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(54) **Titre : METHODES ET COMPOSITIONS POUR DETECTER DES COMBINAISONS D'ACIDES NUCLEIQUES VIRAUX**

(54) **Title: METHODS AND COMPOSITIONS TO DETECT COMBINATIONS OF VIRAL NUCLEIC ACIDS**

(57) **Abrégé/Abstract:**

The disclosure is related to methods, compositions, and kits for targeting combinations of viral nucleic acids, including Adenovirus nucleic acid and at least one of Metapneumovirus nucleic acid and Rhinovirus nucleic acid. Compositions include amplification oligomers and/or detection probe oligomers. Kits and methods comprise at least one of these oligomers. Methods include uniplex and multiplex amplification and detection reactions.

ABSTRACT

The disclosure is related to methods, compositions, and kits for targeting combinations of viral nucleic acids, including Adenovirus nucleic acid and at least one of Metapneumovirus nucleic acid and Rhinovirus nucleic acid. Compositions include amplification oligomers and/or detection probe oligomers. Kits and methods comprise at least one of these oligomers. Methods include uniplex and multiplex amplification and detection reactions.

**COMPOSITIONS, METHODS AND KITS TO DETECT ADENOVIRUS,
METAPNEUMOVIRUS, AND/OR RHINOVIRUS NUCLEIC ACIDS**

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application claims the benefit of priority of U.S. provisional application no. 62/476,753, which was filed on March 25, 2017, and which is incorporated herein by reference.

FIELD

The present disclosure relates to the detection of infectious agents, more specifically to the detection of Adenovirus, Metapneumovirus, and/or Rhinovirus. 10 Compositions, methods and kits are described for the amplification and/or detection of Adenovirus, Metapneumovirus, and/or Rhinovirus by using *in vitro* nucleic acid amplification techniques.

INTRODUCTION

15 Infectious diseases, whether of bacterial, viral, or other origin, present acute and chronic challenges to human health. Many common infections affect the respiratory tract. Respiratory tract diseases are prevalent in patients of all ages, although often are more serious in the very young and the very old. Viruses include DNA viruses and RNA viruses.

Adenovirus (Adeno or Adv) may cause infections in a number of different organs 20 including the gastrointestinal tract, the upper respiratory tract and the eyes. In individuals with a properly functioning immune system, Adenovirus infections are not typically associated with life-threatening disease. However, Adenovirus can cause serious infection in immuno-compromised patients – such as HIV-positive individuals and in patients receiving bone marrow transplants. More than 50 different human Adenovirus serotypes 25 have been identified. On the basis of various properties of Adenovirus, they have been divided into six major subgroups (subgenera or species A-F), with recent literature pointing towards the presence of a seventh serotype.

Early approaches for detecting Adeno detection relied mainly on serological tests and cell culture. In immunosuppressed patients, however, the use of serological tests is 30 limited due to the impaired immune response, and evaluation of positive cultures is a relatively slow method. The introduction of PCR-based assays has provided new methods for the rapid, specific and sensitive detection of Adenovirus. Many of these diagnostic approaches, however, do not effectively cover all Adenovirus serotypes or use low stringency conditions to permit detection of the genetically highly diverse adenoviruses.

The homology of adenovirus DNA sequences between different species is low. Even conserved regions within the Adenovirus genome display only limited homology between adenoviruses from different species. In many instances, considerable differences in DNA sequence even exist between serotypes belonging to the same species. These facts
5 underscore the difficulty to develop molecular tests that facilitate reliable screening for Adenovirus infections with the required broad specificity.

The human metapneumovirus (hMPV) was isolated for the first time in 2001 and is now recognized to be the second major cause of acute respiratory tract disease in infants and adults. It is estimated that it infects over 50% of infants by two years of age and almost
10 all children by five years. hMPV accounts for roughly 5 to 15% of respiratory disease in hospitalized young children (Alto, 2004, *The Journal of the American Board of Family Practice/American Board of Family Practice* 17:466-469; Williams et al., 2004, *N Engl J Med* 350:443-450). Infection with hMPV is a significant burden of disease in at-risk premature infants, chronic lung disease of prematurity, congestive heart disease, and
15 immunodeficiency (Martino et al., 2005, *Biology of Blood and Marrow Transplantation: Journal of the American Society for Blood and Marrow Transplantation* 11:781-796).

There are two distinct genetic lineages that have been established for hMPV and are designated as subtypes A and B. These lineages have further been divided into subgroups A1, A2, B1 and B2, as determined by performing phylogenetic analysis of
20 sequence data, most often utilizing the fusion protein and G glycoprotein gene. No significant differences have been observed among patients infected with different subgroups of hMPV in terms of clinical manifestations (Wei, H., Tsao, K., Huang, C., Huang, Y., Lin, T. *J Microbiol Immunol Infect.* 2012 Sep 26. pii: S1684-1182(12)00151-X). Although information on the mode of transmission and virulence is not definitive,
25 hMPV is likely spread by similar means as common respiratory viruses such as influenza. hMPV has been shown to co-infect with other respiratory pathogens. hMPV appears to provide only partial immunity following infection, likely due to the variety of strains and subtypes that circulate during any given season, and can re-infect individuals potentially leading to repeated episodes of illness. Infections occur mainly during late winter and
30 early spring and the prevalence of each subtype of hMPV varies, seemingly both from year to year, and by location. Likewise, the overall incidence of hMPV can vary from year to year and its prevalence has been reported to range from 2 to 26% in patients with symptoms of respiratory infection.

Human rhinoviruses (HRVs) are the most frequent cause of acute upper respiratory tract infections in humans and are usually associated with the common cold. Common colds caused by HRV occur throughout the year, with peaks of incidence in the autumn and spring, are one of the main reasons for absences from work and school, which have major economic impact. Rhinoviruses can also cause lower respiratory tract infections resulting in severe disease in children, in the elderly and in immunosuppressed patients.

The HRVs, which include over 100 different serotypes, are small, non-enveloped, positive (+)-strand RNA viruses. HRVs are one of the six genera of Picornaviridae, which also includes enteroviruses (EVs). Reverse transcription-polymerase chain reaction (RT-PCR) has been developed in the past few years for the detection of the HRVs in clinical specimens (see, e.g., Billaud et al. (2003) *J. Virol. Methods* 108: 223-228; Blomqvist et al. (1999) *J. Clin. Microbiol.* 37:2813-2816; Kares et al. (2003) *J Clin Virol.* 2004 February; 29(2):99-104; Loens et al. (2003) *J. Clin. Microbiol.* 41: 1971-1976; Savolainen et al. (2002) *J. General Virol.* 83: 333-340; Steininger et al. (2001) *J. Clin. Microbiol.* 39: 129-133). Most of these RT-PCR methods take advantage of the conserved sequences in the 5' noncoding region of the picornavirus genome.

The ability to detect HRV specifically--and particularly avoiding false positives that can result due to the relatedness of HRV and EV--is important to both diagnosis and selection of appropriate available therapy. Specific assays for HRV are also important for development of new drugs. For example, it is critical for clinical trial design that the participants be correctly identified as having an HRV infection where the trial is designed to evaluate a drug for use in treatment of HRV infections. Moreover, in other clinical trials, it may be important to exclude individuals infected with HRV. Further, the HRV detection assays must be simple to perform, provide easily interpreted results, and be relatively inexpensive to make them practical for use.

Conventional methods of differentiation of HRVs from EVs has been done either by virus neutralization assay, by selection with HRV-specific primer pairs, by distinguishing the amplification products of the two viruses based on differences in size, by sequencing the amplification products and comparing the sequence to known HRV and EV sequences, or by hybridization using HRV or EV-specific probes. These approaches can be time-consuming, expensive, and/or require a skilled technician who has experience in interpreting assay results accurately.

There remains a need in the field for a molecular based assay to permit the rapid, sensitive and specific detection of multiple adenovirus serotypes. There also remains a need in the field for the rapid, sensitive and specific detection of the multiple subtypes and subgroups of hMPV. There further remains a need in the field for methods for detecting
5 RVs in a manner that is rapid, sensitive and specific, particularly with respect to the ability to distinguish an RV from an EV.

SUMMARY

It is an object of the present disclosure to provide methods, compositions and kits
10 that can be used to specifically amplify and/or detect with high sensitivity one or more of an Adenovirus, a hMPV, and a HRV nucleic acid. Advantageously, the methods, compositions and kits may be used to specifically detect with high sensitivity many (eg. 5 or more, 10 or more, 20 or more, 30 or more, 40 or more or 50 or more), or all known serotypes and subgroups of adenovirus, hMPV and/or HRV.

15 1. A composition or kit comprising at least first and second amplification oligomers, wherein:

the first amplification oligomer and second amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length comprising at least one Adenovirus position located in the range of
20 nucleotide positions selected from 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47.

25 2. A composition or kit comprising at least first and second amplification oligomers, wherein:

the first amplification oligomer and second amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length comprising at least one Metapneumovirus position located in
30 the range of nucleotide positions selected from 966 to 1147 of SEQ ID NO:150, and/or nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID NO:159.

3. A composition or kit comprising at least first and second amplification oligomers, wherein:

5 the first amplification oligomer and second amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length comprising at least one Rhinovirus position located in the range of nucleotide positions selected from 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156 of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ ID NO:101, and/or 338 to 397 of SEQ ID NO:76.

15 4. A composition or kit comprising at least first and second amplification oligomers configured for two or more target acids, wherein:

(A) for a first target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length comprising at least one Adenovirus position located in the range of nucleotide positions selected from 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47; and

(B) for a second target nucleic acid;

25 (i) the first amplification oligomer and second amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length comprising at least one Metapneumovirus position located in the range of nucleotide positions selected from 966 to 1147 of SEQ ID NO:150, and/or nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID NO:159; or

30 (ii) the first amplification oligomer and second amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50

nucleotides in length comprising at least one Rhinovirus position located in the range of nucleotide positions selected from 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156
5 of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ ID NO:101, and/or 338 to 397 of SEQ ID NO:76.

10 5. A composition or kit comprising at least first and second amplification oligomers configured for two or more target acids, wherein:

(A) for a first target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length comprising at least one
15 Metapneumovirus position located in the range of nucleotide positions selected from 966 to 1147 of SEQ ID NO:150, and/or nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID
20 NO:159; and

(B) for a second target nucleic acid;

(i) the first amplification oligomer and second amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length comprising at least one Adenovirus position located in the
25 range of nucleotide positions selected from 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47; or

(ii) the first amplification oligomer and second amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length comprising at least one Rhinovirus position located in the
30 range of nucleotide positions selected from 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156

of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ ID NO:101, and/or 338 to 397 of SEQ ID NO:76.

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6. A composition or kit comprising at least first and second amplification oligomers configured for two or more target acids, wherein:

(A) for a first target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length comprising at least one Rhinovirus position located in the range of nucleotide positions selected from 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156 of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ ID NO:101, and/or 338 to 397 of SEQ ID NO:76; and

15

(B) for a second target nucleic acid;

(i) the first amplification oligomer and second amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length comprising at least one Adenovirus position located in the range of nucleotide positions selected from 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47; or

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(ii) the first amplification oligomer and second amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length comprising at least one Metapneumovirus position located in the range of nucleotide positions selected from 966 to 1147 of SEQ ID NO:150, and/or nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID NO:159.

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7. A composition or kit comprising at least first and second amplification oligomers configured for three or more target acids, wherein:

5 (A) for a first target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length comprising at least one Adenovirus position located in the range of nucleotide positions selected from 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47; and

10 (B) for a second target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length comprising at least one Metapneumovirus position located in the range of nucleotide positions selected from 966 to 1147 of SEQ ID NO:150, and/or nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID NO:159; and

20 (C) for a third target nucleic acid the first amplification oligomer and second amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length comprising at least one Rhinovirus position located in the range of nucleotide positions selected from 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156 of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ ID NO:101, and/or 338 to 397 of SEQ ID NO:76.

30 8. The composition or kit of any one of claims 1 to 3, wherein the first amplification oligomer comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof.

9. The composition or kit of any of claims 1 to 3 or 8, wherein the second amplification oligomer comprises a nucleic acid sequence that contains at least one 5-Me-dC, or at least one non-Watson Crick base, or at least one degenerate base, or a combination thereof.

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10. The composition or kit of claim 4 or claim 7, wherein the first amplification oligomer configured to amplify an Adenovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, or at least one non-Watson Crick base, or at least one degenerate base, or a combination thereof, and/or wherein the second amplification oligomer configured to amplify an Adenovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, or at least one non-Watson Crick base, or at least one degenerate base, or a combination thereof.

11. The composition or kit of claim 5 or claim 6, wherein the second target nucleic acid is an Adenovirus target nucleic acid and wherein the first amplification oligomer configured to amplify an Adenovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or wherein the second amplification oligomer configured to amplify an Adenovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or both.

12. The composition or kit of claim 5 or claim 7, wherein the first amplification oligomer configured to amplify a Metapneumovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or wherein the second amplification oligomer configured to amplify an Metapneumovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or both.

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13. The composition or kit of claim 4 or claim 6, wherein the second target nucleic acid is an Metapneumovirus target nucleic acid and wherein the first amplification oligomer configured to amplify an Metapneumovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least

one degenerate base, or a combination thereof, or wherein the second amplification oligomer configured to amplify an Metapneumovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or both.

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14. The composition or kit of claim 6 or claim 7, wherein the first amplification oligomer configured to amplify a Rhinovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or wherein the second amplification oligomer
10 configured to amplify an Rhinovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or both.

15. The composition or kit of claim 4 or claim 5, wherein the second target
15 nucleic acid is an Rhinovirus target nucleic acid and wherein the first amplification oligomer configured to amplify an Rhinovirus amplicon comprises a nucleic acid sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or wherein the second amplification oligomer configured to amplify an Rhinovirus amplicon comprises a nucleic acid
20 sequences that contains at least one 5-Me-dC, at least one non-Watson Crick base, at least one degenerate base, or a combination thereof, or both.

16. The composition or kit of any one of claims 1, 4, 7, 8, 10 or 11, wherein for the Adenovirus target nucleic acid the first amplification oligomer comprises a target
25 hybridizing sequence selected from the group consisting of SEQ ID NOS: 1, 5, 11, 12, 25, 26, 31, 32, 33, 34, 35, 38, 71, 72, 73, 74.

17. The composition or kit of claim 5,6 or 9, wherein the second target nucleic acid is Adenovirus and wherein the first amplification oligomer comprises a target
30 hybridizing sequence selected from the group consisting of SEQ ID NOS: 1, 5, 11, 12, 25, 26, 31, 32, 33, 34, 35, 38, 71, 72, 73, 74.

18. The composition or kit of any one of claims 1, 4, 7, 8, 10 or 11, wherein for the Adenovirus target nucleic acid the second amplification oligomer comprises a target

hybridizing sequence selected from the group consisting of SEQ ID NOS: 2, 3, 6, 7, 8, 9, 13, 14, 15, 16, 27, 28, 42, 43, 44, 45, 46, 61, 62, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149.

5 19. The composition or kit of claim 5, 6 or 9, wherein the second target nucleic acid is Adenovirus and wherein the second amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOS: 2, 3, 6, 7, 8, 9, 13, 14, 15, 16, 27, 28, 42, 43, 44, 45, 46, 61, 62, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149.

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 20. The composition or kit of any one of claims 2, 5, 7, 8, 12 or 13, wherein for the Metapneumovirus target nucleic acid the first amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:52, 53, 151, 152, 153, 154, 160.

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 21. The composition or kit of claim 4, 6, or 9, wherein the second target nucleic acid is Metapneumovirus and wherein the first amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:52, 53, 151, 152, 153, 154, 160.

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 22. The composition or kit of any one of claims 2, 5, 7, 8, 12 or 13, wherein for the Metapneumovirus target nucleic acid the second amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:56, 68, 158, 177, 178.

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 23. The composition or kit of claim 4, 6, or 9, wherein the second target nucleic acid is Metapneumovirus and wherein the second amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:56, 68, 158, 177, 178.

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 24. The composition or kit of any one of claims 3, 6, 7, 8, 14 or 15, wherein for the Rhinovirus target nucleic acid the first amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, 121 to 130.

25. The composition or kit of claim 4, 5, or 9, wherein the second target nucleic acid is Rhinovirus and wherein the first amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, 121 to 130.

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26. The composition or kit of any one of claims 3, 6, 7, 8, 14 or 15, wherein for the Rhinovirus target nucleic acid the second amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:57, 95 to 100, 115 to 119, 137.

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27. The composition or kit of claim 4, 5, or 9, wherein the second target nucleic acid is Rhinovirus and wherein the second amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:57, 95 to 100, 115 to 119, 137.

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28. The composition or kit of any one of claims 1 to 27, wherein the composition or kit further comprises a least one detection probe oligomer.

29. The composition or kit of any one of claims 1, 4, 7, 8 to 11, and 16 to 19, wherein the composition or kit further comprises an Adenovirus detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID NOS:4, 10, 17, 18, 19, 20, 21, 22, 23, 24, 29, 30, 36, 37, 39, 40, 63, 64, 139, 140.

30. The composition or kit of any one of claims 5 or 6, wherein the second target nucleic acid is Adenovirus and wherein the composition or kit further comprises a detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID Nos. 4, 10, 17, 18, 19, 20, 21, 22, 23, 24, 29, 30, 36, 37, 39, 40, 63, 64, 139, 140.

31. The composition or kit of any one of claims 1, 4, 7, 8 to 11, and 16 to 19, wherein the composition or kit further comprises an Adenovirus detection probe oligomer comprising a sequence that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:138.

32. The composition or kit of any one of claims 15 or 6, wherein the second target nucleic acid is Adenovirus and wherein the composition or kit further comprises a detection probe oligomer comprising a sequence that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:138.

33. The composition or kit of any one of claims 2, 5, 7, 8, 9, 12, 13, 20, 21, 22, and 23, wherein the composition or kit further comprises a Metapneumovirus detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID Nos. 67, 69, 70, 155, 156, 157, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, and 176.

