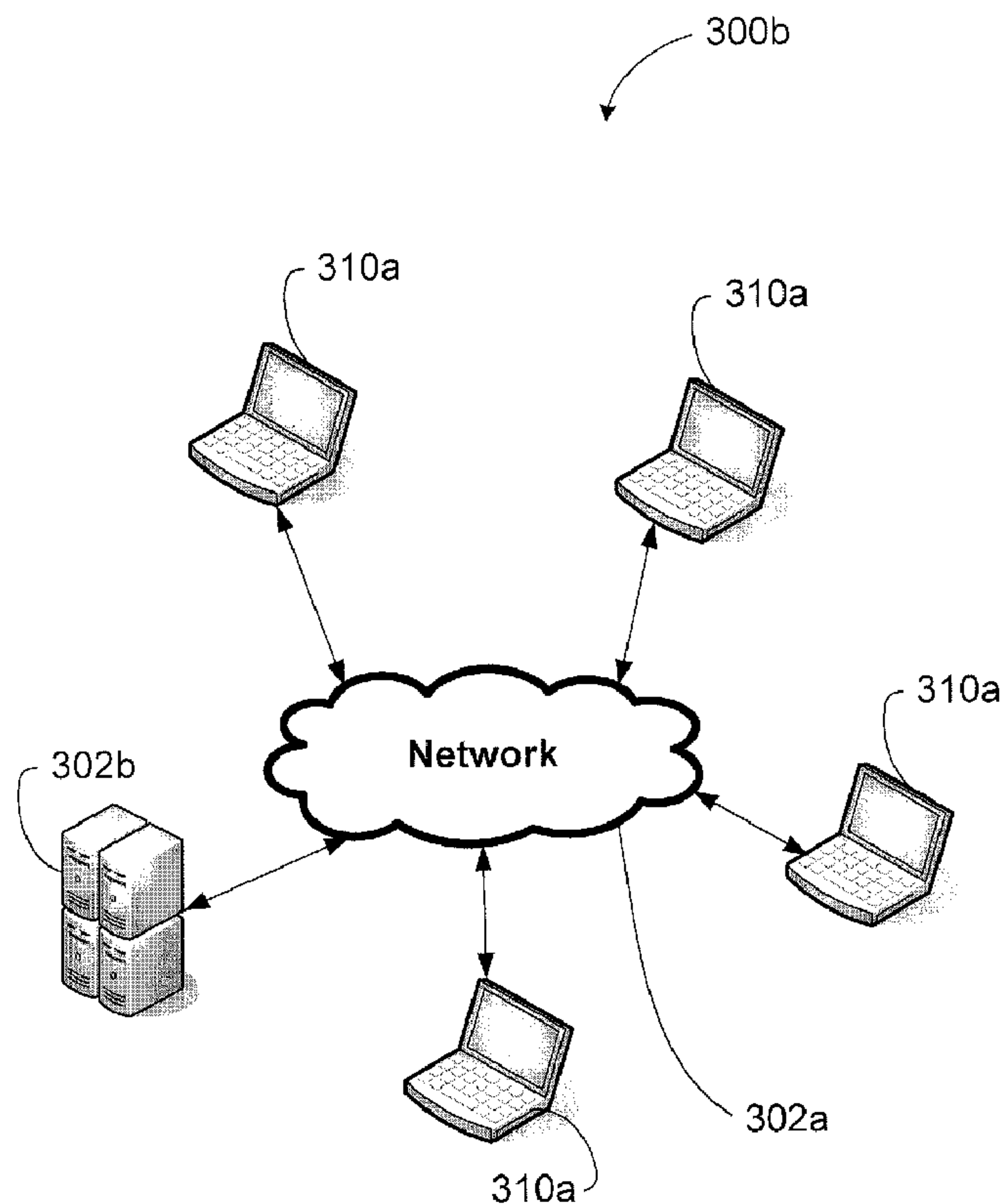




(86) Date de dépôt PCT/PCT Filing Date: 2009/06/24
(87) Date publication PCT/PCT Publication Date: 2009/12/30
(45) Date de délivrance/Issue Date: 2015/03/03
(85) Entrée phase nationale/National Entry: 2010/12/22
(86) N° demande PCT/PCT Application No.: US 2009/048464
(87) N° publication PCT/PCT Publication No.: 2009/158406
(30) Priorité/Priority: 2008/06/25 (US61/075,635)

(51) Cl.Int./Int.Cl. *G06Q 50/02* (2012.01),
G01N 33/02 (2006.01), *G01N 33/12* (2006.01)
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(54) Titre : PROCÉDES ET SYSTÈMES D'AUGMENTATION DE LA SÉCURITÉ DES ALIMENTS PROTÉINIQUES
(54) Title: METHODS AND SYSTEMS FOR INCREASING PROTEIN FOOD SAFETY



(57) Abrégé/Abstract:

Methods, systems, and devices for increasing protein food safety are provided. According to one embodiment, a method in a computer system for increasing protein food safety includes steps: (a) receiving contamination level data; (b) accessing from a



(57) **Abrégé(suite)/Abstract(continued):**

database stored data comprising prior contamination level data, prior interventions associated with the prior contamination level data, and prior actual results associated with the prior contamination level data; (c) selecting a subset of the prior contamination level data, the prior interventions, and the prior actual results, where the prior contamination level data is similar to the contamination level data; (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

PCT

(10) International Publication Number
WO 2009/158406 A8(51) International Patent Classification:
G01N 33/53 (2006.01)

D. [US/US]; 12908 W. 142nd Street, Overland Park, KS 66221 (US).

(21) International Application Number:
PCT/US2009/048464(74) Agents: **HONEYMAN, Marshall, S.** et al.; Lathrop & Gage LLP, 2345 Grand Boulevard, Suite 2400, Kansas City, MO 64108 (US).(22) International Filing Date:
24 June 2009 (24.06.2009)(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/075,635 25 June 2008 (25.06.2008) US(71) Applicant (*for all designated States except US*): **IVY ANIMAL HEALTH, INC.** [US/US]; 911 Barton Street, Overland Park, KS 66214 (US).

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[Continued on next page]

