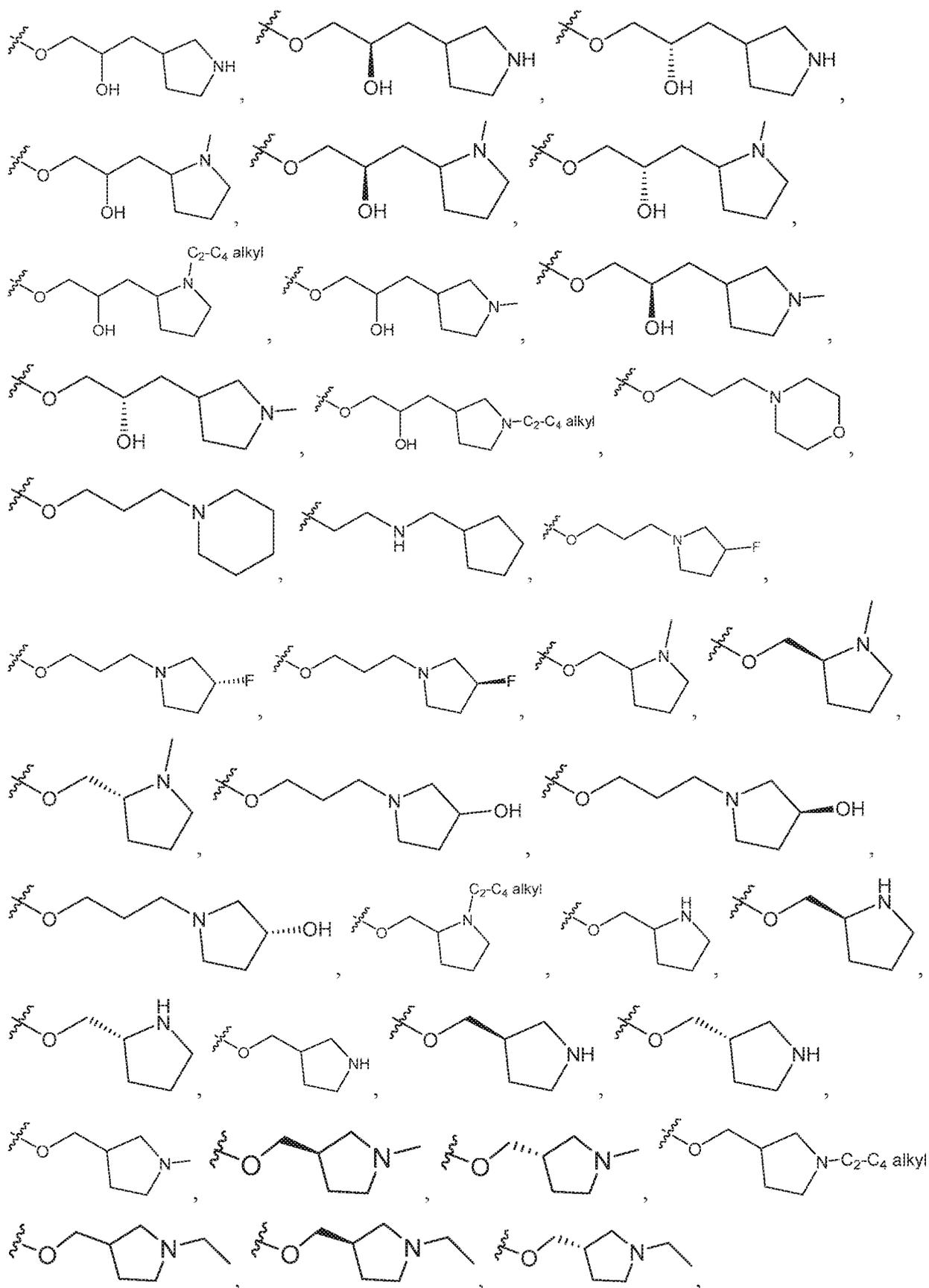
99. The compound of any one of the preceding claims, wherein R<sup>7</sup> is 