34. The composition or kit of any one of claims 4 or 6, wherein the second target nucleic acid is Metapneumovirus and wherein the composition or kit further comprises a detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID Nos. 67, 69, 70, 155, 156, 157, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, and 176.

35. The composition or kit of any one of claims 2, 5, 7, 8, 9, 12, 13, 20, 21, 22, and 23, wherein the composition or kit further comprises a Metapneumovirus detection probe oligomer comprising a sequence that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:161 or within SEQ ID NO:155.

36. The composition or kit of any one of claims 4 or 6, wherein the second target nucleic acid is Metapneumovirus and wherein the composition or kit further comprises a detection probe oligomer comprising a sequence that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:161 or within SEQ ID NO:155.

37. The composition or kit of any one of claims 3, 6, 7, 8, 9, 14, 15, and 24 to 27, wherein the composition or kit further comprises a Rhinovirus detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID Nos. 48, 49, 54, 87 to 94, 109 to 114, and 131 to 136.

38. The composition or kit of any one of claims 4 or 5, wherein the second target nucleic acid is Rhinovirus and wherein the composition or kit further comprises a detection probe oligomer comprising a sequence selected from the group consisting of SEQ ID Nos. 48, 49, 54, 87 to 94, 109 to 114, 131 to 136.

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39. The composition or kit of any one of claims 28 to 38, wherein at least one of the detection probe oligomers comprises at least one 5-Me-dC, or at least one non-Watson Crick base, or at least one of a degenerate base, or a combination thereof.

10 40. The composition or kit of any one of claims 28 to 39, wherein at least one of the detection probe oligomers comprises a detectable label.

41. The composition or kit of claim 40, wherein the detectable label is a fluorophore.

15

42. The composition or kit of claim 40 or claim 41, wherein the detection probe oligomer is a dual labeled detection probe oligomer.

20 43. The composition or kit of claim 42, wherein the detection probe oligomer comprises a fluorescent detectable label and a quencher moiety that can quench a fluorescent emission from the fluorescent label.

25 44. The composition or kit of any one of claims 1, 4, 7 to 11, 16 to 19, 28 to 32, and 39 to 43, wherein the composition or kit further comprises one or more additional amplification oligomers each of which is configured to amplify an Adenovirus target nucleic acid.

30 45. The composition or kit of claim 5 or claim 6, wherein the second target nucleic acid is Adenovirus and wherein the composition or kit further comprises one or more additional amplification oligomers each of which is configured to amplify an Adenovirus target nucleic acid.

46. The composition or kit of claim 44 or 45, wherein each of the one or more additional amplification oligomers comprise a target hybridizing sequence separately

selected from the group consisting of SEQ ID NOS: 1 to 9, 11 to 16, 25 to 28, 31 to 35, 38, 42 to 46, 61, 62, and 71 to 74.

47. The composition or kit of any one of claims 2, 5, 7, 8, 9, 12, 13, 20 to 23,
5 28, 33 to 36, and 39 to 43, wherein the composition or kit further comprises one or more
additional amplification oligomers each of which is configured to amplify a
Metapneumovirus target nucleic acid.

48. The composition or kit of claim 4 or claim 6, wherein the second target
10 nucleic acid is Metapneumovirus and wherein the composition or kit further comprises
one or more additional amplification oligomers each of which is configured to amplify a
Metapneumovirus target nucleic acid.

49. The composition or kit of claim 47 or 48, wherein each of the one or more
15 additional amplification oligomers comprise a target hybridizing sequence separately
selected from the group consisting of SEQ ID NOS:52, 53, 56, 68, 151, 152, 153, 154,
158, 160, 177, 178.

50. The composition or kit of any one of claims 3, 6, 7, 8, 9, 14, 15, 24 to 28,
20 and 37 to 43, wherein the composition or kit further comprises one or more additional
amplification oligomers each of which is configured to amplify a Rhinovirus target nucleic
acid.

51. The composition or kit of claim 4 or claim 5, wherein the second target
25 nucleic acid is Rhinovirus and wherein the composition or kit further comprises one or
more additional amplification oligomers each of which is configured to amplify a
Rhinovirus target nucleic acid.

52. The composition or kit of claim 47 or 48, wherein each of the one or more
30 additional amplification oligomers comprise a target hybridizing sequence separately
selected from the group consisting of SEQ ID NOS:50, 51, 57, 59, 60, 65, 75, 77 to 86, 95
to 100, 102 to 108, 115 to 119, 121 to 130, 137.

53. The composition or kit of any one of claims 1, 4, 7 to 11, 16 to 19, 28 to 32, and 39 to 47, wherein the composition or kit comprises at least first and second amplification oligomers and one or more additional amplification oligomers configured to amplify an Adenovirus target nucleic acid each of the amplification oligomers independently comprising a sequences selected from the group consisting of: SEQ ID NOS:61, 62, 71, 72, 73, and 74.

54. The composition or kit of any one of claims 2, 5, 7, 8, 9, 12, 13, 20 to 23, 28, 33 to 36, 39 to 43, 46 to 49, and 53, wherein the composition or kit comprises at least first and second amplification oligomers and one or more additional amplification oligomers configured to amplify a Metapneumovirus target nucleic acid each of the amplification oligomers each independently comprising a sequences selected from the group consisting of: SEQ ID NOS:52, 53, 56, and 58.

55. The composition or kit of any one of claims 3, 6, 7, 8, 9, 14, 15, 24 to 28, 37 to 43, and 50 to 54, wherein the composition or kit comprises at least first and second amplification oligomers and one or more additional amplification oligomers configured to amplify a Rhinovirus target nucleic acid each of the amplification oligomers each independently comprising a sequences selected from the group consisting of: SEQ ID NOS:50, 51, 57, 59, 60, and 65.

56. The composition or kit of any one of claims 1, 4, 7 to 11, 16 to 19, 28 to 32, 39 to 47 and 53 to 55, wherein the composition or kit further comprises two Adenovirus detection probe oligomers, each of the detection probe oligomers independently comprising a sequence selected from the group consisting of SEQ ID NOS:63 and 64.

57. The composition or kit of any one of claims 2, 5, 7, 8, 9, 12, 13, 20 to 23, 28, 33 to 36, 39 to 43, 46 to 49, and 53 to 56, wherein the composition or kit further comprises three Metapneumovirus detection probe oligomers, each of the detection probe oligomers independently comprising a sequence selected from the group consisting of SEQ ID NOS:67, 69 and 70.

58. The composition or kit of any one of claims 3, 6, 7, 8, 9, 14, 15, 24 to 28, 37 to 43 and 50 to 57, wherein the composition or kit further comprises three Rhinovirus

detection probe oligomers, each of the detection probe oligomers independently comprising a sequence selected from the group consisting of SEQ ID NOS:48, 49 and 54.

59. The composition or kit of any one of the preceding claims, wherein the
5 composition or kit further comprises a nucleic acid target capture probe comprising a target hybridizing sequence and an immobilized probe binding region.

60. The composition or kit of claim 59, wherein the target hybridizing sequence is a poly-K nucleotide sequence.

10

61. The composition or kit of claim 60, wherein the poly-K nucleotide sequence is a random poly-GU sequence.

62. The composition or kit of claim 59, 60 or 61, wherein immobilized probe
15 binding region is a homopolymeric nucleotide sequence, preferably comprising a nucleotide sequence selected from the group consisting of T₀₋₄A₁₀₋₃₆.

63. The composition or kit of any one of claims 1 to 62, wherein the composition further comprises an enzyme, a buffer, dNTPs, or a combination thereof.

20

64. A method for the determining the presence of absence of an Adenovirus target nucleic acid, a Metapneumovirus target nucleic acid, a Rhinovirus target nucleic acid, or a combination thereof in a sample, the method comprising the steps of:

(A) contacting a sample with a combination of amplification oligomers
25 from any one of claims 1 to 58;

(B) performing an *in vitro* nucleic acid amplification reaction wherein any of an Adenovirus target nucleic acid, a Metapneumovirus target nucleic acid, or a Rhinovirus target nucleic acid in the sample is used by the combination of amplification oligomers configured to amplify that target nucleic acid to generate an amplification
30 product; and

(C) detecting the amplification product;
thereby determining the presence or absence of the target nucleic acid in the sample.

65. The method of claim 64, wherein the sample is a sample derived from a human.

66. The method of claim 65, wherein the sample is a mucosal sample.

5

67. The method of claim 65 or claim 66, wherein the sample is obtained using a nasopharyngeal swab.

68. The method of any one of claims 64 to 67, wherein, before step (A) a sample preparation step is performed to separate any target nucleic acid in the sample away from other sample components.

10

69. The method of claim 68, wherein the sample preparation step comprises a target capture step.

15

70. The method of claim 69, wherein the target capture step comprise contacting the sample with a nucleic acid target capture probe comprising a target hybridizing sequence and an immobilized probe binding region.

20

71. The method of of claim 70, wherein the target hybridizing sequence is a poly-K nucleotide sequence.

72. The method of claim 71, wherein the poly-K nucleotide sequence is a random poly-GU sequence.

25

73. The method of claim 70, 71 or 72, wherein immobilized probe binding region is a homopolymeric nucleotide sequence, preferably comprising a nucleotide sequence selected from the group consisting of T₀₋₄A₁₀₋₃₆.

30

74. The method of any one of claims 64 to 73, wherein the detecting step (C) is performed using one or more detection probe oligomers.

75. The method of claim 74, wherein each of the one or more detection probe oligomers are individually selected from the group consisting of: SEQ ID NOS:4, 10, 17,

18, 19, 20, 21, 22, 23, 24, 29, 30, 36, 37, 39, 40, 63, 64, 139, 140, 67, 69, 70, 155, 156, 157, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 48, 49, 54, 87 to 94, 109 to 114, and 131 to 136.

5 76. The method of claim 74 or 75, wherein at least one of the detection probe oligomers comprises at least one 5-Me-dC, or at least one non-Watson Crick base, or at least one of a degenerate base, or a combination thereof.

10 77. The method of claim 74, 75 or 76, wherein at least one of the detection probe oligomers comprises a detectable label.

78. The method of claim 77, wherein the detectable label is a fluorophore.

15 79. The method of claim 77 or claim 78, wherein the detection probe oligomer is a dual labeled detection probe oligomer.

20 80. The method of claim 79, wherein the detection probe oligomer comprises a fluorescent detectable label and a quencher moiety that can quench a fluorescent emission from the fluorescent label.

81. The method of any one of claims 64 to 80, wherein the *in vitro* nucleic acid amplification reaction comprises thermal cycling.

25 82. The method of any one of claims 64 to 81, wherein the *in vitro* nucleic acid amplification reaction comprises PCR with a polymerase enzyme having 5' to 3' exonuclease activity.

30 83. The method of any one of claims 75 to 80, wherein the *in vitro* nucleic acid amplification reaction is performed using an enzyme having 5' to 3' exonuclease activity.

84. The method of any one of claims 77 to 80, wherein the *in vitro* nucleic acid amplification reaction is performed using an enzyme having 5' to 3' exonuclease activity and wherein an amplification product is detected by determining a fluorescence value that is above a predetermined threshold value.

85. A system for performing one or more steps of the method of claim 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, or 84.

86. The system of claim 85, wherein the system is an automated system.

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87. The system of claim 85 or 86, wherein the system performs all of the steps of the method.

88. A method for the *in vitro* detection of an Adenovirus target nucleic acid, a Metapneumovirus target nucleic acid, a Rhinovirus target nucleic acid, or a combination thereof in a sample, wherein the method comprises contacting an Adenovirus target nucleic acid, a Metapneumovirus target nucleic acid, and/or a Rhinovirus target nucleic acid with a detection probe oligomer from any of claims 29 to 43, wherein hybridization between the detection probe oligomers and the target nucleic acid to which the detection probe oligomer is configured to hybridize indicates the presence of that target nucleic acid.

89. The method of claim 88, wherein the method comprises contacting an amplification product from the Adenovirus target nucleic acid, the Metapneumovirus target nucleic acid, and/or the Rhinovirus target nucleic acid with the detection probe oligomer, wherein hybridization between the detection probe oligomers and the amplification product to which the detection probe oligomer is configured to hybridize indicates the presence of that target nucleic acid from which the amplification product was generated.

90. The method of claim 88 or 89, wherein the *in vitro* detection reaction is performed using an enzyme having 5' to 3' exonuclease activity.

91. The method of any one of claims 88 to 90, wherein the *in vitro* detection reaction is performed using an enzyme having 5' to 3' exonuclease activity and wherein the target nucleic acid or the amplification product generated therefrom is detected by determining a fluorescence value that is above a predetermined threshold value.

92. A system for performing the *in vitro* detection reaction of any one of claims 88 to 91.

93. The system of claim 92, wherein the system is an automated system.

94. The system of claim 92 or 93, wherein the system performs all of the steps of the method.

5

95. A dried composition comprising one or more of the amplification oligomers from any one of claims 1 to 27.

96. A dried composition comprising one or more of the amplification oligomers from any one of claims 44 to 55.

10

97. A dried composition comprising one or more of the detection probe oligomers from any of claims 29 to 43 or 56 to 58.

98. A dried composition comprising a combination of amplification oligomers and/or detection probe oligomers from any one of claims 1 to 58.

15

99. The dried composition of any one of claims 95 to 98, wherein the dried composition further comprises an enzyme, dNTPs, or both.

20

100. The dried composition of claim 99, wherein the enzyme having 5' to 3' exonuclease activity.

101. The dried composition of claim 99 or claim 100, wherein the enzyme is a polymerase enzyme.

25

102. The dried composition of any one of claims 95 to 101, wherein the dried composition has an inorganic salt concentration of 10mM or less.

103. The dried composition of any one of claims 95 to 102, wherein the dried composition has an inorganic salt concentration of 7mM or less.

30

104. The dried composition of any one of claims 95 to 103, wherein the dried composition has an inorganic salt concentration of 5mM or less.

105. The dried composition of any one of claims 95 to 101, wherein the dried composition has an inorganic salt concentration of between about 0.5mM to about 10mM.

DETAILED DESCRIPTION

5 Nucleic acid oligomer sequences are disclosed that may serve as primers for amplification detection of Adenovirus, Metapneumovirus, and/or Rhinovirus nucleic acids. These target nucleic acids may be detected in a sample by using methods of *in vitro* nucleic acid amplification – such as PCR (*eg.* TaqmanTM PCR) - or transcription-mediated amplification - such as TMA or NASBA. Probes for detection of the amplified nucleic
10 acid sequences are also described. Detection probes hybridize specifically to at least a portion of the amplified sequence, either after completion of or during the amplification process. Methods disclosed herein can be used to amplify and detect Adenovirus, Metapneumovirus, and/or Rhinovirus nucleic acids present in samples from or derived from animals and humans.

15 The disclosed nucleic acid sequences and methods are useful for amplifying and detecting Adenovirus, Metapneumovirus, and/or Rhinovirus nucleic acids from or derived from viral particles present in a sample in a relatively short time so that diagnosis can be made quickly, allowing initiation of effective treatment and limiting spread of the virus. The methods are useful for screening for individuals who have Adenovirus,
20 Metapneumovirus, and/or Rhinovirus infections and are particularly useful for screening patients who have a higher risk of death or serious complications from Adenovirus, Metapneumovirus, and/or Rhinovirus infections, *eg.*, the young, elderly, or immunocompromised individuals. The methods are also useful for rapid screening of many samples. The methods are useful because they minimize the risk of exposure of
25 laboratory personnel to the infectious agents, thereby limiting the risk of infection and spread of the virus. Thus, the methods and compositions disclosed herein respond to a need for rapid, sensitive, and specific testing of clinical samples that may contain Adenovirus, Metapneumovirus, and/or Rhinovirus.

The disclosed probe sequences may be used as primers, and the disclosed primers
30 may be used as probes. The same is true for the disclosed probe domains and primer domains. Thus, the probe domains disclosed herein may be used as primer domains. Likewise, primer domains disclosed herein may be used as probe domains.

The amplification oligomers disclosed herein are further contemplated as components of multiplex amplification reactions wherein several different amplicon

species can be produced from an assortment (eg. two or more, three or more, four or more, five or more, six or more, or even ten or more) of target-specific primers. For example, it is contemplated that more than one of the amplification systems disclosed herein can be combined to result in a multiplex assay that is both robust and broad in its capacity for target detection – such as the ability to amplify and detect nucleic acid from at least two, at least three, at least four or more organisms. For example, the amplification systems disclosed herein can be combined to result in a multiplex assay for target detection of: Adenovirus target nucleic acid and at least one additional target nucleic acid; Metapneumovirus target nucleic acid and at least one additional target nucleic acid; Rhinovirus target nucleic acid and at least one additional target nucleic acid; Adenovirus target nucleic acid and Metapneumovirus target nucleic acid and at least one additional target nucleic acid; Adenovirus target nucleic acid and Rhinovirus target nucleic acids and at least one additional target nucleic acid; Rhinovirus target nucleic acid and Metapneumovirus target nucleic acid and at least one additional target nucleic acid; Adenovirus target nucleic acid and Metapneumovirus target nucleic acids and Rhinovirus target nucleic acid and at least one additional target nucleic acid. The multiplex assay described herein includes providing two or more amplification systems that each amplify and detect a different subtype or subgroup of a species, different species of an organism, or a combination thereof.

To aid in understanding aspects of the disclosure, some terms used herein are described in more detail. All other scientific and technical terms used herein have the same meaning as commonly understood by those skilled in the relevant art, such as may be provided in *Dictionary of Microbiology and Molecular Biology*, 2nd ed. (Singleton et al., 1994, John Wiley & Sons, New York, NY), *The Harper Collins Dictionary of Biology* (Hale & Marham, 1991, Harper Perennial, New York, NY), and references cited herein. Unless mentioned otherwise, the techniques employed or contemplated herein are standard methods well known to a person of ordinary skill in the art of molecular biology.

Definitions

It is to be noted that the term “a” or “an” “the” entity refers to one or more of that entity; for example, “a nucleic acid,” is understood to represent one or more nucleic acids. As such, the terms “a” (or “an”), “one or more,” and “at least one” can be used interchangeably herein.