(54) Title: METHODS AND SYSTEMS FOR INCREASING PROTEIN FOOD SAFETY

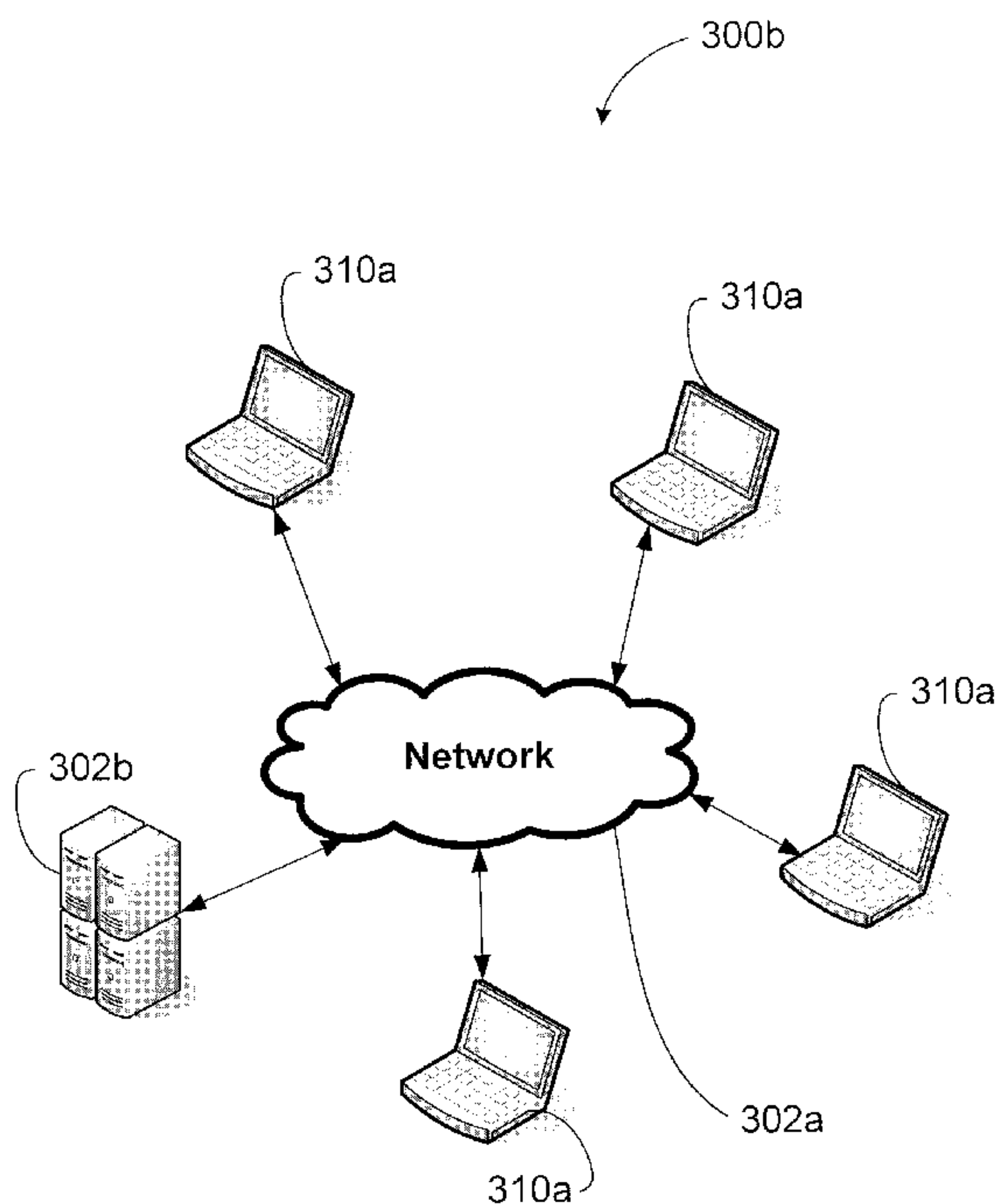


FIG. 3b

(57) **Abstract:** Methods, systems, and devices for increasing protein food safety are provided. According to one embodiment, a method in a computer system for increasing protein food safety includes steps: (a) receiving contamination level data; (b) accessing from a database stored data comprising prior contamination level data, prior interventions associated with the prior contamination level data, and prior actual results associated with the prior contamination level data; (c) selecting a subset of the prior contamination level data, the prior interventions, and the prior actual results, where the prior contamination level data is similar to the contamination level data; (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

WO 2009/158406 A8



MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR),
OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML,
MR, NE, SN, TD, TG).

(48) Date of publication of this corrected version:

14 May 2010

Published:

(15) Information about Correction:

see Notice of 14 May 2010

— *with international search report (Art. 21(3))*

METHODS AND SYSTEMS FOR INCREASING PROTEIN FOOD SAFETY

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BACKGROUND

[0002] The supply chain for food, and especially for protein (i.e., live animals and meat) sources (e.g., beef, poultry, pork, sheep, and goats), is complex. Pathogens may be introduced or multiply along the supply chain, which can render the protein unsafe for consumption.

[0003] To detect harmful levels of pathogens before protein is sold to consumers, contamination levels (i.e., pathogen levels and/or levels of indicator organisms that indicate contamination) are typically measured at one point in the supply chain after the protein has been aggregated. For example, it is currently standard practice in the beef industry to measure pathogen levels when beef is trimmed (which is after the beef has been aggregated in a feed yard). The data from the trim point is used by regulators to determine beef safety, operational well-being, and national averages. As shown in FIG. 1, there can be many points (e.g., feedlot 110, hide wash 120, pre-evisceration carcass wash 130, post split carcass wash 140, post chill carcass wash 150, and subprimal spray cabinet 160) in portion 100 of a beef supply chain before trim point 170. And current practice in the beef industry involves randomly sampling the beef at the trim point 170, instead of testing all of the protein at all points.

[0004] Methods, devices, and systems for increasing protein food safety are provided herein.

SUMMARY

[0005] A method in a computer system for increasing protein food safety according to one embodiment includes the steps of: (a) receiving at least one of contamination level data and external indicator data; (b) accessing from a database

stored data comprising prior contamination level data, prior external indicator data, prior interventions associated with the prior contamination level data and the prior external indicator data, and prior actual results associated with the prior contamination level data and the prior external indicator data; (c) selecting a subset of the prior
5 contamination level data, the prior external indicator data, the prior interventions, and the prior actual results, where the prior contamination level data and the prior external indicator data is similar to the at least one of contamination level data and external indicator data; (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective
10 intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

[0006] A method in a computer system for increasing protein food safety according to another embodiment includes the steps of: (a) receiving contamination level data; (b) accessing from a database stored data comprising prior contamination
15 level data, prior interventions associated with the prior contamination level data, and prior actual results associated with the prior contamination level data; (c) selecting a subset of the prior contamination level data, the prior interventions, and the prior actual results, where the prior contamination level data is similar to the contamination level data; (d) determining if an effective intervention is set forth in the subset based
20 at least partially on the prior actual results in the subset; and (e) if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

[0007] A method in a computer system for increasing protein food safety according to still another embodiment includes the steps of: (a) receiving external
25 indicator data; (b) accessing from a database stored data comprising prior external indicator data, prior interventions associated with the prior external indicator data, and prior actual results associated with the prior external indicator data; (c) selecting a subset of the prior external indicator data, the prior interventions, and the prior actual results, where the prior external indicator data is similar to the external indicator data;
30 (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective intervention is

not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

[0008] In yet another embodiment, a program storage device is provided that is readable by a machine and tangibly embodies a program of instructions executable by the machine to perform method steps for increasing protein food safety. The method steps include: (a) receiving contamination level data; (b) accessing from a database stored data comprising prior contamination level data, prior interventions associated with the prior contamination level data, and prior actual results associated with the prior contamination level data; (c) selecting a subset of the prior contamination level data, the prior interventions, and the prior actual results, where the prior contamination level data is similar to the contamination level data; (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

[0009] In still yet another embodiment, a program storage device is provided that is readable by a machine and tangibly embodies a program of instructions executable by the machine to perform method steps for increasing protein food safety. The method steps include: (a) receiving external indicator data; (b) accessing from a database stored data comprising prior external indicator data, prior interventions associated with the prior external indicator data, and prior actual results associated with the prior external indicator data; (c) selecting a subset of the prior external indicator data, the prior interventions, and the prior actual results, where the prior external indicator data is similar to the external indicator data; (d) determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and (e) if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is flow chart representing a portion of a beef supply chain.

[0011] FIGs. 2a through 2d are block diagrams of methods for improving protein food safety according to different embodiments.

[0012] FIGs. 3a and 3b show exemplary systems for determining an intervention.

5 [0013] FIG. 4 shows an exemplary set of steps performed to select interventions

[0014] FIG. 5 sets forth an example of the methods for improving protein food safety.

DETAILED DESCRIPTION

10 [0015] Various technical terms are used throughout this description. These definitions are intended to provide a clearer understanding of the current disclosure but are in no way intended to limit the scope of the present invention. The definitions and terms should be interpreted broadly and liberally to the extent allowed the meaning of the words.

15 [0016] As one skilled in the art will appreciate, the present invention may be embodied as, among other things: a method, system, or computer-program product. Accordingly, the present invention may take the form of a hardware embodiment, a software embodiment, or an embodiment combining software and hardware. In a preferred embodiment, the present invention takes the form of a computer-program
20 product that includes computer-useable instructions embodied on one or more computer-readable media.

[0017] Computer-readable media include both volatile and nonvolatile media, removable and nonremovable media, and contemplates media readable by a database, a switch, and various other network devices. Network switches, routers,
25 and related components are conventional in nature, as are means of communicating with the same. By way of example, and not limitation, computer-readable media comprise computer-storage media and communications media.

[0018] Computer-storage media, or machine-readable media, include media implemented in any method or technology for storing information. Examples
30 of stored information include computer-useable instructions, data structures, program modules, and other data representations. Computer-storage media include, but are not

limited to RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile discs (DVD), holographic media or other optical disc storage, magnetic cassettes, magnetic tape, magnetic disk storage, and other magnetic storage devices. These memory components can store data momentarily, temporarily, or
5 permanently.