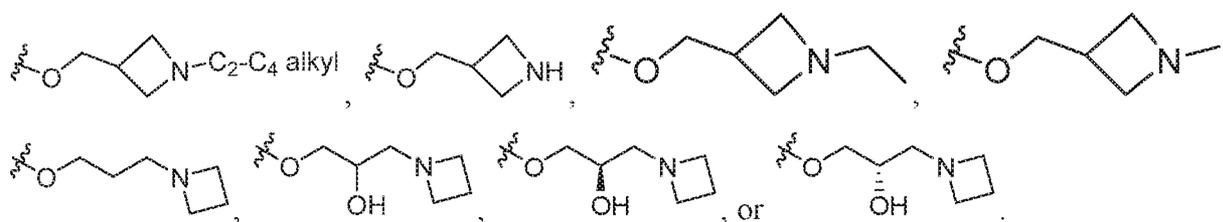
100. The compound of any one of the preceding claims, wherein R<sup>7</sup> is



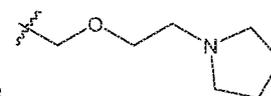
101. The compound of any one of the preceding claims, wherein R<sup>7</sup> is



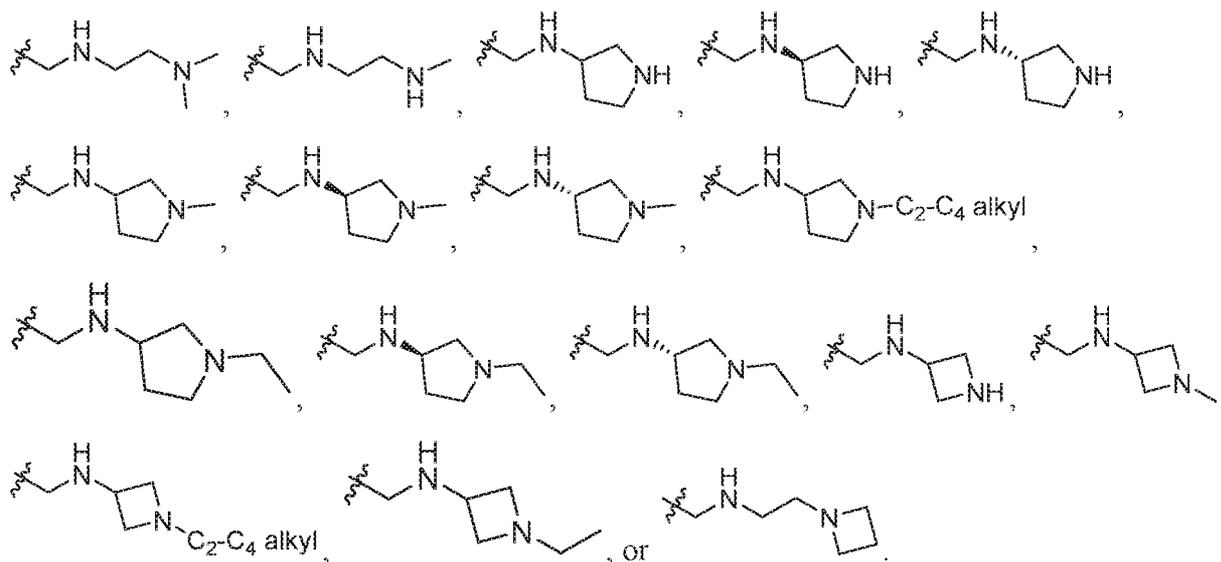
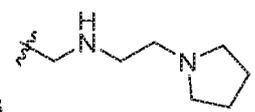