Sample. A “sample” or “specimen”, including “biological” or “clinical” samples

may contain or may be suspected of containing Adeno, hMPV and/or HRV organisms or components thereof, such as nucleic acids or fragments of nucleic acids. A sample may be a complex mixture of components. Samples include “biological samples” which include any tissue or material derived from a living or dead mammal or organism, including, for example, blood, plasma, serum, blood cells, saliva, mucous and cerebrospinal fluid. Samples may also include samples of *in vitro* cell culture constituents including, eg., conditioned media resulting from the growth of cells and tissues in culture medium. The sample may be treated to physically or mechanically disrupt tissue or cell structure to release intracellular nucleic acids into a solution which may contain enzymes, buffers, salts, detergents and the like, to prepare the sample for analysis. In one step of the methods described herein, a sample is provided that is suspected of containing at least an Adeno, hMPV and/or HRV target nucleic acid. Accordingly, this step excludes the physical step of obtaining the sample from a subject.

Nucleic acid. This refers to a multimeric compound comprising two or more covalently bonded nucleosides or nucleoside analogs having nitrogenous heterocyclic bases, or base analogs, where the nucleosides are linked together by phosphodiester bonds or other linkages to form a polynucleotide. Nucleic acids include RNA, DNA, or chimeric DNA-RNA polymers or oligonucleotides, and analogs thereof. A nucleic acid “backbone” may be made up of a variety of linkages, including one or more of sugar-phosphodiester linkages, peptide-nucleic acid bonds (in “peptide nucleic acids” or PNAs, see PCT No. WO 95/32305), phosphorothioate linkages, methylphosphonate linkages, or combinations thereof. Sugar moieties of the nucleic acid may be either ribose or deoxyribose, or similar compounds having known substitutions, e.g., 2' methoxy substitutions and 2' halide substitutions (e.g., 2'-F). Nitrogenous bases may be conventional bases (A, G, C, T, U), analogs thereof (e.g., inosine, 5 methyl 2' deoxyxycytosine (5-Me-dC), isoguanine; *The Biochemistry of the Nucleic Acids* 5-36, Adams et al., ed., 11th ed., 1992, Abraham et al., 2007, *BioTechniques* 43: 617-24), which include derivatives of purine or pyrimidine bases (e.g., N⁴-methyl deoxygaunosine, deaza- or aza-purines, deaza- or aza-pyrimidines, pyrimidine bases having substituent groups at the 5 or 6 position, purine bases having an altered or replacement substituent at the 2, 6 and/or 8 position, such as 2-amino-6-methylaminopurine, O⁶-methylguanine, 4-thio-pyrimidines, 4-amino-pyrimidines, 4-dimethylhydrazine-pyrimidines, and O⁴-alkyl-pyrimidines, and pyrazolo-compounds, such as unsubstituted or 3-substituted pyrazolo[3,4-d]pyrimidine; US Pat. Nos. 5,378,825, 6,949,367 and PCT No. WO 93/13121). Nucleic acids may include “abasic” residues in

which the backbone does not include a nitrogenous base for one or more residues (US Pat. No. 5,585,481). A nucleic acid may comprise only conventional sugars, bases, and linkages as found in RNA and DNA, or may include conventional components and substitutions (e.g., conventional bases linked by a 2' methoxy backbone, or a nucleic acid including a mixture of conventional bases and one or more base analogs). Nucleic acids may include "locked nucleic acids" (LNA), in which one or more nucleotide monomers have a bicyclic furanose unit locked in an RNA mimicking sugar conformation, which enhances hybridization affinity toward complementary sequences in single-stranded RNA (ssRNA), single-stranded DNA (ssDNA), or double-stranded DNA (dsDNA) (Vester et al., 2004, *Biochemistry* 43(42):13233-41). Nucleic acids may include modified bases to alter the function or behaviour of the nucleic acid, e.g., addition of a 3'-terminal dideoxynucleotide to block additional nucleotides from being added to the nucleic acid. Synthetic methods for making nucleic acids *in vitro* are well known in the art although nucleic acids may be purified from natural sources using routine techniques.

Polynucleotide and Oligonucleotide. These terms denote a nucleic acid chain. Throughout this application, nucleic acids are designated by the 5'-terminus to the 3'-terminus. Standard nucleic acids, e.g., DNA and RNA, are typically synthesized "3'-to-5'," i.e., by the addition of nucleotides to the 5'-terminus of a growing nucleic acid. Oligonucleotide is may be used interchangeably with "oligomer and "oligo" and refers to a nucleic acid having generally less than 1,000 nucleotide (nt) residues, including polymers in a range of from about 5 nt residues to about 900 nt residues, from about 10 nt residues to about 800 nt residues with a lower limit of about 12 to 15 nt and an upper limit of about 40 to 600 nt, and other embodiments are in a range having a lower limit of about 15 to 20 nt and an upper limit of about 22 to 100 nt. It is understood that these ranges are exemplary only, and an oligonucleotide may contain each whole number included in the range. Oligonucleotides may be purified from naturally occurring sources, but may be synthesized using any of a variety of well-known enzymatic or chemical methods. The term oligonucleotide does not denote any particular function to the reagent; rather, it is used generically to cover all such reagents described herein. An oligonucleotide may serve various different functions. For example, it may function as a primer if it is specific for and capable of hybridizing to a complementary strand and can further be extended in the presence of a nucleic acid polymerase, it may provide a promoter if it contains a sequence recognized by an RNA polymerase and allows for transcription (eg., a T7 provider), and it may function to prevent hybridization or impede primer extension if appropriately

situated and/or modified.

5 **Nucleotide.** This is a subunit of a nucleic acid consisting of a phosphate group, a 5-carbon sugar and a nitrogenous base. The 5-carbon sugar found in RNA is ribose. In DNA, the 5-carbon sugar is 2'-deoxyribose. The term also includes analogs of such subunits, such as a methoxy group at the 2' position of the ribose (2'-O-Me, or 2' methoxy). As used herein, methoxy oligonucleotides containing "T" residues have a methoxy group at the 2' position of the ribose moiety, and a uracil at the base position of the nucleotide. "C residues" present in an oligonucleotide (e.g., a primer or probe) include methylated (e.g., 5-Me-dC) and unmethylated cytosines unless the context indicates otherwise.

10 **Non-nucleotide unit.** This is a unit that does not significantly participate in hybridization of a polymer. Such units must not, for example, participate in any significant hydrogen bonding with a nucleotide, and would exclude units having as a component one of the five nucleotide bases or analogs thereof.

15 **Target nucleic acid.** This is a nucleic acid comprising a "target sequence" to be amplified. Target nucleic acids may be DNA or RNA and may be either single-stranded or double-stranded. The target nucleic acid may include other sequences besides the target sequence that may be amplified. Typical target nucleic acids are or are derived from the Adv, hMPV and HRV genomes.

20 **Target sequence.** This term refers to the particular nucleotide sequence of the target nucleic acid that is to be amplified. Where the target nucleic acid is originally single-stranded, the term "target sequence" will also refer to the sequence complementary to the target sequence as present in the target nucleic acid. Where the target nucleic acid is originally double-stranded, the term "target sequence" refers to both the sense (+) and antisense (-) strands. The terms "target(s) a sequence" or "target(s) a target nucleic acid" as used herein in reference to a region of an Adeno, hMPV or HRV nucleic acid refers to a process whereby an oligonucleotide stably hybridizes to the target sequence in a manner that allows for amplification and/or detection as described herein. In one embodiment, the oligonucleotide is complementary to the target sequence and contains no mismatches. In another embodiment, the oligonucleotide is complementary but contains 1; or 2; or 3; or 4; or 5 or more mismatches with the target sequence. In another embodiment, the oligonucleotide is complementary to the target sequence but contains one or a combination of a degenerate nucleotide residue, a non-Watson Crick residue, or a nucleoside analog. Preferably, the oligonucleotide that stably hybridizes to the target sequence includes at least 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 30, 35, 40, 45 or 50

contiguous nucleotides complementary to the target sequence. It is understood that at least 10 and as many as 50 is an inclusive range such that 10, 50 and each whole number there between are included. The term “configured to target a sequence” as used herein means that the target hybridizing region of an amplification oligonucleotide is designed to have a polynucleotide sequence that could target a sequence of the referenced Adeno, hMPV or HRV region. Such an amplification oligonucleotide is not limited to targeting that sequence only, but is rather useful as a composition, in a kit or in a method for targeting an Adeno, hMPV or HRV target nucleic acid, as is described herein. The term “configured to” denotes an actual arrangement of the polynucleotide sequence configuration of the amplification oligonucleotide target hybridizing sequence.

Isolated, Separating, Purifying. refer to taking a nucleic acid from its natural milieu, but these terms do not necessarily connote any degree of purification. These terms mean that one or more components of a sample are removed or separated from other sample components. Sample components include target nucleic acids usually in a generally aqueous solution phase, which may also include cellular fragments, proteins, carbohydrates, lipids, and other nucleic acids. Separating or purifying removes at least 70%, or at least 80%, or at least 95% of the target nucleic acid from other sample components. Ranges of %-purity include all whole and rational numbers of the range.

Region. This term refers to a portion of a nucleic acid wherein said portion is smaller than the entire nucleic acid. For example, when the nucleic acid in reference is an oligonucleotide promoter provider, the term “region” may be used refer to the smaller promoter portion of the entire oligonucleotide. Similarly, and also as example only, when the nucleic acid is a target nucleic acid, the term “region” may be used to refer to a smaller area of the nucleic acid.

By “RNA and DNA equivalents” is meant RNA and DNA molecules having essentially the same complementary base pair hybridization properties. RNA and DNA equivalents have different sugar moieties (i.e., ribose versus deoxyribose) and may differ by the presence of uracil in RNA and thymine in DNA. The differences between RNA and DNA equivalents do not contribute to differences in homology because the equivalents have the same degree of complementarity to a particular sequence. Unless otherwise indicated, reference to an Adv, hMPV or HRV nucleic acid includes the respective Adv, hMPV, or HRV RNA and DNA equivalents thereof.

As used herein, an oligonucleotide having a nucleic acid sequence “comprising” or “consisting of” or “consisting essentially of” a sequence selected from a group of

specific sequences means that the oligonucleotide, as a basic and novel characteristic, is capable of stably hybridizing to a nucleic acid having the exact complement of one of the listed nucleic acid sequences of the group under stringent hybridization conditions. An exact complement includes the corresponding DNA or RNA sequence.

5 **Corresponds.** As used herein, a nucleic acid “corresponds” to a specified nucleic acid if the nucleic acid is 100% identical or complementary to the specified nucleic acid.

Substantially corresponding to. As used herein, a nucleic acid “substantially corresponding to” a specified nucleic acid sequence means that the referred to oligonucleotide is sufficiently similar to the reference nucleic acid sequence such that the
10 oligonucleotide has similar hybridization properties to the reference nucleic acid sequence in that it would hybridize with the same target nucleic acid sequence under stringent hybridization conditions. Substantially corresponding nucleic acids vary by at least one nucleotide from the specified nucleic acid. This variation may be stated in terms of a percentage of identity or complementarity between the nucleic acid and the specified
15 nucleic acid. Thus, nucleic acid substantially corresponds to a reference nucleic acid sequence if these percentages of base identity or complementarity are from less than 100% to about 80% (inclusive of all whole and rational numbers therein).

Blocking moiety. As used herein, a “blocking moiety” is a substance used to “block” the 3'-terminus of an oligonucleotide or other nucleic acid so that it cannot be
20 efficiently extended by a nucleic acid polymerase. Oligomers not intended for primer-based extension by a nucleic acid polymerase may include a blocker group that replaces the 3'OH to prevent the enzyme-mediated extension of the oligomer in an amplification reaction. For example, blocked amplification oligomers and/or detection probes present during amplification may not have functional 3'OH and instead include one or more
25 blocking groups located at or near the 3' end. In some embodiments a blocking group near the 3' end and may be within five residues of the 3' end and is sufficiently large to limit binding of a polymerase to the oligomer. In other embodiments a blocking group is covalently attached to the 3' terminus. Many different chemical groups may be used to block the 3' end, e.g., alkyl groups, non-nucleotide linkers, alkane-diol dideoxynucleotide
30 residues, and cordycepin.

Amplification oligomer. An "amplification oligomer", which may also be called an "amplification oligonucleotide" or a “primer” is an oligomer, at least the 3'-end of which is complementary to a target nucleic acid (“target hybridizing sequence”), and which hybridizes to a target nucleic acid, or its complement, and participates in a nucleic

acid amplification reaction. An example of an amplification oligomer is a primer that hybridizes to a target nucleic acid and contains a 3' OH end that is extended by a polymerase in an amplification process. Another example of an amplification oligomer is a “promoter-based amplification oligomer,” which comprises a target hybridizing
5 sequence, and a promoter sequence for initiating transcription by an appropriate polymerase. Size ranges for amplification oligonucleotides include those comprising target hybridizing regions that are about 10 to about 70 nt long (inclusive of all whole and rational numbers therein). In one embodiment, an amplification oligomer may optionally
10 contains one or a combination of a degenerate nucleotide residue, a non-Watson Crick residue, or a nucleoside analog. An amplification oligomer designated to comprise at least one degenerate nucleobase is thus a collection of amplification oligomer species each independently having one of the nucleic acid residues represented by the degenerate nucleotide.

Amplification. This refers to any known procedure for obtaining multiple copies
15 of a target nucleic acid sequence or its complement or fragments thereof. The multiple copies may be referred to as amplicons or amplification products. Amplification of “fragments” refers to production of an amplified nucleic acid that contains less than the complete target nucleic acid or its complement, *eg.*, produced by using an amplification oligonucleotide that hybridizes to, and initiates polymerization from, an internal position
20 of the target nucleic acid. Known amplification methods include both thermally cyclical and isothermal amplification methods. For some embodiment, isothermal amplification methods are preferred. Replicase-mediated amplification, polymerase chain reaction (PCR), ligase chain reaction (LCR), strand-displacement amplification (SDA), and transcription-mediated or transcription-associated amplification are non-limiting
25 examples of nucleic acid amplification methods (see *e.g.*, US Pat. No. 4,786,600; US Pat. Nos. 4,683,195, 4,683,202, and 4,800,159; US Pat. No. 5,427,930 and US Pat. No. 5,516,663; and US Pat. No. 5,422,252; US Pat. No. 5,547,861; and US 5,648,211).

By “assay conditions” is meant conditions permitting stable hybridization of an oligonucleotide to a target nucleic acid. Assay conditions do not require preferential
30 hybridization of the oligonucleotide to the target nucleic acid.

In cyclic amplification methods that detect amplicons in real-time, the term “Threshold cycle” (Ct) is a measure of the emergence time of a signal associated with amplification of target, and is generally 10x standard deviation of the normalized reporter signal. Once an amplification reaches the “threshold cycle,” generally there is considered

to be a positive amplification product of a sequence to which the probe binds. The identity of the amplification product can then be determined through methods known to one of skill in the art, such as gel electrophoresis, nucleic acid sequencing, and other such well known methods.

5 **Real-time amplification.** As used herein, the term “real-time amplification” refers to amplification of target nucleic acid that is monitored by real-time detection means.

Amplicon. This term, which is used interchangeably with “amplification product”, refers to the nucleic acid molecule generated during an amplification procedure that is complementary or homologous to a sequence contained within the target sequence. These
10 terms can be used to refer to a single strand amplification product, a double strand amplification product or one of the strands of a double strand amplification product.

Probe. A probe, also known as a “detection probe” or “detection oligonucleotide” are terms referring to a nucleic acid oligomer that hybridizes specifically to a target sequence in a nucleic acid, or in an amplified nucleic acid, under conditions that promote
15 hybridization to allow detection of the target sequence or amplified nucleic acid. Detection may either be direct (*e.g.*, a probe hybridized directly to its target sequence) or indirect (*e.g.*, a probe linked to its target via an intermediate molecular structure). Probes may be DNA, RNA, analogs thereof or combinations thereof and they may be labeled or unlabeled. A probe’s “target sequence” generally refers to a smaller nucleic acid sequence
20 within a larger nucleic acid sequence that hybridizes specifically to at least a portion of a probe oligomer by standard base pairing. A probe may comprise target-specific sequences and other sequences that contribute to the three-dimensional conformation of the probe (*eg.*, US Pat. Nos. 5,118,801; 5,312,728; 6,849,412; 6,835,542; 6,534,274; and 6,361,945; and US Pub. No. 20060068417). In a preferred embodiment, the detection probe
25 comprises a 2' methoxy backbone which can result in a higher signal being obtained. In another preferred embodiment, the probe comprises a fluorophore covalently attached to the 5'-end of the probe and a quencher at the 3'-end. Such probes are known as Taqman™ probes. In another embodiment, a probe may optionally contains one or a combination of a degenerate nucleotide residue, a non-Watson Crick residue, or a nucleoside analog. A
30 probe designated to comprise at least one degenerate nucleobase is thus a collection of probe species each independently having one of the nucleic acid residues represented by the degenerate nucleotide.

Stable. By “stable” or “stable for detection” is meant that the temperature of a reaction mixture is at least 2.deg.C below the melting temperature of a nucleic acid duplex.