[0019] Communications media typically store computer-useable instructions—including data structures and program modules—in a modulated data signal. The term “modulated data signal” refers to a propagated signal that has one or more of its characteristics set or changed to encode information in the signal. An
10 exemplary modulated data signal includes a carrier wave or other transport mechanism. Communications media include any information-delivery media. By way of example but not limitation, communications media include wired media, such as a wired network or direct-wired connection, and wireless media such as acoustic, infrared, radio, microwave, spread-spectrum, and other wireless media technologies.
15 Combinations of the above are included within the scope of computer-readable media.

[0020] FIG. 2a shows one inventive method 200a of improving protein food safety. According to the method 200a, contamination levels (i.e., pathogen levels and/or levels of indicator organisms that indicate contamination) 210a are measured throughout the supply chain, and at least between the points of aggregation
20 and retail to consumers. At least for each point in the supply chain that a contamination level 210a is measured, an intervention 220a may be selected for the particular protein item and administered (denoted by reference number 225a). An expected result 230a (i.e., an expected condition of a particular protein item after the intervention 220a) is predicted, and an actual result 240a (i.e., an actual result for a
25 particular protein item after the intervention 220a) is tracked. “Intervention” is used in this document to denote one or more biological, pharmaceutical, and/or other health-promoting substance, and the amount of such a substance. The amount of all such substances may be zero, or in other words, the decision to forego such a substance (i.e., the act of not providing any such substance) may nevertheless be
30 referred to herein as an “intervention.”

[0021] Actual results 240a’ from previous protein items (and particularly their relation to expected results 230a’) may be considered along with (or instead of) a

protein item's specific contamination level 210a to select the intervention 220a, and the actual result 240a (and particularly its relation to expected results 230a) for a protein item may be considered when selecting the intervention 220a for future protein items. In FIG. 2a, a previous protein item has a pathogen level denoted 210a', an intervention denoted 220a', an expected result denoted 230a', and an actual result denoted 240a'. It should be understood that, while a single previous actual result 240a' is shown in FIG. 2a, numerous previous actual results 240a' may in practice be used. The previous actual results 240a' may be obtained across plants, companies, brands, areas, etc. Further details regarding the selection of the intervention 220a are set forth below.

[0022] FIG. 2b shows another inventive method 200b of improving protein food safety. According to the method 200b, external indicators (e.g., employee absenteeism, weather patterns/events, lairage time, distance from supplier to plant, chain speed, number of microbial interventions, temperatures, cattle type, employee training programs, mud scores, seasonality, feedyard size, pen size, feedyard ration, wet/dry distiller's grain content in ration, cattle time on feed, carcass/live weight, cattle performance attributes, carcass grade/yield, etc.) 210b are determined throughout the supply chain, and at least between the points of aggregation and retail to consumers. At least for each point in the supply chain that at least one external indicator 210b is determined, an intervention 220b may be selected for the particular protein item and administered (denoted by reference number 225b). Intervention 220b may be the same or different than intervention 220a (FIG. 2a). An expected result 230b (i.e., an expected condition of a particular protein item after the intervention 220b) is predicted, and an actual result 240b (i.e., an actual result for a particular protein item after the intervention 220b) is tracked.

[0023] Actual results 240b' from previous protein items (and particularly their relation to expected results 230b') may be considered along with (or instead of) external indicators 210b to select the intervention 220b, and the actual result 240b (and particularly its relation to expected results 230b) for a protein item may be considered when selecting the intervention 220b for future protein items. In FIG. 2b, a previous protein item has external indicators denoted 210b', an intervention denoted 220b', an expected result denoted 230b', and an actual result denoted 240b'. It should

be understood that, while a single previous actual result 240b' is shown in FIG. 2a, numerous previous actual results 240b' may in practice be used. The previous actual results 240b' may be obtained across plants, companies, brands, areas, etc. Further details regarding the selection of the intervention 220b are set forth below.

5 **[0024]** FIG. 2c shows still another inventive method 200c of improving protein food safety. According to the method 200c, both contamination levels 210a and external indicators 210b may be determined throughout the supply chain, and at least between the points of aggregation and retail to consumers. At least for each point in the supply chain that at least one contamination level 210a is measured or at
10 least one external indicator 210b is determined, an intervention 220c may be selected for the particular protein item and administered (denoted by reference number 225c). Intervention 220c may be the same or different than interventions 220a, 220b (FIG. 2a and FIG. 2b), and further details regarding the selection of the intervention 220c are set forth below. An expected result 230c (i.e., an expected condition of a particular
15 protein item after the intervention 220c) is predicted, and an actual result 240c (i.e., an actual result for a particular protein item after the intervention 220c) is tracked.

[0025] Actual results 240c' from previous protein items (and particularly their relation to expected results 230c') may be considered along with (or instead of) a protein item's specific contamination level 210a and/or external indicators 210b to
20 select the intervention 220c, and the actual result 240c (and particularly its relation to expected result 230c) for a protein item may be considered when selecting the intervention 220c for future protein items. In FIG. 2c, a previous protein item has a pathogen level denoted 210a', external indicators denoted 210b', an intervention denoted 220c', an expected result denoted 230c', and an actual result denoted 240c'. It
25 should be understood that, while a single previous actual result 240c' is shown in FIG. 2c, numerous previous actual results 240c' may in practice be used. The previous actual results 240c' may be obtained across plants, companies, brands, areas, etc. Further details regarding the selection of the intervention 220c are set forth below.

[0026] FIG. 2d shows still yet another inventive method 200d of
30 improving protein food safety. According to the method 200d, both contamination levels 210a and external indicators 210b may be determined throughout the supply chain, and at least between the points of aggregation and retail to consumers, similar

to method 200c. In addition, previous contamination levels 210a' and previous external indicators 210b' for the protein item at earlier points along the supply chain and actual results 240d' for previous protein items (and particularly their relation to expected results) may be used to select the intervention 220d for the protein item.

5 Further, expected results 230d at various future points on the supply chain may be predicted, and actual results 240d (and particularly their relation to expected results 230d) may be considered when selecting the intervention 220d for future protein items. From this description, it should be clear to one of ordinary skill in the art that method 200d provides the ability to focus on multiple points along the supply chain
10 when determining the intervention 220d.

[0027] In FIG. 2d, the protein item has previous pathogen levels denoted 210a' and previous external indicators denoted 210b', and a previous protein item has actual results denoted 240d'. The previous actual results 240d' may be obtained across plants, companies, brands, areas, etc. Further details regarding the selection of
15 the intervention 220d are set forth below.

[0028] It may be preferable to utilize method 200a, 200b, 200c, or 200d at a majority of points (or even every point) in the protein supply chain, and it may be preferable to sample every protein item instead of randomly sampling protein items. Nevertheless, due to cost and/or timing, it may be advantageous to randomly sample
20 protein items at various points in the protein supply chain and to sample every protein item at other points in the protein supply chain.

[0029] At the core of the current disclosure is the determination of interventions (e.g., intervention 220a, 220b, 220c, 220d). Attention is now directed to FIGs. 3 through 4, where exemplary methods, systems, and apparatus for determining
25 interventions are set forth in greater detail.

[0030] FIG. 3a and FIG. 3b show exemplary systems 300a, 300b for determining an intervention (e.g., intervention 220a, intervention 220b, intervention 220c, intervention 220d, etc.). System 300a has a computer 302 with computer memory 304, a processor 306, a storage unit 308, and a user interface 310. Storage
30 unit 308 may be, for example, a disk drive that stores programs and data of computer 302, and is shown storing a database 350 and a computer program product 360. System 300b is similar to system 300a, but components are distributed over space.

For example, various stations 310a may be included instead of a single user interface 310, and a network 302a and server 302b may “replace” the single computer 302.

The server 302b, for example, may include the database 350, though not shown in FIG. 3b, and processors may be included at various locations in the system 300b to

5 function similar to processor 306. It should be understood that portions of the database 350 may be stored in separate locations and that data may be transferred between those locations; the transfer of data is known in the art. Similarly, the computer program product 360 may be included at various (or multiple) locations in the system 300b. While system 300a is generally discussed below, it should be well
10 understood that system 300b may instead be utilized.