102. The compound of any one of the preceding claims, wherein R<sup>7</sup> is



103. The compound of any one of the preceding claims, wherein R<sup>7</sup> is



104. The compound of any one of the preceding claims, wherein at least one of R<sup>8</sup> and R<sup>9</sup> is H.

105. The compound of any one of the preceding claims, wherein each of R<sup>8</sup> and R<sup>9</sup> is H.

106. The compound of any one of the preceding claims, wherein R<sup>8</sup> is H.

107. The compound of any one of the preceding claims, wherein R<sup>9</sup> is -Q<sup>4</sup>-T<sup>4</sup>, in which Q<sup>4</sup> is a bond or C<sub>1</sub>-C<sub>6</sub> alkylene linker optionally substituted with one or more of halo, cyano, hydroxyl, or C<sub>1</sub>-C<sub>6</sub> alkoxy, and T<sup>4</sup> is H, halo, OR<sup>h</sup>, NR<sup>h</sup>R<sup>i</sup>, NR<sup>h</sup>C(O)R<sup>i</sup>, C(O)NR<sup>h</sup>R<sup>i</sup>, C(O)R<sup>h</sup>, C(O)OR<sup>h</sup>, or R<sup>S2</sup>,

in which R<sup>S2</sup> is C<sub>3</sub>-C<sub>8</sub> cycloalkyl or 4- to 7-membered heterocycloalkyl, and R<sup>S2</sup> is optionally substituted with one or more -Q<sup>5</sup>-T<sup>5</sup>.

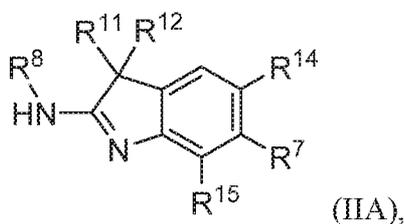
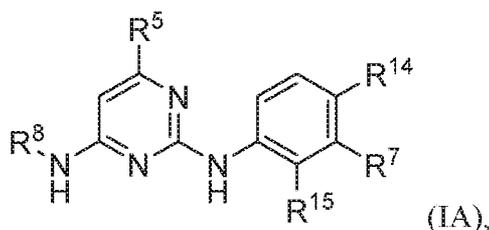
108. The compound of any one of the preceding claims, wherein each Q<sup>5</sup> independently is a bond or C<sub>1</sub>-C<sub>3</sub> alkylene linker.

109. The compound of any one of the preceding claims, wherein each T<sup>5</sup> independently is selected from the group consisting of H, halo, cyano, C<sub>1</sub>-C<sub>6</sub> alkyl, OR<sup>j</sup>, C(O)R<sup>j</sup>, C(O)OR<sup>j</sup>, NR<sup>j</sup>R<sup>k</sup>, C(O)NR<sup>j</sup>R<sup>k</sup>, and NR<sup>j</sup>C(O)R<sup>k</sup>.

110. The compound of any one of the preceding claims, wherein R<sup>9</sup> is C<sub>1</sub>-C<sub>3</sub> alkyl.

111. The compound of any one of the preceding claims, wherein R<sup>14</sup> is H, halo, or C<sub>1</sub>-C<sub>6</sub> alkyl.

112. The compound of any one of the preceding claims, being of Formula (IA) or (IIA):



a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer, wherein:

R<sup>8</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>5</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>11</sup> and R<sup>12</sup> each independently is C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form C<sub>3</sub>-C<sub>12</sub> cycloalkyl;

R<sup>14</sup> and R<sup>15</sup> each independently is H, halogen, or C<sub>1</sub>-C<sub>6</sub> alkoxyl; and

R<sup>7</sup> is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl or 4- to 12-

membered heterocycloalkyl is optionally substituted with one or more of  $R^{7S}$ ; each  $R^{7S}$  independently is oxo, C<sub>1</sub>-C<sub>6</sub> alkyl, or 4- to 12-membered heterocycloalkyl, wherein the C<sub>1</sub>-C<sub>6</sub> alkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of oxo, C<sub>1</sub>-C<sub>6</sub> alkyl, or NR<sup>7Sa</sup>R<sup>7Sb</sup>; R<sup>7Sa</sup> and R<sup>7Sb</sup> each independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>7Sa</sup> and R<sup>7Sb</sup> together with the nitrogen atom to which they are attached form C<sub>3</sub>-C<sub>6</sub> heterocycloalkyl.