Label. As used herein, a "label" refers to a moiety or compound joined directly or indirectly to a probe that is detected or leads to a detectable signal. Direct labeling can occur through bonds or interactions that link the label to the probe, including covalent bonds or non-covalent interactions, e.g. hydrogen bonds, hydrophobic and ionic interactions, or formation of chelates or coordination complexes. Indirect labeling can occur through use of a bridging moiety or "linker" such as a binding pair member, an antibody or additional oligomer, which is either directly or indirectly labeled, and which may amplify the detectable signal. Labels include any detectable moiety, such as a radionuclide, ligand (e.g., biotin, avidin), enzyme or enzyme substrate, reactive group, or chromophore (e.g., dye, particle, or bead that imparts detectable color), luminescent compound (e.g., bioluminescent, phosphorescent, or chemiluminescent labels (e.g., US Pat. Nos. 5,656,207, 5,658,737, and 5,639,604)), or fluorophore. Labels may be detectable in a homogeneous assay in which bound labeled probe in a mixture exhibits a detectable change different from that of an unbound labeled probe, e.g., instability or differential degradation properties (e.g., US Pat. Nos. 5,283,174, 5,656,207, and 5,658,737). Embodiments of fluorophores include those that absorb light in the range of about 495 to 650 nm and emit light in the range of about 520 to 670 nm, which include those known as FAM[™], TET[™], CAL FLUOR[™] (Orange or Red), and QUASAR[™] compounds. Fluorophores may be used in combination with a quencher molecule that absorbs light when in close proximity to the fluorophore to diminish background fluorescence. Such quenchers are well known in the art and include, e.g., BLACK HOLE QUENCHER[™] (or BHQ[™], BHQ-1[™], or BHQ-2[™]) or TAMRA[™] compounds. Synthesis and methods of attaching labels to nucleic acids and detecting labels are well known (e.g., Sambrook *et al.*, *Molecular Cloning, A Laboratory Manual*, 2nd ed. (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989), Chapter 10; US Pat. Nos. 5,658,737, 5,656,207, 5,547,842, 5,283,174, and 4,581,333). More than one label, and more than one type of label, may be present on a particular probe, or detection may use a mixture of probes in which each probe is labeled with a compound that produces a different detectable signal (e.g., US Pat. Nos. 6,180,340 and 6,350,579).

Capture oligonucleotide. As used herein, a "capture oligonucleotide," "target capture oligonucleotide" or "capture probe" refers to a nucleic acid oligomer that hybridizes to a target sequence in a target nucleic acid by and joins to a binding partner on an immobilized probe to capture the target nucleic acid to a support. One example of a capture oligomer includes an oligonucleotide comprising two binding regions: a target

hybridizing sequence and an immobilized probe-binding region. A variation of this example, the two regions may be present on two different oligomers joined together by one or more linkers. Another embodiment of a capture oligomer the target hybridizing sequence is a sequence that includes random or non-random poly-K poly-GU, poly-GT, or poly U sequences to bind non-specifically to a target nucleic acid and link it to an immobilized probe on a support. (see e.g., PCT Pub No. WO 2008/016988 and US Pat. No. 9,051,601). The immobilized probe binding region can be a nucleic acid sequence, referred to as a tail. Tails include a substantially homopolymeric tail of about 10 to 40 nucleotides (e.g., A₁₀ to A₄₀), or of about 14 to 33 nt (e.g., T₃A₁₄ to T₃A₃₀), that bind to a complementary immobilized sequence. Thus, a non-limiting example of preferred nucleic acid tails can in some embodiments include T₀₋₄A₁₀₋₃₆ sequences.

Immobilized oligonucleotide. As used herein, an "immobilized oligonucleotide", "immobilized probe" or "immobilized nucleic acid" refers to a nucleic acid binding partner that joins a capture oligomer to a support, directly or indirectly to facilitate separation of a capture probe bound target nucleic acid from unbound material in a sample. One embodiment of an immobilized probe is an oligomer joined to a support, such as nitrocellulose, nylon, glass, polyacrylate, mixed polymers, polystyrene, silane, polypropylene, metal, or other compositions, of which one embodiment is magnetically attractable particles.

Complementary. By "complementary" is meant that the nucleotide sequences of similar regions of two single-stranded nucleic acids, or to different regions of the same single-stranded nucleic acid have a nucleotide base composition that allow the single-stranded regions to hybridize together in a stable double-stranded hydrogen-bonded region under stringent hybridization or amplification conditions. Sequences that hybridize to each other may be completely complementary or partially complementary to the intended target sequence by standard nucleic acid base pairing (e.g. G:C, A:T or A:U pairing). By "sufficiently complementary" is meant a contiguous sequence that is capable of hybridizing to another sequence by hydrogen bonding between a series of complementary bases, which may be complementary at each position in the sequence by standard base pairing or may contain one or more residues that are not complementary by standard A:T/U and G:C pairing, or are modified nucleotides such as abasic residues, modified nucleotides or nucleotide analogs. Sufficiently complementary contiguous sequences typically are at least 80%, or at least 90%, complementary to a sequence to which an oligomer is intended to specifically hybridize (a %-complementarity range includes all whole and rational

numbers of the range). Sequences that are “sufficiently complementary” allow stable hybridization of a nucleic acid oligomer with its target sequence under appropriate hybridization conditions, even if the sequences are not completely complementary. When a contiguous sequence of nucleotides of one single-stranded region is able to form a series of "canonical" hydrogen-bonded base pairs with an analogous sequence of nucleotides of the other single-stranded region, such that A is paired with U or T and C is paired with G, the nucleotides sequences are "completely" complementary.

Preferentially hybridize. By “preferentially hybridize” is meant that under stringent hybridization assay conditions, an oligonucleotide hybridizes to its target sequences, or replicates thereof, to form stable oligonucleotide: target sequence hybrid, while at the same time formation of stable oligonucleotide: non-target sequence hybrid is minimized. For example, a probe oligonucleotide preferentially hybridizes to a target sequence or replicate thereof to a sufficiently greater extent than to a non-target sequence, to enable one having ordinary skill in the art to accurately detect the RNA replicates or complementary DNA (cDNA) of the target sequence formed during the amplification. Appropriate hybridization conditions are well known in the art for probe, amplification, target capture, blocker and other oligonucleotides, may be predicted based on sequence composition, or can be determined by using routine testing methods (e.g., Sambrook *et al.*, *Molecular Cloning, A Laboratory Manual*, 2nd ed. (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989) at §§ 1.90-1.91, 7.37-7.57, 9.47-9.51 and 11.47-11.57, particularly §§ 9.50-9.51, 11.12-11.13, 11.45-11.47 and 11.55-11.57).

Nucleic acid hybrid. By "nucleic acid hybrid" or "hybrid" or "duplex" is meant a nucleic acid structure containing a double-stranded, hydrogen-bonded region wherein each strand is complementary to the other, and wherein the region is sufficiently stable under stringent hybridization conditions to be detected by means including, but not limited to, chemiluminescent or fluorescent light detection, autoradiography, or gel electrophoresis. Such hybrids may comprise RNA:RNA, RNA:DNA, or DNA:DNA duplex molecules.

Sample preparation. This refers to any steps or methods that treat a sample for subsequent amplification and/or detection of one or more of an Adv, hMPV or HRV nucleic acid present in the sample. The target nucleic acid may be a minority component in the sample. Sample preparation may include any known method of isolating or concentrating components, such as viruses or nucleic acids using standard microbiology methods. Sample preparation may include physical disruption and/or chemical lysis of cellular components to release intracellular components into a substantially aqueous or

organic phase and removal of debris, such as by using filtration, centrifugation or adsorption. Sample preparation may include use of a nucleic acid oligonucleotide that selectively or non-specifically captures a target nucleic acid and separates it from other sample components (eg., as described in US Pat. No. 6,110,678; US Pat. No. 9,051,601, and PCT Pub. No. WO 2008/016988).

Specificity. The term "specificity," in the context of an amplification system, is used herein to refer to the characteristic of an amplification system which describes its ability to distinguish between target and non-target sequences dependent on sequence and assay conditions. In terms of nucleic acid amplification, specificity generally refers to the ratio of the number of specific amplicons produced to the number of side-products (*e.g.*, the signal-to-noise ratio).

Sensitivity. The term "sensitivity" is used herein to refer to the precision with which a nucleic acid amplification reaction can be detected or quantitated. The sensitivity of an amplification reaction is generally a measure of the smallest copy number of the target nucleic acid that can be reliably detected in the amplification system, and will depend, for example, on the detection assay being employed, and the specificity of the amplification reaction, *e.g.*, the ratio of specific amplicons to side-products.

Relative fluorescence unit. As used herein, the term "relative fluorescence unit" ("RFU") is an arbitrary unit of measurement of fluorescence intensity. RFU varies with the characteristics of the detection means used for the measurement.

References, particularly in the claims, to "the sequence of SEQ ID NO: X" refer to the base sequence of the corresponding sequence listing entry and do not require identity of the backbone (*e.g.*, RNA, 2'-O-Me RNA, or DNA) or base modifications (*e.g.*, methylation of cytosine residues) unless otherwise indicated.

A "degenerate" position in an oligomer refers to a position where more than one base pair is present in a population of the oligomer. For example, in SEQ ID NO: 81, the eighth nucleotide is R, which represents G or A. Oligomers with degenerate positions can be synthesized by providing a mixture of nucleotide precursors corresponding to the desired degenerate combination at the step of the synthesis where incorporation of a degenerate position is desired. The resulting oligomers are a mixture of species each containing one of the nucleotides represented by the degenerate designation.

A "non-Watson Crick" (NWC) position in an oligomer refers to a position where the oligomer is configured to hybridize to at least one target nucleic acid sequence with a non-Watson Crick pairing, such as G-U, G-T, or G-A (either the G or the U/T/A can be

the base in the oligomer). In some embodiments, the NWC position is configured to hybridize via a wobble (G-U or G-T) or purine-purine (G-A) pair.

Oligonucleotides for the Amplification of Adenovirus, Metapneumovirus, and/or

5 **Rhinovirus**

Oligonucleotides for amplifying each of an Adenovirus, Metapneumovirus, and/or Rhinovirus target nucleic acid typically comprise at least two amplification oligomers per target. Some embodiments of the disclosure may utilise two, three, four, five, six or more amplification oligomers per target in, for example, multiplex
10 amplification assays. Thus, by way of example, oligonucleotides for amplifying each target organism may comprise one, two, three, four, five or more forward amplification primers and one, two, three, four, five or more reverse amplification primers. For example, oligonucleotides for amplifying Adenovirus may comprise one, two, three, four, five or more forward amplification primers and one, two, three, four, five or more reverse
15 amplification primers. Oligonucleotides for amplifying hMPV may comprise one, two, three, four, five or more forward amplification primers and one, two, three, four, five or more reverse amplification primers. Oligonucleotides for amplifying HRV may comprise one, two, three, four, five or more forward amplification primers and one, two, three, four, five or more reverse amplification primers. Moreover, the subtypes or subgroups of a
20 target organism may require at least two amplification oligomers, each comprising a nucleotide sequence that is specific for a different member or members of one or more of the organism's subtypes/subgroups.

Oligonucleotides for detecting each of an Adenovirus, Metapneumovirus, and/or Rhinovirus target nucleic acid typically comprise at least one detection oligomer per target.
25 Some embodiments of the disclosure may utilise two, three, four, five, six or more detection probe oligomers per target in, for example, a multiplex detection assay. For example, oligonucleotides for detecting Adenovirus may comprise one, two, three, four or more detection probe oligomers. Oligonucleotides for detecting hMPV may comprise one, two, three, four or more detection probe oligomers. Oligonucleotides for detecting HRV
30 may comprise one, two, three, four or more detection probe oligomers. Moreover, the subtypes or subgroups of a target organism may require at least two detection probe oligomers, each comprising a nucleotide sequence that is specific for a different member or members of one or more of the organism's subtypes/subgroups. Combinations of oligomers for the multiplexed amplifying and detecting of one or more of Adenovirus,

Metapneumovirus, and Rhinovirus target nucleic acids typically comprise at least two forward amplification oligomers, at least two reverse amplification oligomers, and at least two detection probe oligomers. Some embodiments of the disclosure may utilise two, three, four, five, or even six or more amplification oligomers and two, three, four, five or even six or more probes for each intended target nucleic acid. Thus, by way of example, oligonucleotides for the multiplexed amplifying and detecting of a number of targets may comprise from 6 to 40 amplification oligomers and from 3 to 15 detection probe oligomers.

The methods for detecting an Adenovirus, Metapneumovirus, and/or Rhinovirus target nucleic acid (including an amplicon) optionally include a detecting step that uses at least one probe that binds specifically to the amplified product (RNA or DNA amplicon, preferably DNA amplicon). Preferably, the probe is labeled and produces a signal detected in a homogeneous system, that is, without separation of bound probe from unbound probe. Other examples of probes may be labeled with a fluorescent compound which emits a detectable signal only when the probe is bound to its target, e.g., a Taqman™ detection probe as described herein.

In one embodiment, at least one of the amplification oligomers is configured to specifically hybridize to a region within a target sequence of Adenovirus corresponding to nucleotides 1 to 99 of SEQ ID No. 47, or corresponding to nucleotides 83 to 175 of SEQ ID No. 47. In one embodiment, at least two amplification oligomers are used, wherein each of said at least two amplification oligomers is from 10 to about 50 nucleotides in length and wherein the amplification oligomers are respectively configured to specifically hybridize to regions within a target sequence of Adenovirus selected from the group consisting of from nucleotides 1 to 99 of SEQ ID No. 47 and from nucleotides 83 to 175 of SEQ ID No. 47 in order to generate an amplicon that can be subsequently detected. In one embodiment, at least one of the amplification oligomers is configured to specifically hybridize to a region within a target sequence of Adenovirus corresponding to nucleotides 52 to 99 and/or 40 to 87 and/or 1 to 23 and/or 7 to 23 and/or 7 to 45 and/or 139 to 155 and/or 103 to 175 and/or 83 to 99 and/or 83 to 98 SEQ ID No. 47 in order to generate an amplicon that can be subsequently detected. In one embodiment, at least one of the amplification oligomers is configured to specifically hybridize to a region within a target sequence of Adenovirus corresponding to nucleotides 52 to 74 and/or 76 to 99 and/or 40 to 56 and/or 65 to 87 and/or 1 to 18 and/or 7 to 23 and/or 28 to 45 and/or 27 to 45 and/or 26 to 45 and/or 139 to 155 and/or 103 to 123 and/or 159 to 175 and/or 83 to 99 and/or 83 to 98 of SEQ ID No. 47 in order to generate an amplicon that can be subsequently detected.

Oligonucleotides for amplifying and/or detecting the Adenovirus target nucleic acid include oligonucleotide sequences selected from the group consisting of SEQ ID NOS: 1 to 46, 62 to 64, 71 to 75, and 138 to 149. Embodiments of amplification oligomers specific for Adenovirus nucleic acid include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS: 1 to 9, 11 to 16, 25 to 28, 31 to 35, 38, 42 to 46, 61, 62, and 71 to 74 or a combination of two or more thereof. According to one embodiment, at least one first amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS: 1, 5, 11, 12, 25, 26, 31, 32, 33, 34, 35, 38, 71, 72, 73, 74, or a combination of two or more thereof. According to one embodiment, at least one second amplification oligomer comprises, consists of consists essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS: 2, 3, 6, 7, 8, 9, 13, 14, 15, 16, 27, 28, 42, 43, 44, 45, 46, 61, 62, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, or a combination of two or more thereof. In one embodiment, one or more of the amplification oligomers for amplifying an Adenovirus target nucleic acid comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

In one embodiment, one or more detection probes are configured to detect a sequence in a region corresponding to nucleotides 74 to 139 of SEQ ID NO:47; and/or nucleotides 56 to 103 of SEQ ID NO:47; and/or nucleotides 18 to 83 of SEQ ID NO:47; and/or nucleotides 23 to 83 of SEQ ID NO:47; and/or nucleotides 23 to 83 of SEQ ID NO:47; and/or nucleotides 23 to 83 of SEQ ID NO:47 and/or nucleotides 52 to 99 of SEQ ID NO:47. In one embodiment, there is provided a detection probe oligonucleotide that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:138.

Probes for the specific detection of Adenovirus sequences include oligomers selected from the group consisting of SEQ ID Nos. 4, 10, 17, 18, 19, 20, 21, 22, 23, 24, 29, 30, 36, 37, 39, 40, 63, 64, 139, 140 or a combination of two or more thereof. In one embodiment, one or more of the detection probe oligomers for detecting an Adenovirus target nucleic acid (including an Adenovirus amplicon) comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

Oligonucleotides for amplifying and/or detecting an hMPV target nucleic acid include oligonucleotide sequences that are configured to hybridize to a region of an hMPV in a region corresponding to nucleotides 966 to 1147 of SEQ ID NO:150, and/or

nucleotides 844 to 1027 of SEQ ID NO:159, and/or 1000 to 1040 of SEQ ID NO:150, and/or 880 to 915 of SEQ ID NO:159, and/or 1027 to 1080 of SEQ ID NO:150, and/or 913 to 958 of SEQ ID NO:159, and/or 1073 to 1115 of SEQ ID NO:150, and/or 953 to 995 of SEQ ID NO:159. Oligonucleotides for amplifying and/or detecting an hMPV target nucleic acid include oligonucleotide sequences selected from the group consisting of SEQ ID NOS:52, 53, 56, 67 to 70, 151 to 158, and 161 to 178. Embodiments of amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:52, 53, 56, 68, 151, 152, 153, 154, 158, 160, 177, 178, or a combination of two or more thereof. Embodiments of first amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:52, 53, 151, 152, 153, 154, 160, or a combination of two or more thereof. Embodiments of second amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:56, 68, 158, 177, 178, or a combination of two or more thereof. In one embodiment, one or more of the amplification oligomers for amplifying an hMPV target nucleic acid comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

Probes for the specific detection of hMPV sequences include oligomers selected from the group consisting of SEQ ID Nos. 67, 69, 70, 155, 156, 157, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, or a combination of two or more thereof. In one embodiment, there is provided a detection probe oligonucleotide that is from 18 to 36 nucleobases in length wherein the 18 to 36 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:161 or within SEQ ID NO:155. In one embodiment, one or more of the detection probe oligomers for detecting an hMPV target nucleic acid (including an hMPV amplicon) comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

Oligonucleotides for amplifying and/or detecting an HRV target nucleic acid include oligonucleotide sequences that are configured to hybridize to a region of an HRV in a region corresponding to nucleotides 230 to 556 of SEQ ID NO:120, and/or 199 to 525 of SEQ ID NO:101, and/or 80 to 410 of SEQ ID NO:76, and/or 263 to 303 of SEQ ID NO:120, and/or 231 to 264 of SEQ ID NO:101, and/or 106 to 156 of SEQ ID NO:76, and/or 312 to 346 of SEQ ID NO:120, and/or 279 to 314 of SEQ ID NO:101, and/or 455 to 506 of SEQ ID NO:76, and/or 480 to 533 of SEQ ID NO:120, and/or 455 to 506 of SEQ

ID NO:101, and/or 338 to 397 of SEQ ID NO:76. Oligonucleotides for amplifying and/or detecting an HRV target nucleic acid include oligonucleotide sequences selected from the group consisting of SEQ ID NOS:48, 49, 50, 51, 54, 57, 59, 60, 65, 75, 77 to 100, 102 to 119, 121 to 137, or a combination of two or more thereof. Embodiments of amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:50, 51, 57, 59, 60, 65, 75, 77 to 86, 95 to 100, 102 to 108, 115 to 119, 121 to 130, 137, or a combination of two or more thereof. Embodiments of first amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, 121 to 130, or a combination of two or more thereof. Embodiments of second amplification oligomers include the amplification oligomers comprising, consisting or consisting essentially of a target hybridizing sequence selected from the group consisting of SEQ ID NOS:57, 95 to 100, 115 to 119, 137, or a combination of two or more thereof. In one embodiment, there is provided an amplification oligonucleotide that is from 18 to 29 nucleobases in length wherein the 18 to 29 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:77. In one embodiment, there is provided an amplification oligonucleotide that is from 18 to 27 nucleobases in length wherein the 18 to 27 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:95. In one embodiment, there is provided an amplification oligonucleotide that is from 18 to 35 nucleobases in length wherein the 18 to 35 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:96. In one embodiment, there is provided an amplification oligonucleotide that is from 18 to 27 nucleobases in length wherein the 18 to 27 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:115. In one embodiment, there is provided an amplification oligonucleotide that is from 18 to 27 nucleobases in length wherein the 18 to 27 nucleobases are all selected from contiguous nucleobases within SEQ ID NO:137. In one embodiment, one or more of the amplification oligomers for amplifying an HRV target nucleic acid comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

Probes for the specific detection of HRV sequences include oligomers selected from the group consisting of SEQ ID Nos. 48, 49, 54, 87 to 94, 109 to 114, 131 to 136, or a combination of two or more thereof. In one embodiment, one or more of the detection probe oligomers for detecting an HRV target nucleic acid (including an HRV amplicon)

comprises at least one of a 5-Me-dC, non-Watson Crick base, degenerate base, or combination thereof.