[0031] Focus is now turned to flowchart 400 in FIG. 4, which shows an exemplary set of steps performed (e.g., by the processor 306 under direction from the computer program product 360) in determining the intervention (e.g., intervention 220a, intervention 220b, intervention 220c, intervention 220d, etc.). At a first step
15 402, the processor 306 (FIG. 3a) receives input data. The input data may, for example, be contamination level data and/or external indicators (e.g., employee absenteeism, weather patterns/events, lairage time, distance from supplier to plant, chain speed, number of microbial interventions, temperatures, cattle type, employee training programs, mud scores, seasonality, feedyard size, pen size, feedyard ration,
20 wet/dry distiller’s grain content in ration, cattle time on feed, carcass/live weight, cattle performance attributes, carcass grade/yield, etc.).

[0032] At step 404, the processor 306 selects previous instances with similar characteristics from the database 350. Various acceptable methods may be used to accomplish this. In cases with a single contamination level or external
25 indicator input, this may be as simple as finding cases within a predetermined range of the contamination level or external indicator input in the database 350. And in cases with multiple input data, statistical analysis may be performed on previous input data, previous interventions, and previous actual results, for example, to determine relationships between input data, and the input data that is most statistically relevant
30 may be used to select instance with similar characteristics from the database 350. In selecting previous instances with similar characteristics, the processor 306 may

additionally filter the database 350 based on time/season, location, plant, and other narrowing factors.

[0033] At step 406, the processor 306 determines if the previous interventions in the previous instances with similar characteristics were effective.

- 5 This may be done by analyzing the previous instances individually or aggregated; and the user may specify (e.g., through the user interface 310) what qualifies as effective, or this may be preset in the computer program product 360. For example, the user may determine a cutoff line or acceptable range for contamination after the intervention, for improvement, or for disparity between expected and actual results. If
- 10 the processor 306 determines that a previous intervention was effective, it causes the system 300a to output (e.g., through the interface 310) an intervention that should be provided (step 408), and the output intervention is the same as the previous intervention that was effective. If the previous intervention was not effective, the processor 306 increases the previous intervention that was not effective (step 410).
- 15 This may involve changing the biological, pharmaceutical, and/or other health-promoting substance, or changing the amount of such substance. The processor 306 then causes the system 300a to output (e.g., through the interface 310) an intervention that should be provided (step 412), and the output intervention is increased relative to the previous intervention that was not effective.

- 20 [0034] At step 415, the processor 306 causes the output intervention (whether from step 408 or step 412) to be stored (e.g., in database 350) along with the input data for future use (e.g., in steps 404 and 406). In addition to determining interventions, the computer program product 360 may perform any required standardizing/normalizing function and compare data across locations, companies,
- 25 and other relevant groupings to provide a benchmarking function.

- [0035] It should be understood that the methods and systems set forth herein may be used with almost any protein source (i.e., live animals and meat, such as beef, poultry, pork, sheep, and goats). FIG. 5 shows an example 501 of the methods and systems in use with beef. More particularly, FIG. 5 shows pathogen
- 30 levels tested at the pre-evisceration carcass wash 130 (FIG. 1). Traditional testing methods and devices and/or quick test methods and devices (such as, for example, those discussed in *At the Retail/Food Service Level: Quick Test for E. Coli Bacteria*,

SafeFood News (Fall 1997 Vol. 2, No. 1), available at <http://www.ext.colostate.edu/safefood/newsltr/v2n1s08.html>) may be used. In example 501, the system 300 (FIG. 3) is used in accordance with method 200d set forth above, though external indicators 210b are not included.

5 **[0036]** To determine the intervention 220d in example 501, reference is simultaneously directed to FIGs. 4 and 5. At the first step 402, the processor 306 (FIG. 3a) receives input data 210a, 210a' (e.g., from the user interface 310 or the database 350) that includes pathogen levels at the pre-evisceration carcass wash 130, the hide wash 120, and the feedlot 110 (FIG. 1). At the step 404, the processor 306
10 selects previous instances with similar characteristics from the database 350, as set forth above. At the step 406, the processor 306 determines if the previous interventions in the previous instances with similar characteristics were effective (e.g., by analyzing previous results 240d'), as set forth in detail above. If the processor 306 determines that a previous intervention was effective, it causes the system 300a to
15 output (e.g., thorough the interface 310) an intervention that should be provided (step 408), and the output intervention is the same as the previous intervention that was effective. If the previous intervention was not effective, the processor 306 increases the previous intervention that was not effective (step 410). This may involve changing the biological, pharmaceutical, and/or other health-promoting substance, or
20 changing the amount of such substance. The processor 306 then causes the system 300a to output (e.g., through the interface 310) an intervention that should be provided (step 412), and the output intervention is increased relative to the previous intervention that was not effective. While different interventions may be used for different protein sources, some examples of interventions for beef at various stages of
25 a beef supply chain include:

30

Stage	Exemplary interventions
animal rearing location (e.g. ranch/farm)	direct fed microbials; antimicrobials; vaccines
feedlot 110	direct fed microbials; antimicrobials; vaccines
hide wash 120	bacteriophage; chlorine; high pressure water
pre-evisceration carcass wash 130	hot water wash; steam pasteurization; lactic acid; acetic acid; peroxyacetic acid; acidified sodium chlorite
post split carcass wash 140	hot water wash; steam pasteurization; lactic acid; acetic acid; peroxyacetic acid; acidified sodium chlorite
post chill carcass wash 150	lactic acid; acetic acid; peroxyacetic acid; acidified sodium chlorite
subprimal spray cabinet 160	lactic acid; acetic acid; peroxyacetic acid; acidified sodium chlorite
trim 170	lactic acid; acidified sodium chlorite

[0037] As shown at step 225d in FIG. 5, the output intervention should then be performed, and the actual results 240d should be tracked and stored (e.g. in the database 350). Additionally, at the step 415, the processor 306 causes the output intervention (whether from step 408 or step 412) to be stored (e.g., in the database 350) along with the input data for future use.

[0038] In the example 501, expected results 230d may be provided by the software product 360 (e.g., through the user interface 310) for the beef item at the post split carcass wash after receiving particular interventions, the expected results 230b for the beef item at the post chill carcass wash after receiving particular interventions, the expected results 230c for the beef item at the subprimal spray cabinet after receiving particular interventions, and the expected results 230d of the beef item at trim. As such, a user may be able to determine the expected results from taking certain actions. For example, if the pathogen level is above a determined level at the pre-evisceration carcass wash, the likelihood of a certain pathogen level (e.g., a pathogen level sufficient to cause a recall) later in the supply chain may be determined if different interventions (including no actions) are taken. In other words, the need for the size and scope of protein food safety interventions throughout the supply chain may be evaluated.

[0039] Though not specifically shown in example 501, the system may also perform any required standardizing/normalizing functions and allow users to compare data across locations, companies, and other relevant groupings, as discussed above, to evaluate effectiveness of protein food safety interventions across plants,
5 companies, brands, etc. and/or to provide a benchmarking function.

[0040] Those skilled in the art appreciate that variations from the specified embodiments disclosed above are contemplated herein and that the described embodiments are not limiting. The description should not be restricted to the above embodiments, but should be measured by the following claims.

CLAIMS:

1. A method in a computer system for increasing protein food safety, the method comprising:

receiving at least one of contamination level data and external indicator data;

5 accessing from a database stored data comprising:

prior contamination level data;

prior external indicator data;

prior interventions associated with the prior contamination level

data and the prior external indicator data; and

10 prior actual results associated with the prior contamination level

data and the prior external indicator data;

selecting a subset of the prior contamination level data, the prior external

indicator data, the prior interventions, and the prior actual results,

where the prior contamination level data and the prior external

15 indicator data is similar to the at least one of contamination level data and external indicator data; and

determining if an effective intervention is set forth in the subset based at least

partially on the prior actual results in the subset; and if an effective

intervention is not set forth in the subset, causing an intervention to be

20 output that is increased relative to the intervention in the subset.

2. The method of claim 1, wherein:

the receiving comprises receiving a plurality of contamination level data and

external indicator data; and

the selecting a subset comprises statistically analyzing the prior contamination

25 level data, the prior external indicator data, the prior interventions, and

the prior actual results to determine the most relevant prior

contamination level data and prior external indicator data, and

selecting in accord with the most relevant prior contamination level

data and prior external indicator data.

30 3. The method of claim 1, wherein:

the receiving comprises receiving a plurality of contamination level data and external indicator data; and

the determining comprises comparing the prior actual results in the subset, individually and/or aggregated, to at least one benchmark.

5 4. The method of claim 1, further comprising updating the database to include:

the at least one of contamination level data and external indicator data; and the output intervention.