113. The compound of any one of the preceding claims, wherein:

R<sup>8</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>5</sup> is C<sub>1</sub>-C<sub>6</sub> alkyl;

R<sup>11</sup> and R<sup>12</sup> each independently is C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form C<sub>3</sub>-C<sub>12</sub> cycloalkyl;

R<sup>14</sup> and R<sup>15</sup> each independently is H, halogen, or C<sub>1</sub>-C<sub>6</sub> alkoxyl; and

R<sup>7</sup> is 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of  $R^{7S}$ ; each  $R^{7S}$  independently is C<sub>1</sub>-C<sub>6</sub> alkyl or 4- to 12-membered heterocycloalkyl, wherein the C<sub>1</sub>-C<sub>6</sub> alkyl or 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of NR<sup>7Sa</sup>R<sup>7Sb</sup>; R<sup>7Sa</sup> and R<sup>7Sb</sup> each independently is H or C<sub>1</sub>-C<sub>6</sub> alkyl, or R<sup>7Sa</sup> and R<sup>7Sb</sup> together with the nitrogen atom to which they are attached form C<sub>3</sub>-C<sub>6</sub> heterocycloalkyl.

114. The compound of any one of the preceding claims, wherein R<sup>8</sup> is methyl.

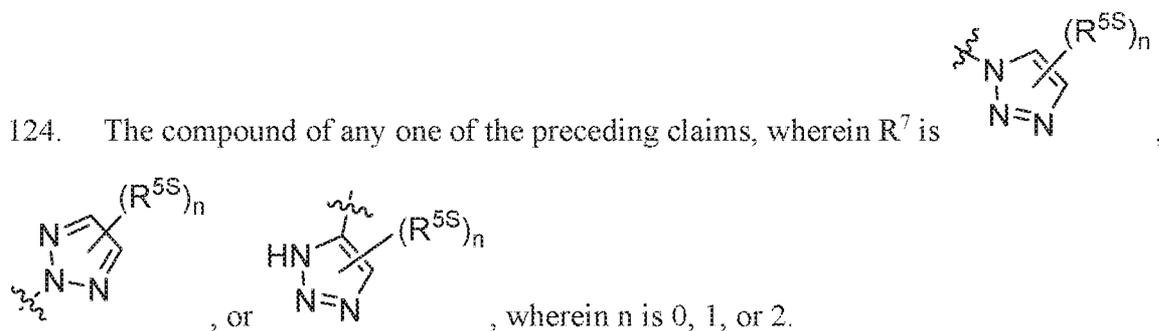
115. The compound of any one of the preceding claims, wherein R<sup>5</sup> is i-propyl.

116. The compound of any one of the preceding claims, wherein R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form C<sub>3</sub>-C<sub>12</sub> cycloalkyl.

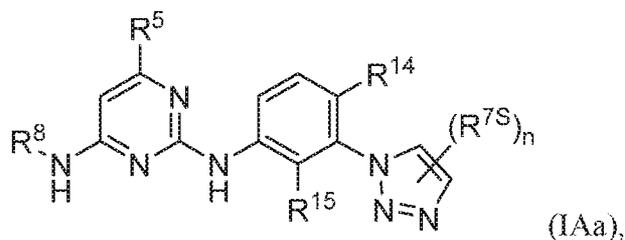
117. The compound of any one of the preceding claims, wherein R<sup>11</sup> and R<sup>12</sup> together with the carbon atom to which they are attached form cyclobutyl.

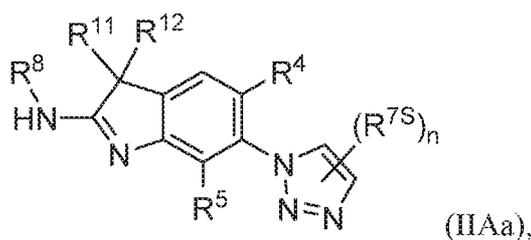
118. The compound of any one of the preceding claims, wherein at least one of R<sup>14</sup> and R<sup>15</sup> is halogen.