Assays for detection of Adeno, hMPV, and/or HRV nucleic acid may include an internal control (IC) nucleic acid that is amplified and detected by using IC-specific primers and probe in the same reaction mixtures used for target nucleic acid amplification and detection. Amplification and detection of the IC-specific sequence demonstrates that assay reagents and conditions were properly used even when no target-specific signal is detected for a tested sample (i.e., negative samples). The IC may be used as an internal calibrator for the assay that provides a quantitative result. The IC may be a randomized sequence derived from a naturally occurring source that is not a target nucleic acid.

Sample Preparation

Preparation of samples for amplification and detection of target nucleic acid sequences may include methods of separating and/or concentrating organisms contained in a sample from other sample components. Sample preparation may include routine methods of disrupting samples or lysing samples to release intracellular contents, including target nucleic acids or genetic sequences comprising target nucleic acid. Sample preparation before amplification may include an optional step of target capture to specifically or non-specifically separate the target nucleic acids from other sample components. Nonspecific target capture methods may involve selective precipitation of nucleic acids from a substantially aqueous mixture, adherence of nucleic acids to a support that is washed to remove other sample components, other methods of physically separating nucleic acids from a mixture that contains Adenovirus nucleic acid and other sample components.

Amplification of the Adenovirus Target Region

Amplifying a target nucleic acid target region using two or more primers may be accomplished using a variety of known nucleic acid amplification reactions. For example, amplification may be achieved using PCR amplification (US Pat. Nos. 4,683,195, 4,683,202, and 4,800,159, Mullis et al.) to produce multiple DNA strands by using thermocycling reactions that separate dsDNA and primers specific for portions of the separated strands to make additional dsDNA molecules by using a DNA polymerase. Well known variations of the basic PCR method may also be used, e.g., PCR coupled with real-time detection – such as Taqman PCR.

Nucleic Acid Detection

Detection of the nucleic acids may be accomplished by a variety of methods. Detection methods may use nucleic acid probes comprising a target hybridizing sequence that is complementary to a portion of the amplified product and detecting the presence of the probe:product complex, or by using a complex of probes that may amplify the detectable signal associated with the amplified products (e.g., US Pat. Nos. 5,424,413; 5,451,503; 5,849,481; 5,639,604 and 5,283,174). Directly or indirectly labeled probes that specifically associate with the amplified product provide a detectable signal that indicates the presence of the target nucleic acid in the sample. For example, if the target nucleic acid is Adenovirus DNA, the amplified product will contain a sequence in or complementary to an Adenovirus target sequence. A probe is configured to bind directly or indirectly to a portion of the amplification product to indicate the presence of Adenovirus in the tested sample.

In embodiments that detect the amplified product near or at the end of the amplification step, a linear detection probe may be used to provide a signal to indicate hybridization of the probe to the amplified product. One example of such detection uses a luminescently labeled probe that hybridizes to target nucleic acid. Luminescent label is then hydrolyzed from non-hybridized probe. Detection is performed by chemiluminescence using a luminometer (see, e.g., International Patent Application Pub. No. WO 89/002476). In other embodiments that use real-time detection, the detection probe may be a hairpin probe such as, for example, a molecular beacon, molecular torch, or hybridization switch probe that is labeled with a reporter moiety that is detected when the probe binds to amplified product. Such probes may comprise target-hybridizing sequences and non-target-hybridizing sequences. Various forms of such probes are described, e.g., in U.S. Pat. Nos. 5,118,801; 5,312,728; 5,925,517; 6,150,097; 6,849,412; 6,835,542; 6,534,274; and 6,361,945; and US Patent Application Pub. Nos. 20060068417A1 and 20060194240A1).

Homogeneously detectable labels, such as fluorescent labels and electronically detectable labels, are intended for use in the practice of the present disclosure. Examples of detectable labels that are preferred as members of an interactive pair of labels interact with each other by FRET or non-FRET energy transfer mechanisms. Fluorescence resonance energy transfer (FRET) involves the radiationless transmission of energy quanta from the site of absorption to the site of its utilization in the molecule, or system of molecules, by resonance interaction between chromophores, over distances considerably

greater than interatomic distances, without conversion to thermal energy, and without the donor and acceptor coming into kinetic collision. The "donor" is the moiety that initially absorbs the energy, and the "acceptor" is the moiety to which the energy is subsequently transferred, hi addition to FRET, there are at least three other "non-FRET" energy transfer processes by which excitation energy can be transferred from a donor to an acceptor molecule.

When two labels are held sufficiently close that energy emitted by one label can be received or absorbed by the second label, whether by a FRET or non-FRET mechanism, the two labels are said to be in "energy transfer relationship" with each other, wherein fluorescent emission from a fluorophore attached to one portion of the probe is quenched by a quencher moiety on another portion of the probe (e.g., "Taqman" detection probe chemistry). Label moieties for the Taqman probes include a fluorophore and a second moiety having fluorescence quenching properties (i.e., a "quencher"). In this embodiment, the characteristic signal is likely fluorescence of a particular wavelength, but alternatively could be a visible light signal. When fluorescence is involved, changes in emission are preferably due to FRET, or to radiative energy transfer or non-FRET modes. When a detection probe having a pair of interactive labels in the "quenched" state is stimulated by an appropriate frequency of light, a fluorescent signal is generated at a first level, which may be very low. When this same probe is in an "unquenched" state and is stimulated by an appropriate frequency of light, the fluorophore and the quencher moieties are sufficiently separated from each other that energy transfer between them is substantially precluded. Under that condition, the quencher moiety is unable to quench the fluorescence from the fluorophore moiety. If the fluorophore is stimulated by light energy of an appropriate wavelength, a fluorescent signal of a second level, higher than the first level, will be generated. The difference between the two levels of fluorescence is detectable and measurable. Examples of fluorophore/quencher label pairs that may be used in connection with the disclosure, include fluorescein/tetramethylrhodamine, IAEDANS/fluorescein, EDANS/D ABCYL, coumarin/D ABCYL, fluorescein/fluorescein, BODIPY FL/BODIPY FL, fluorescein/D ABCYL, lucifer yellow/D ABCYL, BODIPY/D ABCYL, eosine/D ABCYL, erythrosine/D ABCYL, tetramethylrhodamine/D ABCYL, CalOrange/BHQ1, CalRed/BHQ2, Texas Red/DABCYL, CY5/BH1, CY5/BH2, CY3/BH1, CY3/BH2, fluorescein/QSY7, FAM/BHQ1 and Quasar/BHQ2. Those having an ordinary level of skill in the art will understand that when donor and acceptor dyes are different, energy transfer can be detected by the appearance of sensitized fluorescence of

the acceptor or by quenching of donor fluorescence. When the donor and acceptor species are the same, energy can be detected by the resulting fluorescence depolarization. Non-fluorescent acceptors such as DABCYL and the QSY 7 dyes advantageously eliminate the potential problem of background fluorescence resulting from direct (i.e., non-sensitized) acceptor excitation.

Synthetic techniques and methods of bonding labels to nucleic acids and detecting labels are well known in the art (e.g., see Sambrook et al., *Molecular Cloning. A Laboratory Manual*. 2nd ed. (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989), Chapter 10; Nelson et al., U.S. Patent No. 5,658,737; Woodhead et al., U.S. Patent No. 5,656,207; Hogan et al., U.S. Patent No. 5,547,842; Arnold et al., U.S. Patent No. 5,283,174; Kourilsky et al., U.S. Patent No. 4,581,333), and Becker et al., European Patent App. No. 0 747 706.

Kits

The oligomers for use in the methods described herein are suited for preparation of kits. Such a kit may comprise containers, each with one or more of the various oligomers optionally together with one or more of the reagents (eg. enzymes) required to perform the methods described herein. The components of the kit may be supplied in concentrated form. A set of instructions for using the components of the kit will also typically be included. Where the kit comprises combinations of oligomers then the individual oligomers may be provided in individual form, with appropriate instructions for mixing same, or combinations thereof that are ready mixed.

In one aspect, there is provided a kit comprising the composition of the present disclosure and optionally a set of instructions for performing same.

Correlation of Detection of a Target Sequence with Diagnosis

The detection of amplified target sequences characteristic of Adenovirus, Metapneumovirus, and/or Rhinovirus in a biological sample from an individual is indicative, respectively, of infection by Adenovirus, Metapneumovirus, and/or Rhinovirus.

EXAMPLES

Example 1: Analysis of certain Adenovirus amplification primers and probes

Materials & Methods

5 In a first amplification reaction, the following was used: Fast Start Master Buffer (Roche) at 1 x to 2 x concentration, 2 Units of Fast Start Taq DNA polymerase (Roche), 100nM of a forward amplification primer (SEQ ID No. 5) and 100 nM of a reverse amplification primer (SEQ ID No. 6 or SEQ ID No. 8) and 100 nM probe (SEQ ID No. 10).

10 The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus added per reaction. Control reactions were performed by setting up a reaction as described above but not adding any template nucleic acids. The amplification cycles used were as follows for both sets of amplification reactions: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and
15 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

Table 1: Adenovirus Amplification and Detection with Primer and Probe Sets

	SEQ ID Nos. 5, 6 and 10		SEQ ID Nos. 5, 8 and 10	
	C _T	RFU	C _T	RFU
Target/Sample	26.9	519	26.4	383

20

The results are presented as C_T/RFU (cycle threshold/relative fluorescent unit) values and represent the average of 12 experiments using various Adenovirus serotypes. Amplification was not seen in any of the control reactions.

25 Conclusion

The primers and probes used appeared to be sensitive and specific for Adenovirus nucleic acid.

Example 2: Analysis of further certain Adenovirus amplification primers and probes

Materials & Methods

The following reagents were used: Fast Start Master Buffer (Roche) at 1 x to 2 x concentration, 2 Units of Fast Start Taq DNA polymerase (Roche), 200nM of a forward amplification primer (SEQ ID No. 11 or SEQ ID No. 12) and 200 nM of a reverse amplification primer (SEQ ID No. 13 or SEQ ID No: 15) and 200 nM probe (SEQ ID No. 17 or SEQ ID No. 19).

The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus added per reaction. Control reactions were performed by setting up a reaction as described above but not adding any template nucleic acids. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

15

Results

Table 2. Adenovirus Amplification and Detection with Primer and Probe Sets

	SEQ ID Nos. 11, 13 and 17		SEQ ID Nos. 11, 13 and 19	
	C _T	RFU	C _T	RFU
Target/Sample	8.7	29.8	32	460
	SEQ ID Nos. 11, 15 and 17		SEQ ID Nos. 11, 15 and 19	
	C _T	RFU	C _T	RFU
Target/Sample	13.3	29.5	32.3	406.4
	SEQ ID Nos. 12, 15 and 19		SEQ ID Nos. 12, 15 and 17	
	C _T	RFU	C _T	RFU
Target/Sample	29.6	620	12.6	32.8
	SEQ ID Nos. 12, 13 and 19		SEQ ID Nos. 12, 13 and 17	
	C _T	RFU	C _T	RFU
Target/Sample	29.6	504	8.3	18.9

The results are presented as C_T/RFU values and represent the average of 8 experiments using various Adenovirus serotypes. Amplification was not seen in any of the control reactions.

Conclusion

Combinations of SEQ ID Nos. 11, 13 and 19, SEQ ID Nos. 11, 15 and 19, SEQ ID Nos. 12, 15 and 19 or SEQ ID Nos. 12, 13 and 19 were sensitive and specific for Adenovirus nucleic acid. The combinations comprising the SEQ ID No. 12 forward primer appears to have better sensitivity than the combination comprising the SEQ ID No. 11 forward primer. The combination comprising SEQ ID Nos. 12, 15 and 19 appeared to be most sensitive in these experiments.

Example 3: Adenovirus serotype analysis using SEQ ID Nos. 12, 15 and 19

10 Materials & Methods

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 2 Units of Fast Start Taq DNA polymerase (Roche), 400nM of a forward amplification primer (SEQ ID No. 12) and 400 nM of a reverse amplification primer (SEQ ID No. 15) was used together with 400 nM probe (SEQ ID No. 19). The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus added per reaction. Control reactions were set-up, but no template nucleic acid was added. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

Table 3. Adenovirus Serotype Analysis

Serotype	C _T	RFU
2-1	26	1203
4-1	31	666
6-1	29	926
7-1	32	605
9-1	26	1137
10-1	28	1252
11-1	28	630
12-1	26	1119
13-1	26	1100
14-1	30	682

Serotype	C _T	RFU
15-1	26	1078
16-1	29	723
17-1	23	1100
18-1	34	387
19-1	27	1146
20-1	23	996
21-1	31	568
22-1	25	1044
23-1	23	1109
24-1	25	1221
25-1	32	836
26-1	24	1107
27-1	25	1070
28-1	26	989
29-1	27	1116
30-1	22	1166
31-1	21	1127
33-1	28	941
34-1	28	654
35-1	29	542
36-1	24	997
37-1	24	1125
38-1	26	1033
39-1	23	1143
40-1	27	1114
41-1	25	994
42-1	23	1125
43-1	22	1149
44-1	22	1141
45-1	27	1071
46-1	27	1047
47-1	22	1144

Serotype	C _T	RFU
48-1	25	1174
49-1	26	1068
50-1	25	672
51-1	26	1099
1-1	29	956
3-1	32	540
5-1	29	791
7A-1	26	632
8-1	34	553
32-2	24	974

The Serotype column is set-up to reflect “serotype number-1 x 10^x TCID₅₀/mL.” C_T values have all been rounded down. The results are presented as C_T/RFU values.

5 Conclusion

The combination of SEQ ID Nos. 12, 15 and 19 was able to detect all serotypes of Adenovirus that were tested.

Example 4: Analysis of further Adenovirus probe combinations together with SEQ ID

10 NOS: 12 and 15 primers

Materials & Methods

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 2 Units of Fast Start Taq DNA polymerase (Roche), 100nM of a forward amplification primer (SEQ ID No. 12) and 100 nM of a reverse amplification primer (SEQ ID No. 15) was used together with either: 150 nM probe (SEQ ID No. 21) and 50 nM probe (SEQ ID No. 24); 100 nM probe (SEQ ID No. 21) and 100 nM probe (SEQ ID No. 24); 50 nM probe (SEQ ID No. 21) and 150 nM probe (SEQ ID No. 24). The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus added per reaction. Control reactions were set-up without the addition of template nucleic acid. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

Table 4: Amplification and detection using different concentrations of probe combinations

	150 nM SEQ ID No. 21 and 50 nM SEQ ID No. 24;		100 nM SEQ ID No. 21 and 100 nM SEQ ID No. 24;	
	C _T	RFU	C _T	RFU
Target	34.8	291	26.9	318
	50 nM SEQ ID No. 21 and 150 nM SEQ ID No. 24			
	C _T	RFU		
Target	26.8	339		

The results are presented as C_T/RFU values and represent the average of 6 experiments using various Adenovirus serotypes.

Conclusion

SEQ ID No. 21 and ID No. 24 probes in combination with SEQ ID No. 12 and 15 were able to sensitively and specifically detect Adenovirus at the various concentrations tested.

Example 5: Analysis of further probe and primer combinations for the detection of Adenovirus

Materials & Methods

The following reagents used:

Fast Start Master Buffer (Roche) at 1 x concentration, 2 Units of Fast Start Taq DNA polymerase (Roche) and either: (i) 50mM of a forward amplification primer (SEQ ID No. 25), 50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 27), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21 and SEQ ID No. 23); (ii) 50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 27), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21 and SEQ ID No. 23); (iii) 50mM of a forward amplification primer (SEQ ID No. 25), 50mM of a reverse amplification primer (SEQ ID No. 27), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21 and SEQ ID No. 23); (iv) 50mM of a forward amplification primer (SEQ ID No. 25),

50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21 and SEQ ID No. 23); (v) 50mM of a forward amplification primer (SEQ ID No. 25), 50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21 and SEQ ID No. 23); (vi) 50mM of a forward amplification primer (SEQ ID No. 25), 50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 27), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probe (SEQ ID No. 23); or (vii) 50mM of a forward amplification primer (SEQ ID No. 25), 50mM of a forward amplification primer (SEQ ID No. 26), 50mM of a reverse amplification primer (SEQ ID No. 27), 50mM of a reverse amplification primer (SEQ ID No. 28) and 100 nM of probes (SEQ ID No. 21).