10 5. The method of claim 1, wherein causing an intervention to be output that is increased relative to the intervention in the subset is at least one of:

causing an intervention to be output that is a different biological or pharmaceutical substance than the intervention in the subset; and causing an intervention to be output that has a different amount of biological or pharmaceutical substance than the intervention in the subset.

15 6. The method of claim 1, wherein the external indicator data includes data related to at least one of: employee absenteeism, weather patterns/events, lairage time, distance from supplier to plant, chain speed, number of microbial interventions, temperatures, cattle type, employee training programs, mud scores, seasonality, feedyard size, pen size, feedyard ration, wet/dry distiller's grain content in ration, 20 cattle time on feed, carcass/live weight, cattle performance attributes, and carcass grade/yield.

7. The method of claim 1, wherein:

the receiving comprises receiving a plurality of contamination level data and external indicator data;

25 the selecting a subset comprises statistically analyzing the prior contamination level data, the prior external indicator data, the prior interventions, and the prior actual results to determine the most relevant prior contamination level data and prior external indicator data, and selecting in accord with the most relevant prior contamination level 30 data;

the determining comprises comparing the prior actual results in the subset,
 individually or aggregated, to at least one benchmark; and
 causing an intervention to be output that is increased relative to the
 intervention in the subset is at least one of:

- 5 causing an intervention to be output that is a different biological or
 pharmaceutical substance than the intervention in the subset;
 and
 causing an intervention to be output that has a different amount of
 biological or pharmaceutical substance than the intervention
 10 in the subset.

8. The method of claim 7, further comprising updating the database to
 include:

the at least one of contamination level data and external indicator data; and
 the output intervention.

- 15 9. The method of claim 1, further comprising causing an intervention to
 be output that is generally the same as the effective intervention if an effective
 intervention is set forth in the subset.

10. A method in a computer system for increasing protein food safety, the
 method comprising:

- 20 receiving contamination level data;
 accessing from a database stored data comprising:
 prior contamination level data;
 prior interventions associated with the prior contamination level
 data; and
 25 prior actual results associated with the prior contamination level
 data;
 selecting a subset of the prior contamination level data, the prior interventions,
 and the prior actual results, where the prior contamination level data is
 similar to the contamination level data; and

determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

5 11. The method of claim 10, wherein:

the determining comprises comparing the prior actual results in the subset, individually and/or aggregated, to at least one benchmark; and causing an intervention to be output that is increased relative to the intervention in the subset is at least one of:

10 causing an intervention to be output that is a different biological or pharmaceutical substance than the intervention in the subset; and
 causing an intervention to be output that has a different amount of biological or pharmaceutical substance than the intervention
15 in the subset.

12. A method in a computer system for increasing protein food safety, the method comprising:

receiving external indicator data;

accessing from a database stored data comprising:

20 prior external indicator data;
 prior interventions associated with the prior external indicator data;
 and

 prior actual results associated with the prior external indicator data;

selecting a subset of the prior external indicator data, the prior interventions,

25 and the prior actual results, where the prior external indicator data is similar to the external indicator data; and

determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and if an effective intervention is not set forth in the subset, causing an intervention to be
30 output that is increased relative to the intervention in the subset.

13. The method of claim 12, wherein:

the receiving comprises receiving a plurality of external indicator data; and

the selecting a subset comprises statistically analyzing the prior external

indicator data, the prior interventions, and the prior actual results to

5 determine the most relevant prior external indicator data, and selecting
in accord with the most relevant prior external indicator data.

14. The method of claim 13, wherein:

the determining comprises comparing the prior actual results in the subset,

individually and/or aggregated, to at least one benchmark; and

10 causing an intervention to be output that is increased relative to the
intervention in the subset is at least one of:

causing an intervention to be output that is a different biological or
pharmaceutical substance than the intervention in the subset;
and

15 causing an intervention to be output that has a different amount of
biological or pharmaceutical substance than the intervention
in the subset.

15. The method of claim 12, wherein:

the determining comprises comparing the prior actual results in the subset,

20 individually and/or aggregated, to at least one benchmark; and

causing an intervention to be output that is increased relative to the
intervention in the subset is at least one of:

causing an intervention to be output that is a different biological or
pharmaceutical substance than the intervention in the subset;
and

25 causing an intervention to be output that has a different amount of
biological or pharmaceutical substance than the intervention
in the subset.

16. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for increasing protein food safety, the method steps comprising:

receiving contamination level data;

5 accessing from a database stored data comprising:

prior contamination level data;

prior interventions associated with the prior contamination level data; and

prior actual results associated with the prior contamination level

10 data;

selecting a subset of the prior contamination level data, the prior interventions, and the prior actual results, where the prior contamination level data is similar to the contamination level data; and

determining if an effective intervention is set forth in the subset based at least

15 partially on the prior actual results in the subset; and if an effective intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

17. The program storage device of claim 16, wherein the method steps further comprise causing an intervention to be output that is generally the same as the
20 effective intervention if an effective intervention is set forth in the subset.

18. The program storage device of claim 16, wherein:

the determining comprises comparing the prior actual results in the subset,

individually and/or aggregated, to at least one benchmark; and

causing an intervention to be output that is increased relative to the

25 intervention in the subset is at least one of:

causing an intervention to be output that is a different biological or pharmaceutical substance than the intervention in the subset; and

causing an intervention to be output that has a different amount of
30 biological or pharmaceutical substance than the intervention in the subset.

19. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for increasing protein food safety, the method steps comprising:

receiving external indicator data;

5 accessing from a database stored data comprising:

prior external indicator data;

prior interventions associated with the prior external indicator data;

and

prior actual results associated with the prior external indicator data;

10 selecting a subset of the prior external indicator data, the prior interventions, and the prior actual results, where the prior external indicator data is similar to the external indicator data; and

determining if an effective intervention is set forth in the subset based at least partially on the prior actual results in the subset; and if an effective
15 intervention is not set forth in the subset, causing an intervention to be output that is increased relative to the intervention in the subset.

20. The program storage device of claim 19, wherein:

the determining comprises comparing the prior actual results in the subset,

individually and/or aggregated, to at least one benchmark; and

20 causing an intervention to be output that is increased relative to the intervention in the subset is at least one of:

causing an intervention to be output that is a different biological or pharmaceutical substance than the intervention in the subset;

and

25 causing an intervention to be output that has a different amount of biological or pharmaceutical substance than the intervention in the subset.