119. The compound of any one of the preceding claims, wherein at least one of  $R^{14}$  and  $R^{15}$  is F.
120. The compound of any one of the preceding claims, wherein at least one of  $R^{14}$  and  $R^{15}$  is Cl.
121. The compound of any one of the preceding claims, wherein at least one of  $R^{14}$  and  $R^{15}$  is methoxy.
122. The compound of any one of the preceding claims, wherein one of  $R^{14}$  and  $R^{15}$  is F or Cl, and the other one is methoxy.
123. The compound of any one of the preceding claims, wherein  $R^7$  is 5- to 10-membered heteroaryl containing 1-4 heteroatoms selected from N, O, and S, wherein the 5- to 10-membered heteroaryl is optionally substituted with one or more of  $R^{7S}$ .



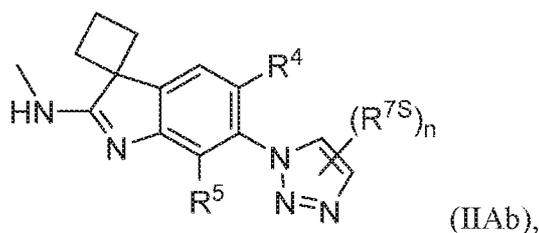
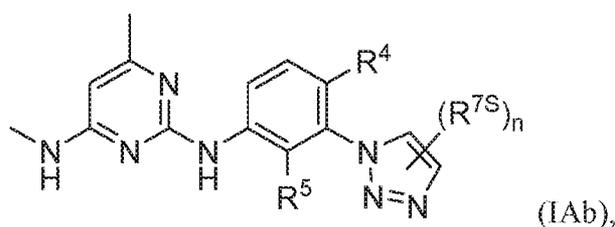
125. The compound of any one of the preceding claims, being of Formula (IAa) or (IIAa):





a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer.

126. The compound of any one of the preceding claims, being of Formula (IAb) or (IIAb):



a tautomer thereof, a pharmaceutically acceptable salt thereof, or a pharmaceutically acceptable salt of the tautomer.