The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus added per reaction. Two different concentrations were tested.

The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

Tables 5a-5d. Amplification and detection using different concentrations and combinations of primers and probes.

Table 5a.

	SEQ ID Nos. 25, 26, 27, 28, 21 and 23		SEQ ID Nos. 26, 27, 28, 21 and 23	
	C _T	RFU	C _T	RFU
Target(10 ¹)	38.5	240	39.2	143
Target(10 ³)	29.8	373	30.8	227

Table 5b.

	SEQ ID Nos. 25, 27, 28, 21 and 23		SEQ ID Nos. 25, 26, 28, 21 and 23	
	C _T	RFU	C _T	RFU

Target(10^1)	37.8	212	41.5	99
Target(10^3)	30.2	275	32	258

Table 5c.

	SEQ ID Nos. 25, 26, 27, 21 and 23		SEQ ID Nos. 25, 26, 27, 28 and 23	
	C_T	RFU	C_T	RFU
Target(10^1)	41.8	96	37.7	254
Target(10^3)	31.8	320	30	360

Table 5d.

	SEQ ID Nos. 25, 26, 27, 28 and 21	
	C_T	RFU
Target (10^1)	7.1	21
Target (10^3)	0	3

5

The results are presented as RFU values and represent the average of 6 experiments for each concentration.

Conclusion

10 Leaving out one of the primers or probes from the assay made little difference for the most part. However, omitting probe SEQ ID No. 23 resulted in lower detection in this particular experiment.

Example 6: Analysis of primer and probe combinations for detecting Adenovirus 18

15 **Materials & Methods**

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 3 Units of Fast Start Taq DNA polymerase (Roche), 150 nM forward amplification primers (SEQ ID No. 25 and SEQ ID No. 26) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 300 nM probe (SEQ ID No. 29).

20 The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from Adenovirus 18 added per reaction. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with

optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

5 Table 6. Amplification and detection of Adenovirus 18.

Serotype	C _T	RFU
18-6	17	1240
18-5	20	975
18-4	24	1242
18-3	30	1023
18-2	33	942
18-1	35	747
18-0	31	1215

The Serotype column is set-up to reflect “serotype number-1 x 10^x TCID₅₀/mL.” C_T values have all been rounded down. The results are presented as C_T/RFU values.

10 Conclusion

This combination of primers and probes successfully detects Adenovirus 18.

Example 7: Analysis of further primer and probe combinations for detecting Adenovirus **Materials & Methods**

15 The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 3 Units of Fast Start Taq DNA polymerase (Roche), 150 nM forward amplification primers (SEQ ID No. 31 and SEQ ID No. 26) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 21 and SEQ ID No. 23). The total reaction volume was 20
20 microlitres with 5 microlitres of template nucleic acid extracted from various Adenovirus serotypes added per reaction. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

25

Results

Table 7. Primer and probe combinations for detecting various Adenovirus serotypes.

Serotype	FAM		Cy5	
	C _T	RFU	C _T	RFU
1	38.7	40	35.9	172
3	37.4	59	35.5	208
4	0	22	37.2	185
7	32.2	711	32	209
11	24.2	843	32.2	190
14	28.8	737	31.9	196
16	23.8	879	32.1	212
21	31.9	671	31.4	219
25	32.8	399	31.7	217
34	29.3	645	31.7	205
35	29.6	771	30.7	220
50	24.6	786	30.9	210

The results are presented as C_T/RFU values. The Fam-channel shows detection results for the template nucleic acids. The Cy5-channel shows detection results for an internal control nucleic acid.

Conclusion

With the exception of serotype 4, this combination of primers and probes successfully detected all of the serotypes tested.

Example 8: Analysis of further primer and probe combinations for detecting Adenovirus

Materials & Methods

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 3 Units of Fast Start Taq DNA polymerase (Roche) and either: (i) 150 nM forward amplification primers (SEQ ID Nos. 33 and 34) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 21 and SEQ ID No. 23); (ii) 150 nM forward amplification primers (SEQ ID Nos. 33 and 35) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 21 and SEQ ID No. 23); or (iii)

150 nM forward amplification primers (SEQ ID Nos. 34 and 35) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 21 and SEQ ID No. 23). The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from various Adenovirus serotypes added per reaction. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

10 Results

Tables 8a-8c. Amplification and detection of various Adenovirus serotypes using combinations of primers and probes.

Table 8a.

Serotype	SEQ ID Nos. 33, 34, 27, 28, 21 and 23			
	FAM		Cy5	
	C _T	RFU	C _T	RFU
1	35.6	318	35.9	243
3	37.3	87	35.8	210
4	36.9	150	35.6	232
19	38.1	95	35.2	217
31	35.7	247	34.6	257
41	36.7	244	35.9	285
14	29.7	868	31.5	250

15 Table 8b.

Serotype	SEQ ID Nos. 33, 35, 27, 28, 21 and 23			
	FAM		Cy5	
	C _T	RFU	C _T	RFU
1	0	12	35.7	248
3	36.4	159	35.1	231
4	36.8	171	35.6	249
19	36.7	151	35.3	181
31	35.8	170	34.6	197
41	39.3	50	36	243

14	29.2	1062	31.5	256
----	------	------	------	-----

Table 8c

Serotype	SEQ ID Nos. 34, 35, 27, 28, 21 and 23			
	FAM		Cy5	
	C _T	RFU	C _T	RFU
1	37.5	198	35.5	199
3	0	5	35.5	213
4	0	15	36.1	158
19	0	12	35.1	224
31	35.6	369	34.6	240
41	36.6	284	35.7	263
14	33.1	942	32.1	203

The results are presented as C_T and RFU values. The Fam-channel shows detection results for the template nucleic acids. The Cy5-channel shows detection results for an internal control nucleic acid.

Conclusion

Table 8a of primers and probes successfully detected all of the serotypes tested. Tables 8b and 8c detected most serotypes tested.

Example 9: Analysis of further primer and probe combinations for detecting Adenovirus

Materials & Methods

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 3 Units of Fast Start Taq DNA polymerase (Roche) and 150 nM forward amplification primers (SEQ ID Nos. 25 and 26) and 150 nM reverse amplification primers (SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 36 and SEQ ID No. 37). The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from the Adenovirus 19 serotype positive control plasmid, which added per reaction at six different concentrations. The amplification cycles used were as follows: Hold for 600 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

Table 9. Amplification and detection of a serial dilution of target nucleic acid

Concentration	FAM	
	C _T	RFU
10 ⁴	28.1	1127
10 ⁴	28.2	1040
10 ⁴	28	1196
10 ³	31.9	938
10 ³	32.1	922
10 ³	32.3	969
10 ²	35.3	865
10 ²	35.4	800
10 ²	35.2	800
10 ¹	37.8	571
10 ¹	33.6	59
10 ¹	38.6	419
10 ⁰	0	10
10 ⁰	0	0
10 ⁰	0	0
10 ⁻¹	0	0
10 ⁻¹	0	0
10 ⁻¹	0	0

The results are presented as C_T/RFU values.

5

Conclusion

These primers and probes successfully detected the control tested Adenovirus 19 serotype.

10 **Example 10: Further analysis of the primer and probe combination from Example 9.**

Materials & Methods

The following reagents used: Fast Start Master Buffer (Roche) at 1 x concentration, 3 Units of Fast Start Taq DNA polymerase (Roche) and 150 nM forward amplification primers (SEQ ID Nos. 25 and 26) and 150 nM reverse amplification primers

(SEQ ID No. 27 and SEQ ID No. 28) were used together with 150 nM probe (SEQ ID No. 36 and SEQ ID No. 37). The total reaction volume was 20 microlitres with 5 microlitres of template nucleic acid extracted from various Adenovirus serotypes and tested at a concentration of 3×10^0 . The amplification cycles used were as follows: Hold for 600
 5 seconds at 95 deg. C with optics off; 95 deg. C. for 30 seconds with optics off and 55 deg. C. for 60 seconds with optics on (5 cycles); 95 deg. C. for 10 seconds with optics off and 55 deg. C. for 60 seconds (40 cycles) with optics on.

Results

10 Table 10. Amplification and detection of Adenovirus target nucleic acids

Serotype	C _T	RFU
2	31.6	1465
5	33.9	903
6	0	0
7	39	366
8	37.4	625
9	32	1223
10	36.3	837
11	26.6	950
12	31.8	1176
13	29.7	1487
14	34	671
15	33.5	1018
16	33.4	729
17	30.2	1622
18	40	175
20	27.2	1217
21	34.1	733
22	31.2	1150
23	30.1	1471
24	33.2	1110
25	37.3	661
26	29.1	1814
27	29.5	1637

Serotype	C _T	RFU
28	34.2	1032
29	32.9	1159
30	28.4	1496
32	26.6	2079
33	33.9	1017
34	34.2	690
35	33.1	702
36	29.1	1312
37	30.2	1393
38	31.8	1202
39	30	1650
40	32.6	1290
42	29.1	1261
43	28.8	1832
44	23.3	1218
45	32.1	1289
46	32.5	1183
47	26.4	1209
48	29.4	1565
49	31.5	1264
50	32	846
51	31.4	1125

The results are presented as C_T and RFU values.

Discussion

All of the serotypes tested were detected using this primer and probe concentration with the exception of serotype 6. This serotype was successfully detected at 3×10^1 TCID₅₀/mL and above.

Example 11. Multiplex amplification and detection of Adenovirus and human Metapneumovirus and Rhinovirus.

10 Materials & Methods

Analytical Sensitivity and Reactivity: A PCR formulation containing primers and probes for the amplification and detection of Adenovirus, human Metapneumovirus, and Rhinovirus was prepared to include (per reaction): 15 uL of Supermix (11.1 Units Taq); 1.2 uL of MMLV reverse transcriptase (RT) (24 Units); 2.0 uL of Primer Probe Mix; 0.084 uL of 0.5M EDTA; and 1.716 uL of Water. (AMR formulation.) Target nucleic acids were extracted from a number of stock organisms¹ and diluted to 0.1 TCID₅₀/mL, 1 TCID₅₀/mL and 10 TCID₅₀/mL for each organism. 10 uL of target nucleic acid elute from each dilution was individually combined with a reaction volume of the PCR formulation for a 30 uL total reaction volume. Primers and probes used in this experiment are shown in SEQ ID NOs:48-49, & 51-74, which include internal controls. Probes used in this example were dual labelled probes comprising quenchers and fluorophores.

A multiplex, real-time PCR reaction was set up using the Panther instrument (Hologic, Inc., San Diego, CA) for sample preparation and the benchtop PCR thermocycler for real-time amplification and detection. Detection reactions used Taqman™ (Roche Molecular Systems, Inc., Pleasanton, CA) chemistry. Adenovirus target nucleic acids were detected in a ROX channel, hMPV nucleic acids were detected in a HEX channel, HRV nucleic acids were detected in a FAM channel, and the internal control was detected in a RED677 channel of the thermocycler. The assay was performed using 10 replicates of each viral target at the known concentrations Each individual sample preparation was evaluated as one real time RT-PCR replicate on a benchtop PCR thermocycler. Positive or negative determinations were made using background subtracted curves. Table 11 thru Table 13 demonstrate 100% hit rate at viral concentrations at or below 10 TCID₅₀/mL.

Subsequent to these studies, two additional bases were added to the 5' end of primer SEQ ID NO:75 to generate primer SEQ ID NO:50. A Rhinovirus sensitivity assay was performed as above with SEQ ID NO:50 in place of SEQ ID NO:75 and the results are presented in Table 14.

Table 11: Rhinovirus detection using AdV/hMPV/RV combined oligonucleotide formulation

Rhinovirus	Concentration (TCID ₅₀ /ml)	Percent Hit Rate (n=10)	Avg Ct	StDev Ct	RFU	StDev RFU

¹ Target nucleic acids were isolated from previously characterized stock organisms obtained from TriCore Reference Laboratories (Albuquerque, NM); ZeptoMetrix Corporation (Buffalo, NY); and ATCC (Manassas, VA).

Rhinovirus A-18	10 ⁰	100%	34.2	0.4	14828	4048
Rhinovirus B-26	10 ⁰	100%	35.1	0.4	4641	662

Table 12: hMPV detection using AdV/hMPV/RV combined oligonucleotide formulation

hMPV	Concentration (TCID50/ml)	Percent Hit Rate (n=10)	Avg Ct	StDev Ct	RFU	StDev RFU
hMPV A1-16	10 ¹	100%	37.7	0.6	3019	630
hMPV A2-20	10 ¹	100%	34.8	0.3	6186	583
hMPV B1-3	10 ¹	100%	35.8	1.0	5818	1357
hMPV B2-8	10 ¹	100%	34.1	0.4	8043	1206

Table 13: Adenovirus detection using AdV/hMPV/RV combined oligonucleotide formulation

5

Adenovirus	Concentration (TCID50/ml)	Percent Hit Rate (n=10)	Avg Ct	StDev Ct	RFU	StDev RFU
AdV 1 (Species C)	10 ⁻¹	100%	38.1	0.8	2919	921
AdV 3 (Species B)	10 ⁰	100%	36.1	0.3	5809	1157
AdV 4 (Species E)	10 ⁻³	100%	37.9	1.9	2738	965
AdV 9 (Species D)	10 ⁻¹	100%	37.6	0.7	2786	831
AdV 12 (Species A)	10 ⁻¹	100%	36.4	0.8	2186	549

AdV 40 (Species F)	10 ⁰	100%	38.5	1.4	2320	1184
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Table 14: Rhinovirus B detection using AdV/hMPV/RV combined oligonucleotide formulation containing SEQ ID NO:74

Rhinovirus	Concentration (TCID ₅₀ /ml)	Percent Hit Rate (n=10)	Avg Ct	StDev Ct	RFU	StDev RFU
Rhinovirus B-26	10 ⁰	100%	36.4	0.3	7509	1459

5 **Conclusion:**

A multiplexed combination of the amplification and detection oligonucleotides presented in this review is capable of detecting viral concentrations at or below 10 TCID₅₀/mL.

10 **Example 12. Clinical Specimen Detection and Clinical Specificity using a Multiplexed Amplification and Detection Assay**

Materials & Methods

PCR formulations (AMR formulation) containing all of the primers and probes listed above in Example 11 (using SEQ ID NO:74) were used to test clinical specimens that had been identified to be Rhinovirus positive, hMPV positive, and/or Adenovirus positive or negative for all three viruses by a commercial assay. The commercial assays include the BioFire FilmArray RVP Respiratory Panel (BioFire Diagnostics, Salt Lake City, UT), the GenMark eSensor Respiratory Virus Panel (RVP) (GenMark Diagnostics, Inc., Carlsbad, CA), and the Luminex xTAG Respiratory Virus Panel (Luminex Corporation, Austin, TX). All samples were extracted using the Panther instrument and PCR cycling was performed on a benchtop PCR thermocycler instrument as described above. The AMR assay detected HRV, hMPV, and Adenovirus in these previously characterized clinical specimens with a concordance of 94.8% (164/173) for HRV, 97.2% (279/287) for hMPV, and 93.2% (466/500) for Adenovirus. The AMR assay identified 86 of 88 clinical specimen as negative, providing a 97.7% concordance with the reference assay (Luminex xTAG Respiratory Virus Panel). In addition the internal control was valid for all clinically negative specimens. The two ‘false positive’ results received using the

AMR formulation assay were determined to be true positives using the GenMark eSensor RVP assay and the Prodesse ProAdeno+ Assay (Hologic, Inc., San Diego, CA). Thus, removing the clinical specimen falsely identified as negative by the Luminex assay indicated a 100% concordance by the AMR assay (86/86).

5 **Conclusion:**

A multiplexed combination of the amplification and detection oligonucleotides presented in this example is capable of detecting viral targets in clinical specimens and demonstrates good concordance with competitor assays.

10 **Specificity**

Materials & Methods

A PCR formulation (AMR formulation) containing all of the primers and probes listed in Example 11 (using SEQ ID NO:74) were evaluated for cross reactivity with other organisms. These organisms are those commonly found in specimen type (nasopharyngeal and lower respiratory specimens) that are tested in the clinic for the presence or absence of one or more of Adenovirus, hMPV and HRV. Organisms were either pooled and tested or tested individually (see, AMR panels 1 thru 26 in Table 15). Three replicates from each panel were individually processed on the Panther instrument and PCR cycling was performed on a benchtop PCR thermocycler instrument as described above. Table 15 demonstrates that only viruses targeted by the AMR formulation (AMR 24-26) were detected. Cross-reactivity with organisms not targeted by the assay (AMR 1 – 23) was not observed.

Table 15: Organisms and concentrations of the AMR formulation specificity panel²

Panel	Organism	Test Concentration	Cross- Reactivity Results
AMR 1	Acinetobacter baumannii 307-0294	1x10 ^{7.6} CFU/ml	Not observed
	Cornavirus 229E	1x10 ^{4.0} TCID50/ml	Not observed

² Target nucleic acids were isolated from previously characterized stock organisms obtained from TriCore Reference Laboratories (Albuquerque, NM); ZeptoMetrix Corporation (Buffalo, NY); and ATCC (Manassas, VA).