1/9

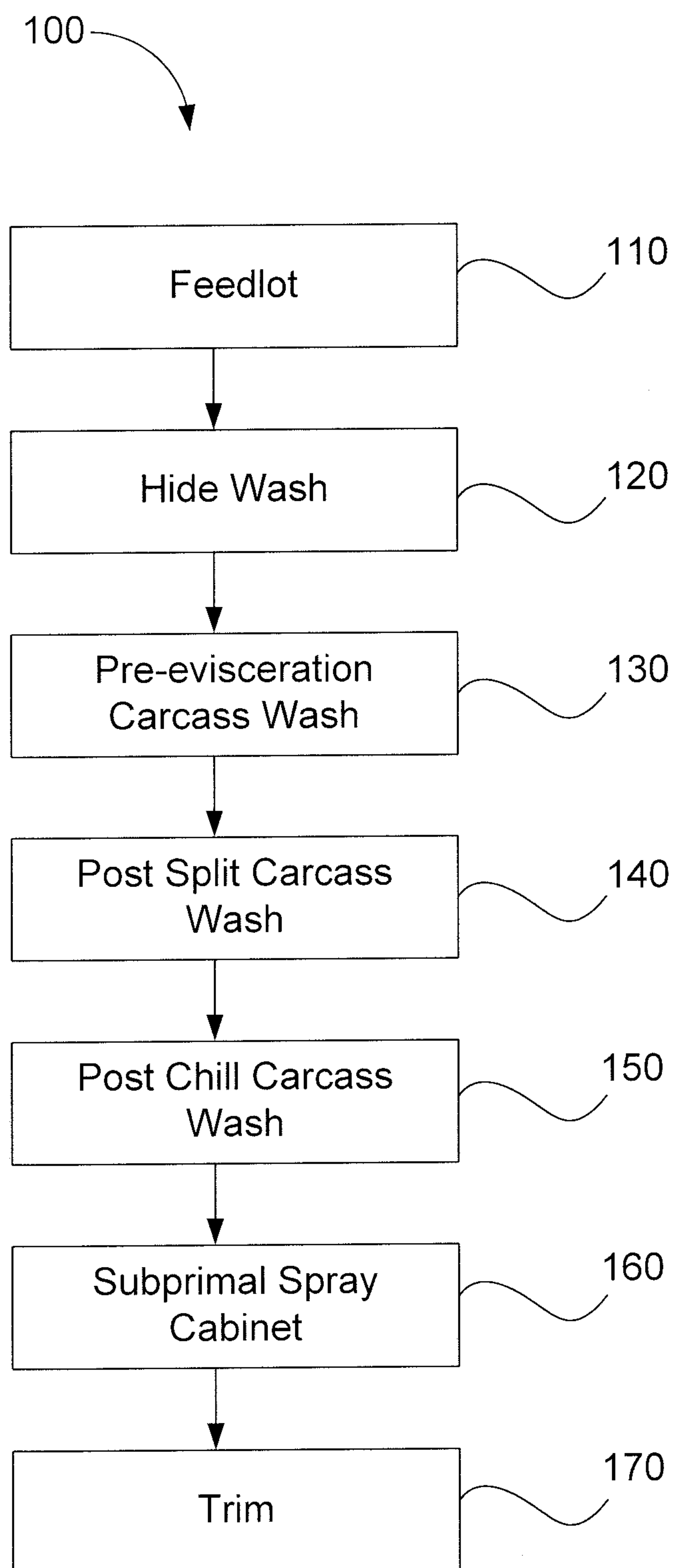


FIG. 1

2/9

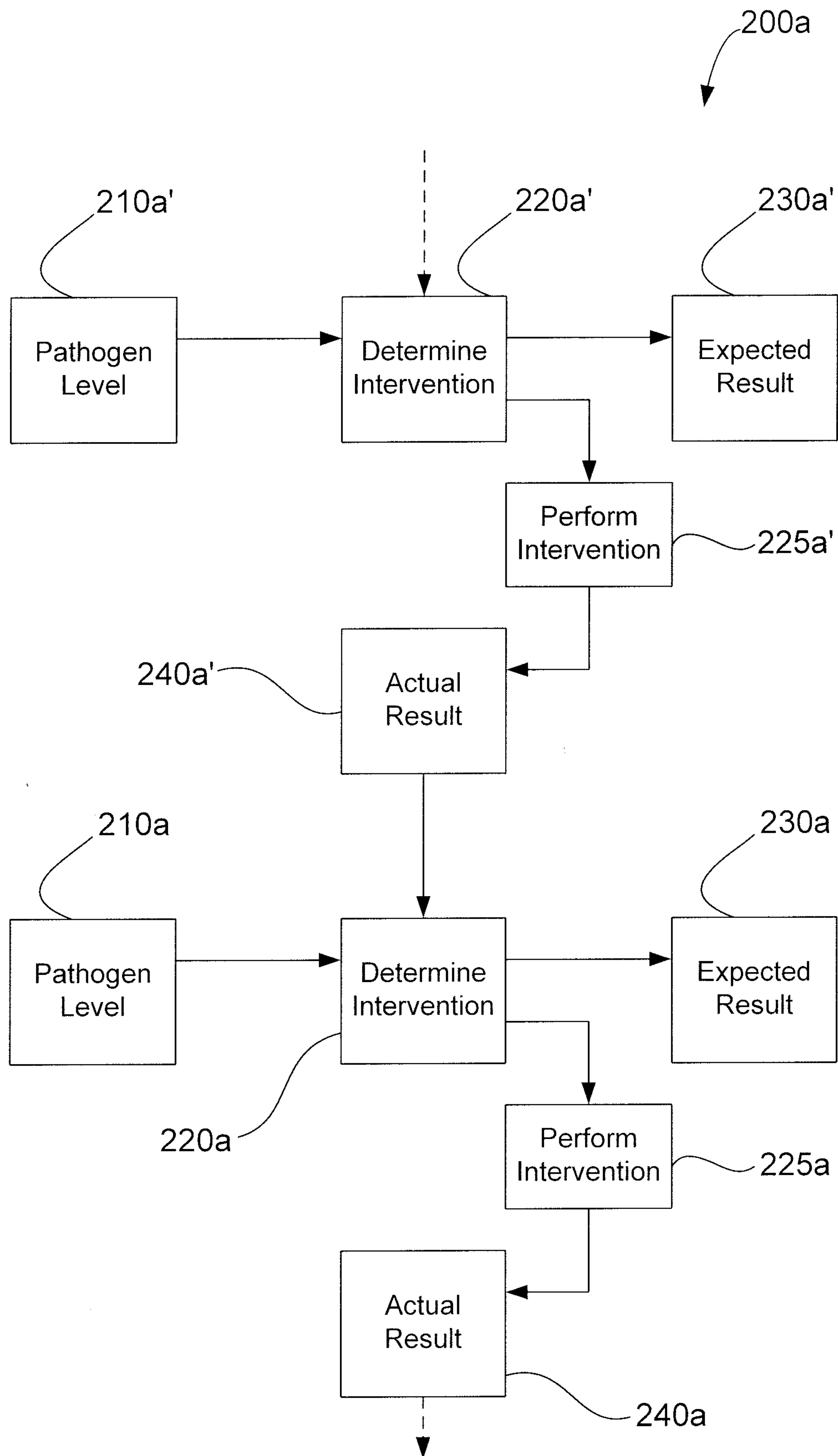


FIG. 2a

3/9