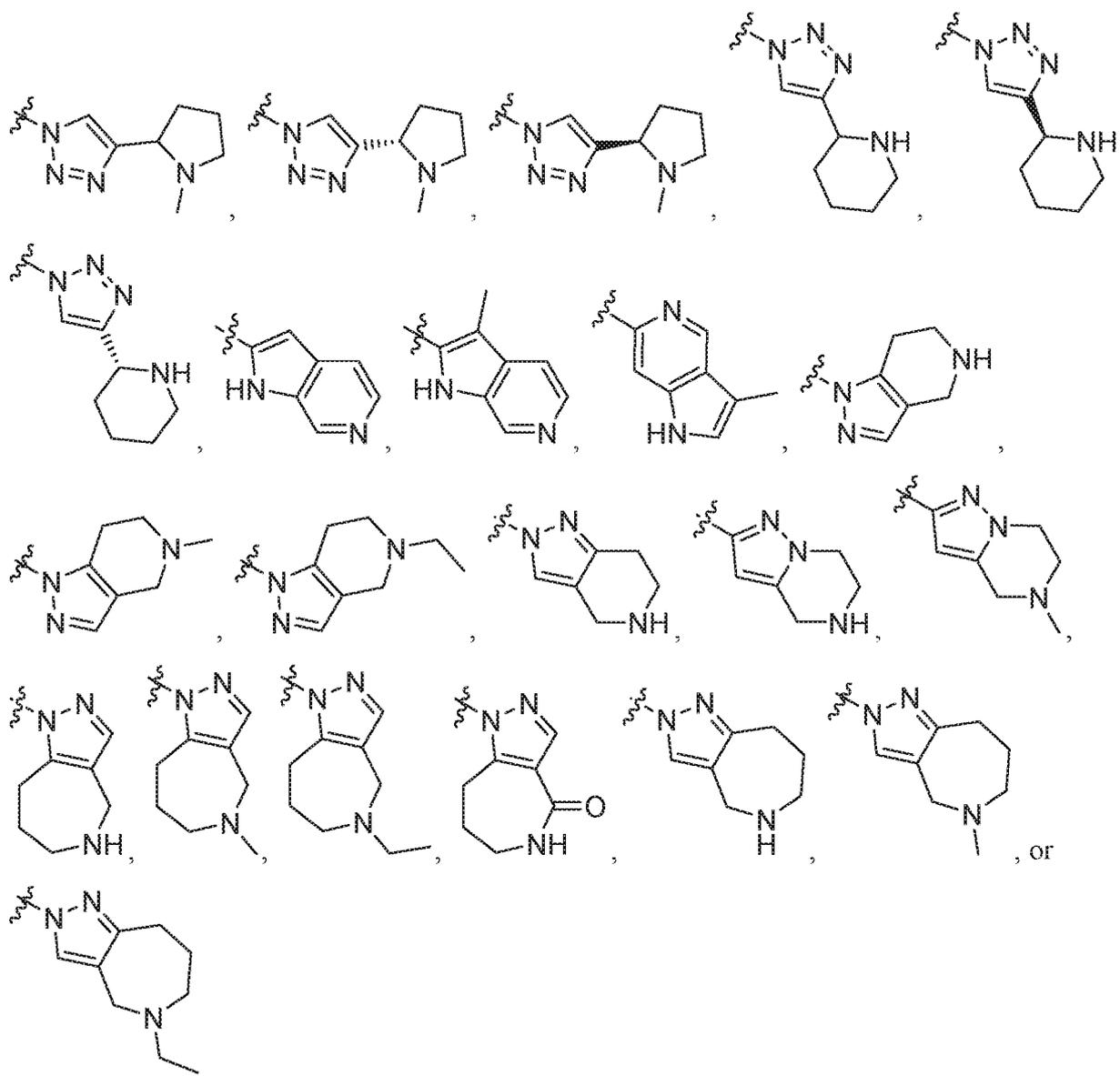
127. The compound of any one of the preceding claims, wherein  $R^7$  is 4- to 12-membered heterocycloalkyl containing 1-4 heteroatoms selected from N, O, and S, wherein the 4- to 12-membered heterocycloalkyl is optionally substituted with one or more of  $R^{7S}$ .

128. The compound of any one of the preceding claims, wherein at least one  $R^{7S}$  is COOH.

129. The compound of any one of the preceding claims, wherein at least one  $R^{7S}$  is oxo.

130. The compound of any one of the preceding claims, wherein at least one  $R^{7S}$  is  $C_1$ - $C_6$  haloalkyl.





135. The compound of any one of the preceding claims, being selected from the compounds listed in Tables 1 and 1A, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

136. The compound of any one of the preceding claims, being selected from the compounds listed in Table 1, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.

137. The compound of any one of the preceding claims, being selected from the compounds listed in Table 1A, tautomers thereof, pharmaceutically acceptable salts thereof, and pharmaceutically acceptable salts of the tautomers.
138. The compound of any one of the preceding claims, being Compound No. A50.
139. The compound of any one of the preceding claims, being Compound No. A51.
140. The compound of any one of the preceding claims, being Compound No. A52.
141. The compound of any one of the preceding claims, being Compound No. A53.
142. The compound of any one of the preceding claims, being Compound No. A54.
143. The compound of any one of the preceding claims, being Compound No. A55.
144. The compound of any one of the preceding claims, being Compound No. A70.
145. The compound of any one of the preceding claims, being Compound No. A71.
146. The compound of any one of the preceding claims, being Compound No. A72.
147. The compound of any one of the preceding claims, being Compound No. A73.
148. The compound of any one of the preceding claims, being Compound No. A74.
149. The compound of any one of the preceding claims, being Compound No. A75.
150. The compound of any one of the preceding claims, wherein the compound inhibits a kinase with an enzyme inhibition  $IC_{50}$  value of about 100 nM or greater, 1  $\mu$ M or greater, 10  $\mu$ M or greater, 100  $\mu$ M or greater, or 1000  $\mu$ M or greater.