	Bordetella parapertussis	1x10 ^{7.2} CFU/ml	Not observed
	Burkholderia cepacia Z066	1x10 ^{8.0} CFU/ml	Not observed
	Candida albicans Z006	1x10 ^{6.5} CFU/ml	Not observed
	Chlamydia pneumoniae	1x10 ^{5.8} CFU/ml	Not observed
AMR 2	Bordetella pertussis	1x10 ^{7.6} CFU/ml	Not observed
	Candida glabrata Z007	1x10 ^{6.9} CFU/ml	Not observed
	Chlamydia trachomatis	1x10 ^{5.8} CFU/ml	Not observed
	Corynebacterium diphtheriae Z116	1x10 ^{7.9} CFU/ml	Not observed
	Cornavirus NL63	1x10 ^{3.5} TCID50/ml	Not observed
	Cytomegalovirus AD-169, MRC-5	1x10 ^{3.9} TCID50/ml	Not observed
AMR 3	E. coli ETEC; ST+, LT+	1x10 ^{7.8} CFU/ml	Not observed
	HPIV-1	1x10 ^{3.7} TCID50/ml	Not observed
	HSV-1 Macinytre Strain	1x10 ^{5.8} TCID50/ml	Not observed
	Cornavirus OC43	1x10 ^{5.3} TCID50/ml	Not observed
	IA/California/07/2009 2009 H1N1	1x10 ^{3.5} TCID50/ml	Not observed
	Lactobacillus acidophilus Z048	1x10 ^{6.7} CFU/ml	Not observed
AMR 4	HPIV-2	1x10 ^{5.6} TCID50/ml	Not observed

	Neisseria elongata Z071	1x10 ^{8.1} CFU/ml	Not observed
	RSV A	1x10 ^{6.1} TCID50/ml	Not observed
	IA/Massachusetts/15/13 2009 H1N1	1x10 ^{3.4} TCID50/ml	Not observed
	Legionella pneumophila Philadelphia	1x10 ^{8.5} CFU/ml	Not observed
	Mycobacterium intracellular lysate	1x10 ^{5.6} CFU/ml	Not observed
AMR 5	HPIV-3	1x10 ^{6.1} TCID50/ml	Not observed
	HSV-2 Type 2G Strain	1x10 ^{4.8} TCID50/ml	Not observed
	IA/Victoria/361/2011	1x10 ^{3.5} TCID50/ml	Not observed
	Staphylococcus aureus MSSA	1x10 ^{7.9} CFU/ml	Not observed
	Epstein-Barr Virus B95-8	1x10 ^{6.8} copies/ml	Not observed
	Haemophilus Influenzae type b; Eagan	1x10 ^{7.2} CFU/ml	Not observed
AMR 6	HPIV-4a	1x10 ^{4.0} TCID50/ml	Not observed
	IA/Switzerland/9715293/2013 H3N2	1x10 ^{3.4} TCID50/ml	Not observed
	Mycoplasma pneumoniae M129	1x10 ^{6.1} CFU/ml	Not observed
	Streptococcus pyogenes Z018	1x10 ^{7.7} CFU/ml	Not observed
	Staphylococcus haemolyticus Z067	1x10 ^{7.3} CFU/ml	Not observed
	Lactobacillus plantarum 17-5	1x10 ^{7.2} CFU/ml	Not observed

AMR 7	Legionella micdadei Tatlock	1x10 ^{7.7} CFU/ml	Not observed
	IB/Brisbane/33/08	1x10 ^{3.45} TCID50/ml	Not observed
	Staphylococcus epidermidis MRSE	1x10 ^{7.8} TCID50/ml	Not observed
	Streptococcus agalactiae	1x10 ^{7.2} CFU/ml	Not observed
	Klebsiella pneumonia Z026	1x10 ^{8.1} CFU/ml	Not observed
AMR 8	Measles Virus	1x10 ^{3.7} TCID50/ml	Not observed
	Moraxella catarrhalis Ne 11	1x10 ^{5.3} CFU/ml	Not observed
	IB/Massachusetts/2/2012	1x10 ^{3.5} TCID50/ml	Not observed
	Streptococcus pneumoniae	1x10 ^{6.2} CFU/ml	Not observed
	Mumps Virus 1	1x10 ^{4.3} TCID50/ml	Not observed
AMR 9	Mycobacterium tuberculosis lysate	1x10 ^{5.4} TCID50/ml	Not observed
	Neisseria meningitidis A	1x10 ^{7.2} CFU/ml	Not observed
	Mycoplasma hominis	1x10 ^{3.3} CFU/ml	Not observed
	RSV B	1x10 ^{6.4} TCID50/ml	Not observed
	Streptococcus salivarius	1x10 ^{6.7} CFU/ml	Not observed
AMR 10	Pseudomonas aeruginosa Z139	1x10 ^{8.3} CFU/ml	Not observed
	Serratia marcescens Z053	1x10 ^{7.9} CFU/ml	Not observed

	Streptococcus sanguinis Z089	1x10 ^{7.3} CFU/ml	Not observed
	Ureaplasma urealyticum	1x10 ^{8.0} CFU/ml	Not observed
	Varicella Zoster Virus Ellen	1x10 ^{3.5} TCID50/ml	Not observed
AMR 11	Coxsackie B3	1x10 ^{6.6} TCID50/ml	Not observed
AMR 12	Coxsackie B4	1x10 ^{3.8} TCID50/ml	Not observed
AMR 13	Coxsackie B5/10/2006	1x10 ^{5.8} TCID50/ml	Not observed
AMR 14	Coxsackievirus A10	1x10 ^{3.7} TCID50/ml	Not observed
AMR 15	Coxsackievirus A21	1x10 ^{3.9} TCID50/ml	Not observed
AMR 16	Echovirus 6	1x10 ^{6.3} TCID50/ml	Not observed
AMR 17	Enterovirus 11	1x10 ^{6.8} TCID50/ml	Not observed
AMR 18	Enterovirus 2	1x10 ^{6.8} TCID50/ml	Not observed
AMR 19	Enterovirus 3	1x10 ^{4.8} TCID50/ml	Not observed
AMR 20	Enterovirus 68	1x10 ^{2.8} TCID50/ml	Not observed
AMR 21	Enterovirus 70	1x10 ^{3.8} TCID50/ml	Not observed
AMR 22	Enterovirus 71	1x10 ^{6.2} TCID50/ml	Not observed
AMR 23	Poliovirus 1	1x10 ^{6.3} TCID50/ml	Not observed
AMR 24	Adenovirus 1	1x10 ^{6.3} TCID50/ml	17.3 AdV Ct

	hMPV-3 Subtype B1	1x10 ^{6.1} TCID50/ml	22.9 hMPV Ct
	Rhinovirus 1A	1x10 ^{4.4} TCID50/ml	22.5 RV Ct
AMR 25	Adenovirus 4	1x10 ^{3.7} TCID50/ml	21.4 AdV Ct
	hMPV-9 Subtype A1	1x10 ^{7.5} TCID50/ml	19.1 hMPV Ct
	Rhinovirus 26B	1x10 ^{3.7} TCID50/ml	24.0 RV Ct
AMR 26	Adenovirus 7a	1x10 ^{5.6} TCID50/ml	16.9 AdV Ct

Ct = cycle time.

Conclusion:

A multiplexed combination of the amplification and detection oligonucleotides presented in this review exhibits specificity for the targets of the AdV/hMPV/RV assay.

As described above in Example 11, SEQ ID NO:50 was subsequently substituted by SEQ ID NO:75 in the multiplex reagent. This modified PCR reaction formulation was tested in an amplification and detection reaction using clinical samples and challenge organisms. The modified AMR formulation provided results similar to those shown in this Example 12 (data not shown).

Exemplary nucleic acid sequences.

The instant Table 16 provides exemplary sequences that are useful with the present disclosure. This table does not limit the scope of the disclosure. Sequences are presented according to World Intellectual Property Organization (WIPO) Handbook on Industrial Property Information and Documentation, Standard ST.25 (1998), including Tables 1 through 6 of Appendix 2.

Table 16. Exemplary nucleic acid sequences

SEQ ID No	Sequence 5' > 3'
1	CAGGACGCCTCGGRGTAYCTSAG
2	GGAGCCACVGTGGGRTT
3	AAYCCCACBGTGGCTCC
4	CCGGGTCTGGTGCAGTTTGCCCGC
5	CACATCGCCGGACAGGA
6	CATACTGAAGTAGGTGTCTGT
7	ACAGACACCTACTTCAGTATG
8	CGGTGGTCACATCGTGG
9	CCACGATGTGACCACCG
10	AGTACCTCAGTCCGGGTCTGGTG
11	ATGGCTACCCCTTCGATG
12	ACCCCMTCGATGATGCC
13	GCGGGCGAATTGCACCA
14	TGGTGCAATTCGCCCGC
15	GCGGGCAAAYTGCACCA
16	TGGTGCAATTCGCCCGC
17	GACTCAGGTACTCCGAAGCATCCT
18	AGGATGCTTCGGAGTACCTGAGTC
19	CTCAGGTACTCCGAGGCGTCCT
20	AGGACGCCTCGGAGTACCTGAG
21	CTCAGGTACTCCGAAGCATCCT
22	AGGATGCTTCGGAGTACCTGAG

23	CAGGTA ^T CCGAGGCGTCCT
24	AGGACGCCTCGGAGTACCTG
25	ACCCCATCGATGATGCC
26	ACCCCTCGATGATGCC
27	GCGGGCAA ^A CTGCACCA
28	GCGGGCAA ^A TTGCACCA
29	CTCAGGTATTCCGAGGCATCCT
30	AGGATGCCTCGGAATACCTGAG
31	ACCCCATCGATGCTGCC
32	ACCCCATCGATGATGCC
33	TGGGCGTACATGCACATC
34	GTGGTCTTACATGCACATC
35	GTGGGCATACATGCACATC
36	AGGATGCTTCGGAGTACCTGAG
37	AGGACGCCTCGGAGTACCTG
38	ARTGGKCDTACATGCACATC
39	CAGGACGCCTCGGAGTACCT
40	AGGATGCTTCGGAGTACCTGAG
41	CACGATGTGACCACAGA
42	CAYGATGTGACCACAGA
43	CACGAYGTGACCACAGA
44	CACGATGTGACCACSGA
45	CACGATGTGACCACVGA
46	CAYGAYGTGACCACVGA
47	Human adenovirus 9 gene for hexon, complete cds AB330090.1 and gi number GI:190356540
48	AGCCTGCGTGGCGGCCA
49	AGCCUGCGTGGTGCCUGCC
50	CACTAGTUTGGTCGATGAGGCT
51	CCATCTGTAGATTAGGGUAATGAGGCT
52	CCCAACTTTGCAAGTGTTGTTCTCGG
53	CCCAATTTTGCTAGTGTTGTTCTTGG
54	CCUGCGTGGCTGCCTGC

55	CGTCGACCGAAGTCCTGCAAAGGTCAC
56	CTGCTGCTGAAAATAGTTCTGTGTTTGG
57	GAAACACGGACACCCAAAGTAGT
58	GGCCTCTGCTAAAGCAACACC
59	GTAGATCGGGGCAATGGGGCT
60	GTAGATCGGGGTAATGGGGCT
61	GTGGCGCGGGCGAACTGC
62	GTTGCACGGGCGAACTGC
63	TACATGCACATCGCCGGGCAGGA
64	TACATGCACATCTCGGGCCAGGA
65	TAGACCTGGCAGATGAGGC
66	TGCCGCAGAACGTTGCGAA
67	TGCCTCAGGCTTAGGCATAATAGGTATGTATCG
68	TGCTGCAGAAAATAGCTCTGTGTTTGG
69	TGCTTCAGGTCTAGGTATAATCGGAATGTACAG
70	TGCTTCAGGTTTAGGCATAATCGGAATGTACAG
71	TGGCCACTCCGTCGATGATG
72	TGGCTACCCCATCGATGATG
73	TGGCTACCCCATCGATGCTG
74	TGGCTACCCCATCGATGATG
75	CTAGTUTGGTCGATGAGGCT
76	Human rhinovirus C isolate Resp_4051/07 5' UTR. HM581865.1 GI:302378331
77	CCATCTGTAGRTYRGGGYAATGRGGCTAC
78	GTAGATTAGGGUAATGAGGCTAC
79	GTAGATTAGGGUAATGAGGCT
80	GTAGATCRGGGUAATGGGGCT
81	GTAGATCRGGGYAATGGGGCT
82	GTAGATCRGGGUAATGRGGCT
83	GTAGATCGGGGTAATGGGGCTAC
84	GTAGATCGGGGCAATGGGGCTAC
85	GTAGATCRGGGYAATGRGG
86	GTAGATCRGGGYAATGRGGCTAC

87	AGCCTGCGTGGYKSCCWRCC
88	AGCCYGCGTGGTGCCCYGCC
89	CUGCGTGGTGCCCYGCC
90	CYGCGTGGTGCCCUGCC
91	AGCCYGCGTGGTGC
92	AGCCTGCGTGGCGGCCA
93	AGCCYGCGTGGTGCCC
94	CCUGCGTGGCTGCCTGC
95	GRTTAGCCRCATTCAGGGGCCGGAGGA
96	GAAACACGGACACCCAAAGTAGTYGGTYCCRTCCC
97	AAGTAGTTGGTCCCATCCC
98	AAGTAGTTGGTTCCATCCC
99	AAGTAGTCGGTCCCATCCC
100	AAGTAGTTGGTCCCGTCCC
101	Human rhinovirus 37 5' UTR EU096024.1
102	CACTAGTTTGGYCGATGAGGCT
103	CTAGTYTGGTCGATGAGGC
104	CTAGTYTGGTCGATGAGG
105	GTYTGGTCGATGAGGC
106	TAGTYTGGTCGATGAGGCT
107	TAGTUTGGTCGATGAGGCT
108	RCATTCAGGGGCCGGAGG
109	AGCCTGCGTGGCGGCCARCC
110	CCUGCGTGGCTGCCTRC
111	CTGCGTGGTGCCCTACC
112	CCYGCGTGGCTGCCTAC
113	AGCCYGCGTGGCTG
114	AGCCYGCGTGGCTGCC
115	GRTTAGCCRCATTCRGGRGCCGGAGGA
116	GCATTCAGGGGCCGGAGG
117	GAAACACGGACACCCAAAGTAGTYGG
118	GAAACACGGACACCCAAAGTAGTYGGTCC
119	AAGTAGTCGGTCCCGTCCC

120	Human rhinovirus A2 EU095989.1 GI:158830711
121	YRGRCYTGGCAGATGRGGC
122	TARACCTGGCAGATGRGGC
123	TAGACCTGGCAGATGGGGC
124	TAGACCTGGCAGATGRGGC
125	TARACCTGGCAGATGGGGC
126	TARACCTGGTAGATGRGGC
127	TARACCTGGCAGATGRG
128	TARACCTGGCAGATGRGG
129	CARACCTGGCAGATGRGGC
130	CCTGCCAGATGRGGC
131	WGCCTGCGYGGCKGCCWRC
132	CCYGC GCGGCTGCCTRC
133	CCYGC GTGGCTGCCTRC
134	CCYGC GTGGCTGCCTGC
135	WGCCYGC GTGGCTGCCTGC
136	AGCCYGC GTGGCTGCCTGC
137	GRRTAGCCGCATT CRGGRGCCGGAGGA
138	TACATGCACATCKCSGGVCAGGAYGCYTCGGAGTACCTGAGCCCCG
139	ACGCCTCGGAGTACCTGAGCCC
140	CGGGGCTCAGGTACTCCGAGGCGT
141	GTKGCRCGGGCRAAYTGCACCA
142	GTKGCRCGGGCRAACTGC
143	GTGGCGCGGGCAA ACTG
144	GTKGCRCGGGCRAACTGC
145	GTGGCRCGGGCRAACTGC
146	GTKGCRCGGGCRAACTGC
147	GTGGCGCGGGCRAACTGC
148	GTGGCRCGGGCRAACTGC
149	GTKGCRCGGGCRAACTGC
150	Human metapneumovirus isolate NL/1/99, complete genome. AY525843.1 GI:50059145
151	CSSCCAATTTTGCTAGTGTTGTTCTTGG

152	CGGCCAATTTTGCTAGTGTTGTTCTTGG
153	CAATTTTGCTAGTGTTGTTCTTGG
154	CCAATTTTGCTAGTGTTGTTCTTGG
155	TGCTTCAGGTYTAGGYATAATCGGAATGTWCAGAGG
156	TGCTTCAGGTTTAGGCATAATCGGAATGTTTCAGAGG
157	TGCTTCAGGTCTAGGTATAATCGGAATGT
158	GCAGAAAATAGCTCTGTGTTTGG
159	Human metapneumovirus isolate SIN05NTU84 nucleoprotein (N) gene, partial cds JQ309642.1 GI:374721604
160	CTTTGCAAGTGTTGTTCTCGG
161	TGCCTCAGGCYTAGGCATAATMGGYATGTATCGHGGG
162	TCAGGCTTAGGCATAATAGGTATGTATCG
163	CCTCAGGCTTAGGCATAATAGGTATGTATCGAG
164	CCTCAGGCTTAGGCATAATAGGTATGTATCG
165	CCTCAGGCTTAGGCATAATAGGTATGTATCGCG
166	CCTCAGGCTTAGGCATAATAGGTATGTATCGUG
167	TGCCTCAGGCCTAGGCATAATCGGCATGTATCGUGGG
168	TGCCTCAGGCCTAGGCATAATCGGCATGTATCGTGGG
169	CTCAGGCTTAGGCATAATAGGTATGTATCGCG
170	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGC
171	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGCG
172	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGCGG
173	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGUGGG
174	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGAGGG
175	TGCCTCAGGCTTAGGCATAATCGGTATGTATCGCGGG
176	TGCCTCAGGCTTAGGCATAATAGGTATGTATCGCGGG
177	CTGCTGCWGAAAATAGYTCTGTGTTTGG
178	TGCTGAAAATAGTTCTGTGTTTGG

Sequence symbols are per Table 1 of World Intellectual Property Organization (WIPO) Handbook on Industrial Property Information and Documentation, Standard ST.25 (1998) (“WIPO ST.25 (1998)”).

5 The contents of the articles, patents, and patent applications, and all other documents and electronically available information mentioned or cited herein, are hereby

incorporated by reference in their entirety to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference. Applicants reserve the right to physically incorporate into this application any and all materials and information from any such articles, patents, patent applications, or other
5 physical and electronic documents.