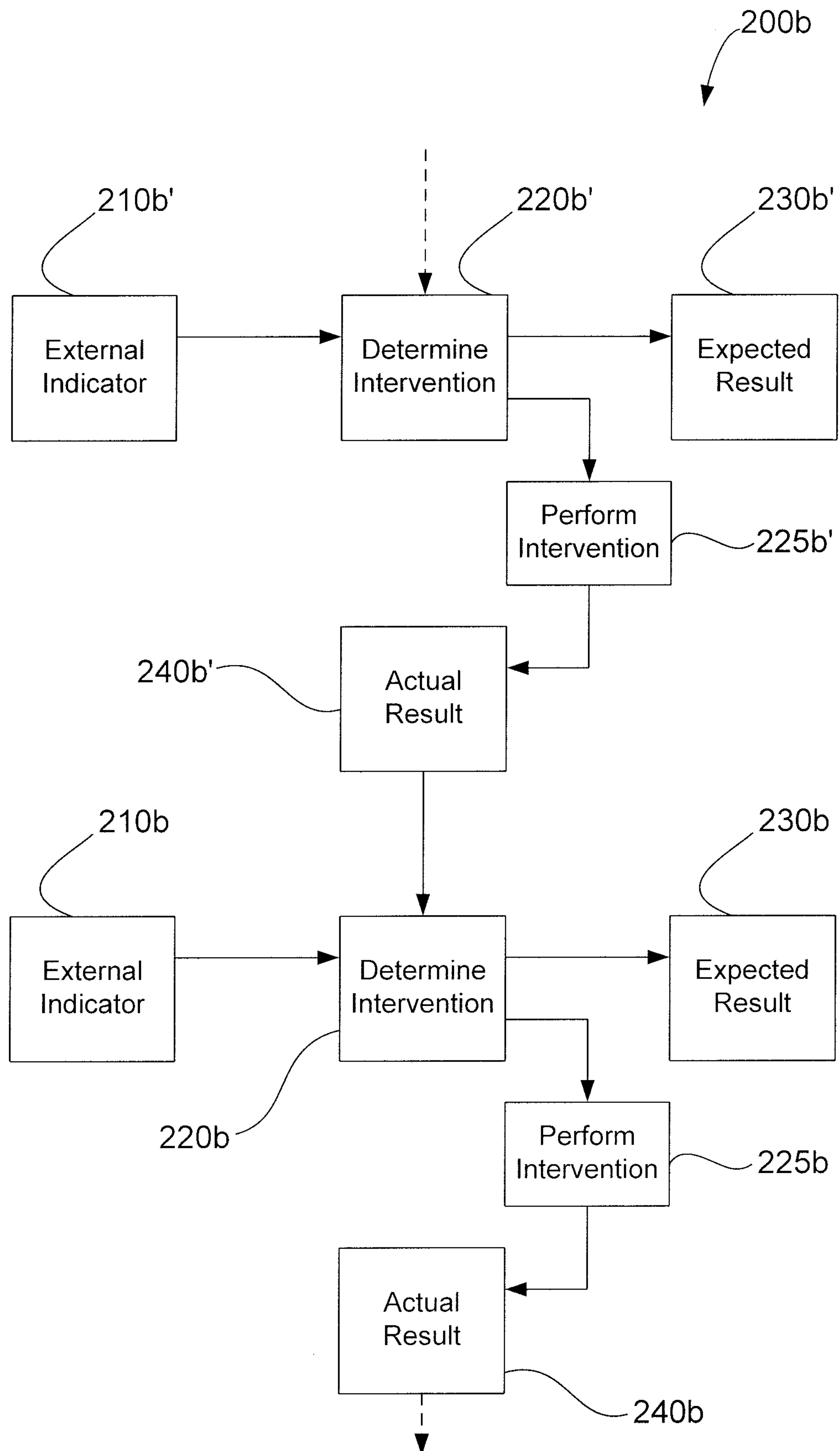


FIG. 2b

4/9

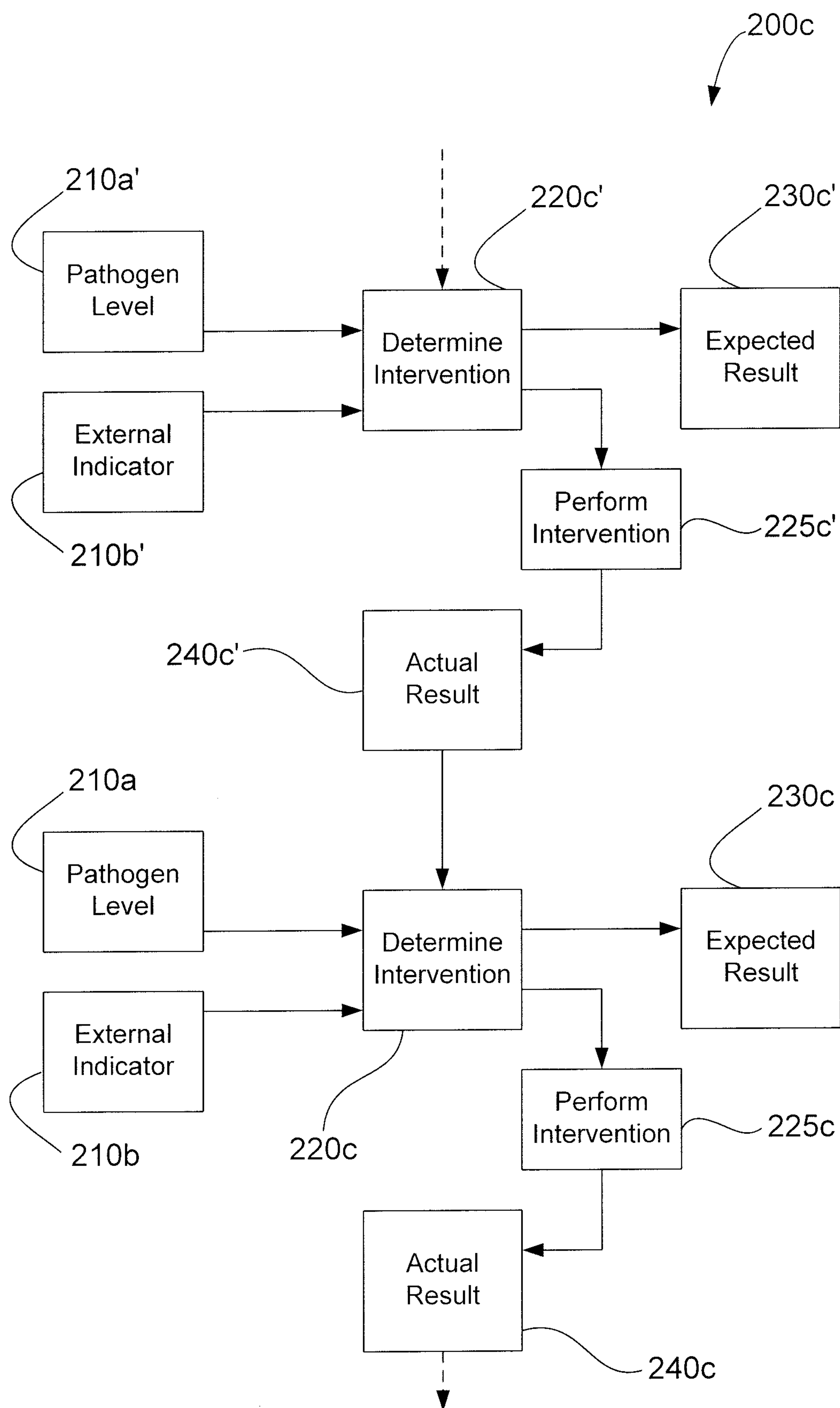


FIG. 2c

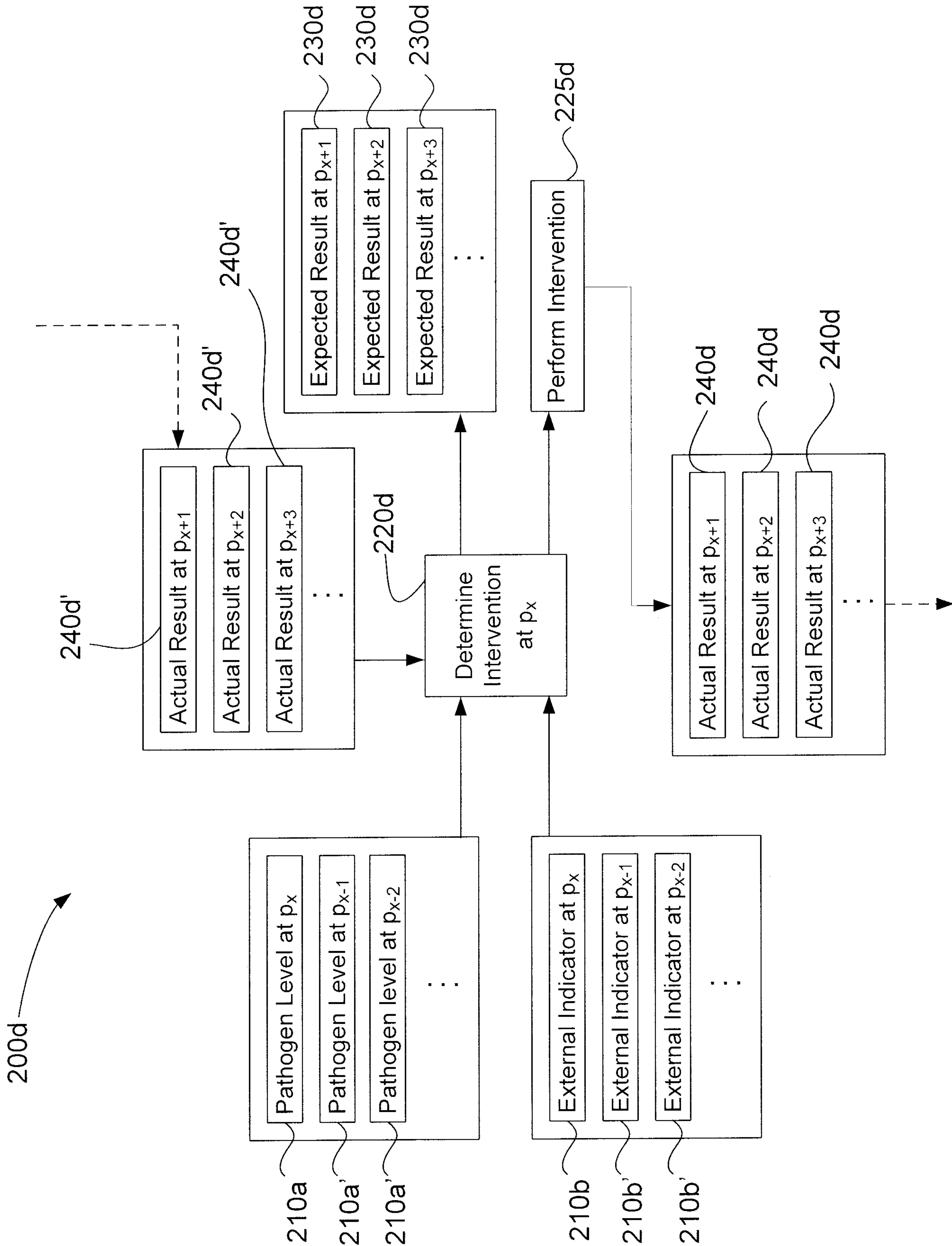