151. The compound of any one of the preceding claims, wherein the compound inhibits a kinase with an enzyme inhibition  $IC_{50}$  value of about 1 mM or greater.
152. The compound of any one of the preceding claims, wherein the compound inhibits a kinase with an enzyme inhibition  $IC_{50}$  value of 1  $\mu$ M or greater, 2  $\mu$ M or greater, 5  $\mu$ M or greater, or 10  $\mu$ M or greater, wherein the kinase is one or more of the following: AbI, AurA, CHK1, MAP4K, IRAK4, JAK3, EphA2, FGFR3, KDR, Lck, MARK1, MNK2, PKCb2, SIK, and Src.
153. A pharmaceutical composition comprising a compound of any one of the preceding claims and a pharmaceutically acceptable carrier.
154. A method of inhibiting one or both of EHMT1 and EHMT2, the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.
155. The method of any one of the preceding claims, wherein the subject has an EHMT-mediated disorder.
156. The method of any one of the preceding claims, wherein the subject has a blood disorder.
157. The method of any one of the preceding claims, wherein the subject has a cancer.
158. A method of preventing or treating an EHMT-mediated disorder, the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.
159. A method of preventing or treating a blood disorder, the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.

160. A method of preventing or treating a cancer, the method comprising administering to a subject in need thereof a therapeutically effective amount of a compound of any one of the preceding claims.
161. The method of any one of the preceding claims, wherein the blood disorder is sickle cell anemia or  $\beta$ -thalassemia.
162. The method of any one of the preceding claims, wherein the blood disorder is a hematological cancer.
163. The method of any one of the preceding claims, wherein the cancer is lymphoma, leukemia, melanoma, breast cancer, ovarian cancer, hepatocellular carcinoma, prostate carcinoma, lung cancer, brain cancer, or hematological cancer.
164. The method of any one of the preceding claims, wherein the hematological cancer is acute myeloid leukemia (AML) or chronic lymphocytic leukemia (CLL).
165. The method of any one of the preceding claims, wherein the lymphoma is diffuse large B-cell lymphoma, follicular lymphoma, Burkitt's lymphoma or Non-Hodgkin's Lymphoma.
166. The method of any one of the preceding claims, wherein the cancer is chronic myelogenous leukemia (CML), acute myeloid leukemia, acute lymphocytic leukemia or mixed lineage leukemia, or myelodysplastic syndromes (MDS).
167. The method of any one of the preceding claims, wherein the compound is a selective inhibitor of EHMT1.
168. The method of any one of the preceding claims, wherein the compound is a selective inhibitor of EHMT2.
169. The method of any one of the preceding claims, wherein the compound is an inhibitor of EHMT1 and EHMT2.

170. A compound of any one of the preceding claims for use in inhibiting one or both of EHMT1 and EHMT2 in a subject in need thereof.
171. A compound of any one of the preceding claims for use in preventing or treating an EHMT-mediated disorder in a subject in need thereof.
172. A compound of any one of the preceding claims for use in preventing or treating a blood disorder in a subject in need thereof.
173. A compound of any one of the preceding claims for use in preventing or treating a cancer in a subject in need thereof.
174. Use of a compound of any one of the preceding claims in the manufacture of a medicament for inhibiting one or both of EHMT1 and EHMT2 in a subject in need thereof.
175. Use of a compound of any one of the preceding claims in the manufacture of a medicament for preventing or treating an EHMT-mediated disorder in a subject in need thereof.
176. Use of a compound of any one of the preceding claims in the manufacture of a medicament for preventing or treating a blood disorder in a subject in need thereof.
177. Use of a compound of any one of the preceding claims in the manufacture of a medicament for preventing or treating a cancer in a subject in need thereof.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/056333