The methods illustratively described herein may suitably be practiced in the absence of any element or elements, limitation or limitations, not specifically disclosed herein. It is recognized that various modifications are possible within the scope of the disclosure claimed. Thus, it should be understood that although the present disclosure has
10 been specifically disclosed by preferred embodiments and optional features, modification and variation of the disclosure embodied therein herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this disclosure.

The disclosure has been described broadly and generically herein. Each of the
15 narrower species and subgeneric groupings falling within the generic disclosure also form part of the methods. This includes the generic description of the methods with a proviso or negative limitation removing any subject matter from the genus, regardless of whether or not the excised material is specifically recited herein.

Other embodiments are within the following claims. In addition, where features
20 or aspects of the methods are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

CLAIMS

What is claimed is:

1. A composition comprising a combination of amplification oligomers configured for amplification of an Adenovirus target nucleic acid and at least one additional target nucleic acid selected from the group consisting of a Metapneumovirus target nucleic acid and a Rhinovirus target nucleic acid, wherein:

(A) for the Adenovirus target nucleic acid, a first Adenovirus amplification oligomer and a second Adenovirus amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 52 to 74 of SEQ ID NO:47, nucleotide positions 76 to 99 of SEQ ID NO:47, nucleotide positions 40 to 56 of SEQ ID NO:47, nucleotide positions 65 to 87 of SEQ ID NO:47, nucleotide positions 1 to 18 of SEQ ID NO:47, nucleotide positions 7 to 23 of SEQ ID NO:47, nucleotide positions 28 to 45 of SEQ ID NO:47, nucleotide positions 27 to 45 of SEQ ID NO:47, nucleotide positions 26 to 45 of SEQ ID NO:47, nucleotide positions 139 to 155 of SEQ ID NO:47, nucleotide positions 103 to 123 of SEQ ID NO:47, nucleotide positions 159 to 175 of SEQ ID NO:47, nucleotide positions 83 to 99 of SEQ ID NO:47, and nucleotide positions 83 to 98 of SEQ ID NO:47; and

(B) for the at least one additional target nucleic acid,

(1) a first Metapneumovirus amplification oligomer and a second Metapneumovirus amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 966 to 1147 of SEQ ID NO:150, nucleotide positions 844 to 1027 of SEQ ID NO:159, nucleotide positions 1000 to 1040 of SEQ ID NO:150, nucleotide positions 880 to 915 of SEQ ID NO:159, nucleotide positions 1027 to 1080 of SEQ ID NO:150, nucleotide positions 913 to 958 of SEQ ID NO:159, nucleotide positions 1073 to 1115 of SEQ ID NO:150, and nucleotide positions 953 to 995 of SEQ ID NO:159; and/or

(2) a first Rhinovirus amplification oligomer and a second Rhinovirus amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about

50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 230 to 556 of SEQ ID NO:120, nucleotide positions 199 to 525 of SEQ ID NO:101, nucleotide positions 80 to 410 of SEQ ID NO:76, nucleotide positions 263 to 303 of SEQ ID NO:120, nucleotide positions 231 to 264 of SEQ ID NO:101, nucleotide positions 106 to 156 of SEQ ID NO:76, nucleotide positions 312 to 346 of SEQ ID NO:120, nucleotide positions 279 to 314 of SEQ ID NO:101, nucleotide positions 455 to 506 of SEQ ID NO:76, nucleotide positions 480 to 533 of SEQ ID NO:120, nucleotide positions 455 to 506 of SEQ ID NO:101, and nucleotide positions 338 to 397 of SEQ ID NO:76.

2. The composition of claim 1, further comprising an Adenovirus detection probe oligomer configured to hybridize to a region of the Adenovirus amplicon, wherein the Adenovirus detection probe oligomer comprises at least one of

(i) a detectable label,

(ii) a substitution at the 2' position of at least one ribose moiety,

(iii) a blocking moiety at or near the 3' end of the detection probe oligomer, wherein the blocking moiety is configured to prevent enzyme-mediated extension of the detection probe in an amplification reaction, and

(iv) a non-target-hybridizing sequence that contributes to the three-dimensional conformation of the detection probe oligomer.

3. The composition of claim 1, further comprising

(a) a Metapneumovirus detection probe oligomer configured to hybridize to a region of the Metapneumovirus amplicon, if the first and second Metapneumovirus amplification oligomers are present, and/or

(b) a Rhinovirus detection probe oligomer configured to hybridize to a region of the Rhinovirus amplicon, if the first and second Rhinovirus amplification oligomers are present.

4. The composition of claim 1, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:1, 5, 11, 12, 25, 26, 31 to 34, 35, 38, and 71 to 74; and/or

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:2, 3, 6 to 9, 13 to 16, 27, 28, 42 to 46, 61, 62, and 138 to 149.

5. The composition of claim 4, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:71, 72, 73, and 74; and

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:61 and 62.

6. The composition of claim 1, wherein the composition comprises the first and second Metapneumovirus amplification oligomers, wherein

the first Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:52, 53, 151, 152, 153, 154, and 160; and/or

the second Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:56, 68, 158, 177, and 178.

7. The composition of claim 1, wherein the composition comprises the first and second Rhinovirus amplification oligomers, wherein

the first Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, and 121 to 130; and/or

the second Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:57, 95 to 100, 115 to 119, and 137.

8. A dried composition comprising:

(A) a combination of amplification oligomers configured for amplification of an Adenovirus target nucleic acid and at least one additional target nucleic acid selected from the group consisting of a Metapneumovirus target nucleic acid and a Rhinovirus target nucleic acid, wherein

(1) for the Adenovirus target nucleic acid, a first Adenovirus amplification oligomer and a second Adenovirus amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 52 to 74 of SEQ ID NO:47, nucleotide positions 76 to 99 of SEQ ID NO:47, nucleotide positions 40 to 56 of SEQ ID NO:47, nucleotide positions 65 to 87 of SEQ ID NO:47, nucleotide positions 1 to 18 of SEQ ID NO:47, nucleotide positions 7 to 23 of SEQ ID NO:47, nucleotide positions 28 to 45 of SEQ ID NO:47, nucleotide positions 27 to 45 of SEQ ID NO:47, nucleotide positions 26 to 45 of SEQ ID NO:47, nucleotide positions 139 to 155 of SEQ ID NO:47, nucleotide positions 103 to 123 of SEQ ID NO:47, nucleotide positions 159 to 175 of SEQ ID NO:47, nucleotide positions 83 to 99 of SEQ ID NO:47, and nucleotide positions 83 to 98 of SEQ ID NO:47; and

(2) for the at least one additional target nucleic acid,

(a) a first Metapneumovirus amplification oligomer and a second Metapneumovirus amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide

positions 966 to 1147 of SEQ ID NO:150, nucleotide positions 844 to 1027 of SEQ ID NO:159, nucleotide positions 1000 to 1040 of SEQ ID NO:150, nucleotide positions 880 to 915 of SEQ ID NO:159, nucleotide positions 1027 to 1080 of SEQ ID NO:150, nucleotide positions 913 to 958 of SEQ ID NO:159, nucleotide positions 1073 to 1115 of SEQ ID NO:150, and nucleotide positions 953 to 995 of SEQ ID NO:159; and/or

(b) a first Rhinovirus amplification oligomer and a second Rhinovirus amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 230 to 556 of SEQ ID NO:120, nucleotide positions 199 to 525 of SEQ ID NO:101, nucleotide positions 80 to 410 of SEQ ID NO:76, nucleotide positions 263 to 303 of SEQ ID NO:120, nucleotide positions 231 to 264 of SEQ ID NO:101, nucleotide positions 106 to 156 of SEQ ID NO:76, nucleotide positions 312 to 346 of SEQ ID NO:120, nucleotide positions 279 to 314 of SEQ ID NO:101, nucleotide positions 455 to 506 of SEQ ID NO:76, nucleotide positions 480 to 533 of SEQ ID NO:120, nucleotide positions 455 to 506 of SEQ ID NO:101, and nucleotide positions 338 to 397 of SEQ ID NO:76;

(B) an inorganic salt;

(C) a polymerase enzyme having 5' to 3' exonuclease activity;

(D) a reverse transcriptase; and

(E) dNTPs.

9. The dried composition of claim 8, further comprising an Adenovirus detection probe oligomer configured to hybridize to a region of the Adenovirus amplicon, wherein the Adenovirus detection probe oligomer comprises at least one of

(i) a detectable label,

(ii) a substitution at the 2' position of at least one ribose moiety,

(iii) a blocking moiety at or near the 3' end of the detection probe oligomer, wherein the blocking moiety is configured to prevent enzyme-mediated extension of the detection probe in an amplification reaction, and

(iv) a non-target-hybridizing sequence that contributes to the three-dimensional conformation of the detection probe oligomer.

10. The dried composition of claim 8, further comprising

(a) a Metapneumovirus detection probe oligomer configured to hybridize to a region of the Metapneumovirus amplicon, if the first and second Metapneumovirus amplification oligomers are present, and/or

(b) a Rhinovirus detection probe oligomer configured to hybridize to a region of the Rhinovirus amplicon, if the first and second Rhinovirus amplification oligomers are present.

11. The dried composition of claim 8, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:1, 5, 11, 12, 25, 26, 31 to 34, 35, 38, and 71 to 74; and/or

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:2, 3, 6 to 9, 13 to 16, 27, 28, 42 to 46, 61, 62, and 138 to 149.

12. The dried composition of claim 11, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:71, 72, 73, and 74; and

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:61 and 62.

13. The dried composition of claim 8, wherein the dried composition comprises the first and second Metapneumovirus amplification oligomers, wherein

the first Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:52, 53, 151, 152, 153, 154, and 160; and/or

the second Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:56, 68, 158, 177, and 178.

14. The dried composition of claim 8, wherein the dried composition comprises the first and second Rhinovirus amplification oligomers, wherein

the first Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, and 121 to 130; and/or

the second Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:57, 95 to 100, 115 to 119, and 137.

15. A formulation for amplification and detection of an Adenovirus target nucleic acid and at least one additional target nucleic acid selected from the group consisting of a Metapneumovirus target nucleic acid and a Rhinovirus target nucleic acid, the formulation comprising:

(A) a combination of amplification oligomers configured for amplification of the Adenovirus target nucleic acid and at least one additional target nucleic acid, wherein

(1) for the Adenovirus target nucleic acid, a first Adenovirus amplification oligomer and a second Adenovirus amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 52 to 74 of SEQ ID NO:47, nucleotide positions 76 to 99 of SEQ ID NO:47, nucleotide positions 40 to 56 of SEQ ID

NO:47, nucleotide positions 65 to 87 of SEQ ID NO:47, nucleotide positions 1 to 18 of SEQ ID NO:47, nucleotide positions 7 to 23 of SEQ ID NO:47, nucleotide positions 28 to 45 of SEQ ID NO:47, nucleotide positions 27 to 45 of SEQ ID NO:47, nucleotide positions 26 to 45 of SEQ ID NO:47, nucleotide positions 139 to 155 of SEQ ID NO:47, nucleotide positions 103 to 123 of SEQ ID NO:47, nucleotide positions 159 to 175 of SEQ ID NO:47, nucleotide positions 83 to 99 of SEQ ID NO:47, and nucleotide positions 83 to 98 of SEQ ID NO:47; and

(2) for the at least one additional target nucleic acid,

(a) a first Metapneumovirus amplification oligomer and a second Metapneumovirus amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 966 to 1147 of SEQ ID NO:150, nucleotides 844 to 1027 of SEQ ID NO:159, nucleotide positions 1000 to 1040 of SEQ ID NO:150, nucleotide positions 880 to 915 of SEQ ID NO:159, nucleotide positions 1027 to 1080 of SEQ ID NO:150, nucleotide positions 913 to 958 of SEQ ID NO:159, nucleotide positions 1073 to 1115 of SEQ ID NO:150, and nucleotide positions 953 to 995 of SEQ ID NO:159; and/or

(b) a first Rhinovirus amplification oligomer and a second Rhinovirus amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 230 to 556 of SEQ ID NO:120, nucleotide positions 199 to 525 of SEQ ID NO:101, nucleotide positions 80 to 410 of SEQ ID NO:76, nucleotide positions 263 to 303 of SEQ ID NO:120, nucleotide positions 231 to 264 of SEQ ID NO:101, nucleotide positions 106 to 156 of SEQ ID NO:76, nucleotide positions 312 to 346 of SEQ ID NO:120, nucleotide positions 279 to 314 of SEQ ID NO:101, nucleotide positions 455 to 506 of SEQ ID NO:76, nucleotide positions 480 to 533 of SEQ ID NO:120, nucleotide positions 455 to 506 of SEQ ID NO:101, and nucleotide positions 338 to 397 of SEQ ID NO:76;

(B) a combination of detection probe oligomers comprising

(1) an Adenovirus detection probe oligomer configured to hybridize to a region of the Adenovirus amplicon; and

(2) at least one additional detection probe oligomer comprising

(a) a Metapneumovirus detection probe oligomer configured to hybridize to a region of the Metapneumovirus amplicon, if the first and second Metapneumovirus amplification oligomers are present; and/or

(b) a Rhinovirus detection probe oligomer configured to hybridize to a region of the Rhinovirus amplicon, if the first and second Rhinovirus amplification oligomers are present;

(E) a polymerase enzyme having 5' to 3' exonuclease activity;

(F) a reverse transcriptase;

(G) dNTPs;

(H) EDTA; and

(I) water.

16. The formulation of claim 15, wherein each of the detection probe oligomers comprises a detectable label.

17. The formulation of claim 16, wherein each of the detection probe oligomers is a dual labeled detection probe oligomer comprising a fluorescent detectable label and a quencher moiety that can quench a fluorescent emission from the fluorescent label.

18. The formulation of claim 15, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:1, 5, 11, 12, 25, 26, 31 to 34, 35, 38, and 71 to 74; and/or

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:2, 3, 6 to 9, 13 to 16, 27, 28, 42 to 46, 61, 62, and 138 to 149.

19. The formulation of claim 18, wherein

the first Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:71, 72, 73, and 74; and

the second Adenovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:61 and 62.

20. The formulation of claim 15, wherein the formulation comprises the first and second Metapneumovirus amplification oligomers, wherein

the first Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:52, 53, 151, 152, 153, 154, and 160; and/or

the second Metapneumovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:56, 68, 158, 177, and 178.

21. The formulation of claim 15, wherein the formulation comprises the first and second Rhinovirus amplification oligomers, wherein

the first Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:50, 51, 59, 60, 65, 75, 77 to 86, 102 to 108, and 121 to 130; and/or

the second Rhinovirus amplification oligomer comprises a target hybridizing sequence selected from the group consisting of SEQ ID NOs:57, 95 to 100, 115 to 119, and 137.

22. A method for determining the presence or absence of an Adenovirus target nucleic acid and at least one additional target nucleic acid in a sample, wherein the at least one additional target nucleic acid is selected from a Metapneumovirus target nucleic acid and a Rhinovirus target nucleic acid, the method comprising the steps of:

(A) contacting the sample with a combination of amplification oligomers configured for amplification of the Adenovirus and at least one additional target nucleic acids, wherein:

(1) for the Adenovirus target nucleic acid, a first Adenovirus amplification oligomer and a second Adenovirus amplification oligomer are configured to amplify an Adenovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 52 to 74 of SEQ ID NO:47, nucleotide positions 76 to 99 of SEQ ID NO:47, nucleotide positions 40 to 56 of SEQ ID NO:47, nucleotide positions 65 to 87 of SEQ ID NO:47, nucleotide positions 1 to 18 of SEQ ID NO:47, nucleotide positions 7 to 23 of SEQ ID NO:47, nucleotide positions 28 to 45 of SEQ ID NO:47, nucleotide positions 27 to 45 of SEQ ID NO:47, nucleotide positions 26 to 45 of SEQ ID NO:47, nucleotide positions 139 to 155 of SEQ ID NO:47, nucleotide positions 103 to 123 of SEQ ID NO:47, nucleotide positions 159 to 175 of SEQ ID NO:47, nucleotide positions 83 to 99 of SEQ ID NO:47, and nucleotide positions 83 to 98 of SEQ ID NO:47; and

(2) for the at least one additional target nucleic acid,

(a) a first Metapneumovirus amplification oligomer and a second Metapneumovirus amplification oligomer are configured to amplify a Metapneumovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 966 to 1147 of SEQ ID NO:150, nucleotides 844 to 1027 of SEQ ID NO:159, nucleotide positions 1000 to 1040 of SEQ ID NO:150, nucleotide positions 880 to 915 of SEQ ID NO:159, nucleotide positions 1027 to 1080 of

SEQ ID NO:150, nucleotide positions 913 to 958 of SEQ ID NO:159, nucleotide positions 1073 to 1115 of SEQ ID NO:150, and nucleotide positions 953 to 995 of SEQ ID NO:159; and/or

(b) a first Rhinovirus amplification oligomer and a second Rhinovirus amplification oligomer are configured to amplify a Rhinovirus amplicon of at least about 50 nucleotides in length corresponding to a range of nucleotide positions selected from: nucleotide positions 230 to 556 of SEQ ID NO:120, nucleotide positions 199 to 525 of SEQ ID NO:101, nucleotide positions 80 to 410 of SEQ ID NO:76, nucleotide positions 263 to 303 of SEQ ID NO:120, nucleotide positions 231 to 264 of SEQ ID NO:101, nucleotide positions 106 to 156 of SEQ ID NO:76, nucleotide positions 312 to 346 of SEQ ID NO:120, nucleotide positions 279 to 314 of SEQ ID NO:101, nucleotide positions 455 to 506 of SEQ ID NO:76, nucleotide positions 480 to 533 of SEQ ID NO:120, nucleotide positions 455 to 506 of SEQ ID NO:101, and nucleotide positions 338 to 397 of SEQ ID NO:76;

(B) performing an in vitro nucleic acid amplification reaction wherein any of the Adenovirus target nucleic acid and a least one additional target nucleic acid, if present in the sample, is used by the combination of amplification oligomers to amplify that target nucleic acid to generate an amplification product; and

(C) detecting the amplification product; thereby determining the presence or absence of the Adenovirus target nucleic acid and at least one additional target nucleic acid in the sample.