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC(8) - A61K 31/495; A61K 31/50; A61K 31/501; C07D 257/08; C07D 403/02; C07D 403/12 (2019.01)  
 CPC - A61K 31/495; A61K 31/50; A61K 31/501; C07D 257/08; C07D 403/02; C07D 403/12 (2019.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 USPC - 514/247; 544/238; 544/244 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/0071418 A1 (COPELAND et al) 22 March 2012 (22.03.2012) entire document	1, 2
A	US 2002/0143176 A1 (LIU et al) 03 October 2002 (03.10.2002) entire document	1, 2
A	- PUBCHEM, Substance Record for SID 162351176, Available Date: 21 May 2013 [retrieved on 15 November 2018]. Retrieved from the Internet: <URL: <a href="https://pubchem.ncbi.nlm.nih.gov/substance/162351176">https://pubchem.ncbi.nlm.nih.gov/substance/162351176</a> >. entire document	1, 2

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 January 2019

Date of mailing of the international search report

17 FEB 2019

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
 P.O. Box 1450, Alexandria, VA 22313-1450  
 Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300  
 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/056333

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.: 6-177  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See Extra Sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1, 2

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Continued from Box No. III Observations where unity of invention is lacking

Claims 1 and 2 have been analyzed subject to the restriction that the claims read on a compound of Formula (I) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or tautomer, wherein: X1 is N; X2 is N; X3 is N; X4 is N; each of X5 and X6 is independently N; R1 is H; R7 is -Q2-T2, in which Q2 is a bond and T2 is H; R8 is H; R9 is -Q4-T4, in which Q4 is a bond and T4 is H; and each of R14 and R15, independently is H.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees need to be paid.

Group I+: claims 1-5 are drawn to compounds of Formula (I), (II), or (III) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or tautomer.

The first invention of Group I+ is restricted to a compound of Formula (I) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or tautomer, wherein: X1 is N; X2 is N; X3 is N; X4 is N; each of X5 and X6 is independently N; R1 is H; R7 is -Q2-T2, in which Q2 is a bond and T2 is H; R8 is H; R9 is -Q4-T4, in which Q4 is a bond and T4 is H; and each of R14 and R15, independently is H. It is believed that claims 1 and 2 read on this first named invention and thus these claims will be searched without fee to the extent that they read on the above embodiment.

Applicant is invited to elect additional formula(e) for each additional compound to be searched in a specific combination by paying an additional fee for each set of election. Each additional elected formula(e) requires the selection of a single definition for each compound variable. An exemplary election would be a compound of Formula (I) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or tautomer, wherein: X1 is CR2; X2 is N; X3 is N; X4 is N; each of X5 and X6 is independently N; R1 is H; R2 is H; R7 is -Q2-T2, in which Q2 is a bond and T2 is H; R8 is H; R9 is -Q4-T4, in which Q4 is a bond and T4 is H; and each of R14 and R15, independently is H. Additional formula(e) will be searched upon the payment of additional fees. Applicants must specify the claims that read on any additional elected inventions. Applicants must further indicate, if applicable, the claims which read on the first named invention if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the "+" group(s) will result in only the first claimed invention to be searched/examined.

The inventions listed in Groups I+ do not relate to a single general inventive concept under PCT Rule 13.1, because under PCT Rule 13.2 they lack the same or corresponding special technical features for the following reasons:

The Groups I+ formulae do not share a significant structural element requiring the selection of alternatives for the compound variables X1, X2, X3, X4, X5, X6, R1, R7, R8, R9, R14, R15 and accordingly these groups lack unity a priori.

Additionally, even if Groups I+ were considered to share the technical features of a compound of Formula (I) or a tautomer thereof, or a pharmaceutically acceptable salt of the compound or tautomer, these shared technical features do not represent a contribution over the prior art as disclosed by Substance Record for SID 162351176 to PubChem.

Substance Record for SID 162351176 to PubChem teaches a compound of Formula (III), wherein X5 is CH, X8 is NR13; R7 is -Q2-T2, in which Q2 is a bond and T2 is H; R8 is H; R9 is -Q4-T4, in which Q4 is a bond and T4 is H; R13 is H, and each of R14 and R15, independently is H (Pg. 3;...see shown structure...).

The inventions listed in Groups I+ therefore lack unity under Rule 13 because they do not share a same or corresponding special technical feature.