FIG. 2d

6/9

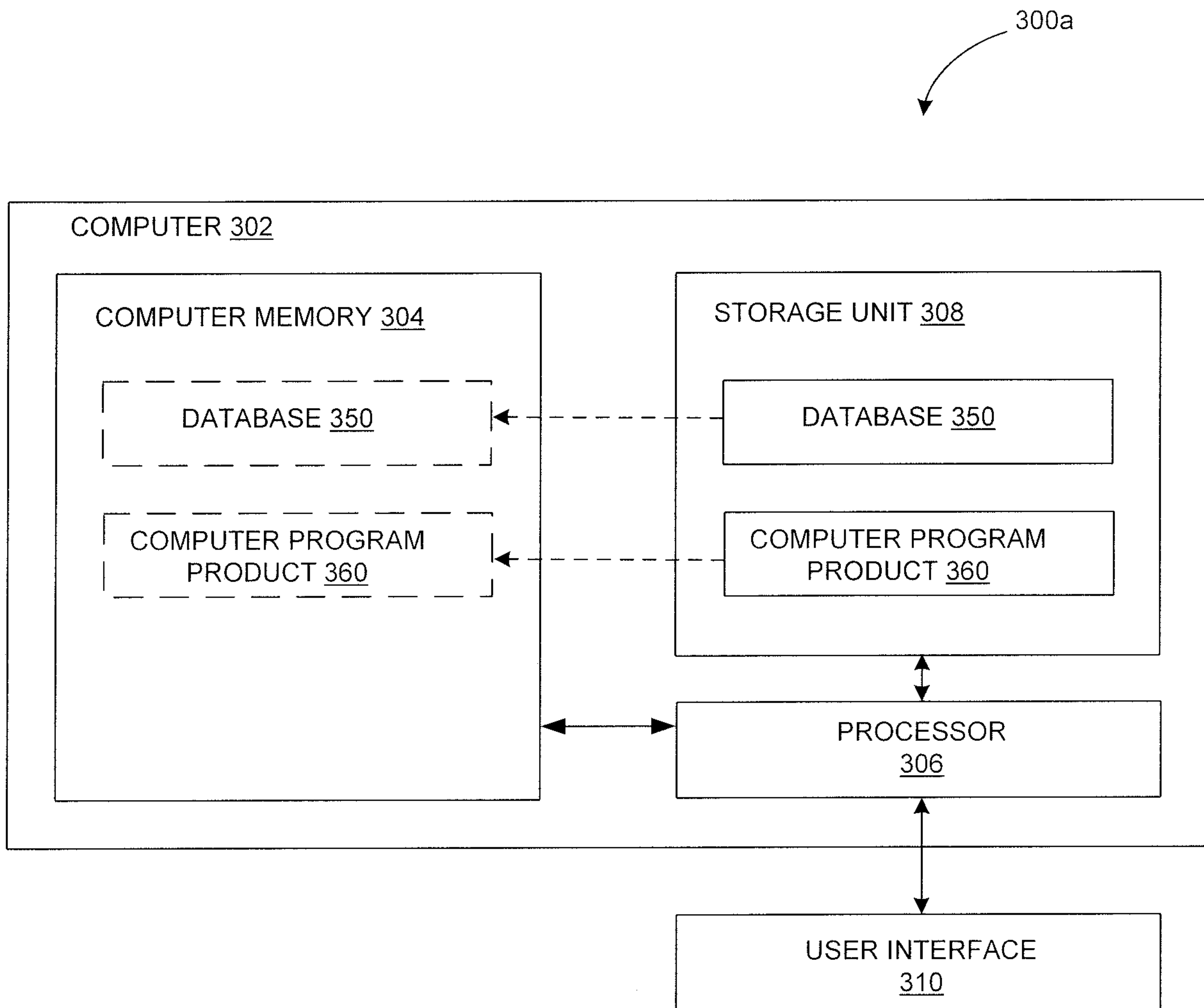


FIG. 3a

7/9

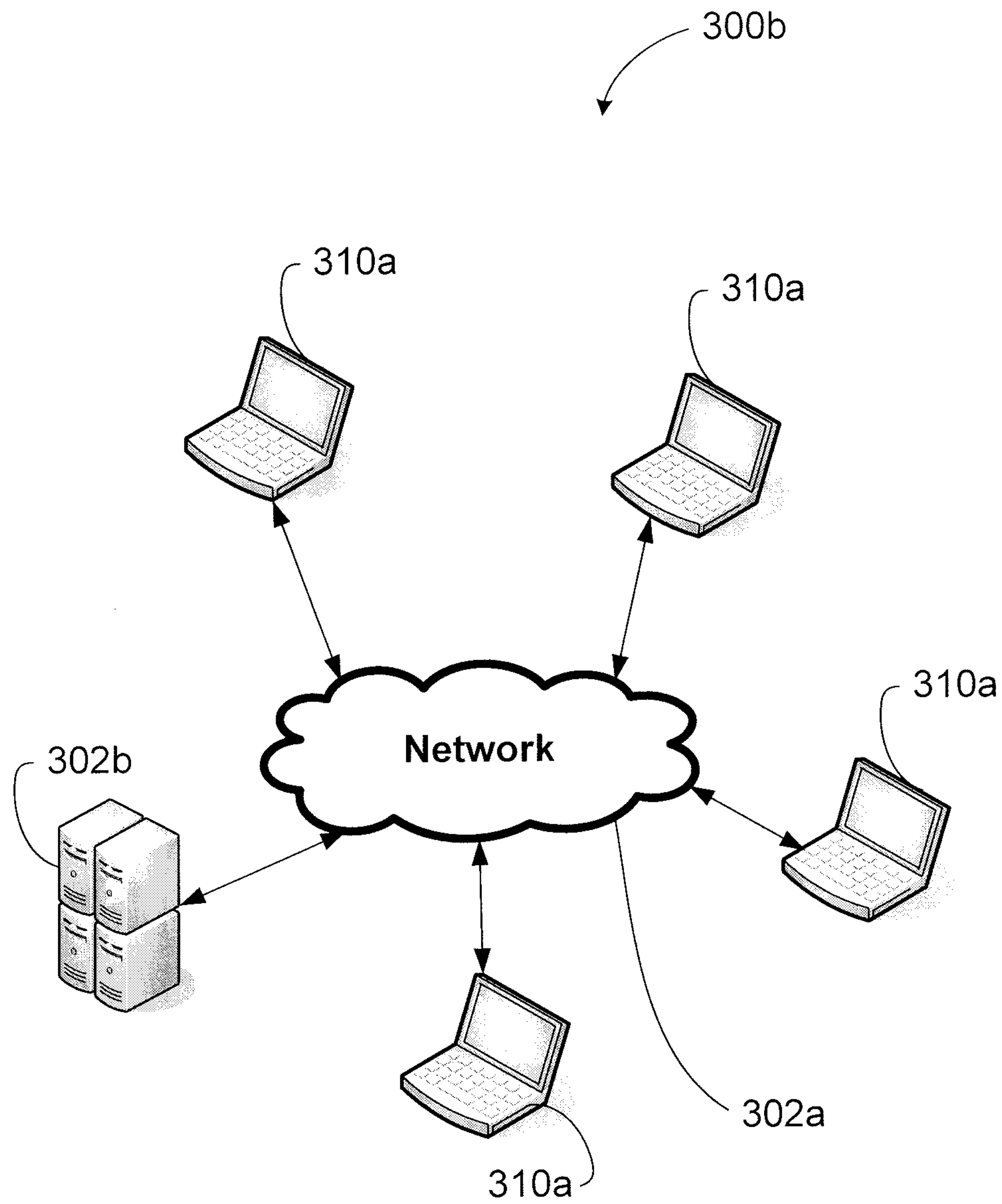


FIG. 3b

8/9

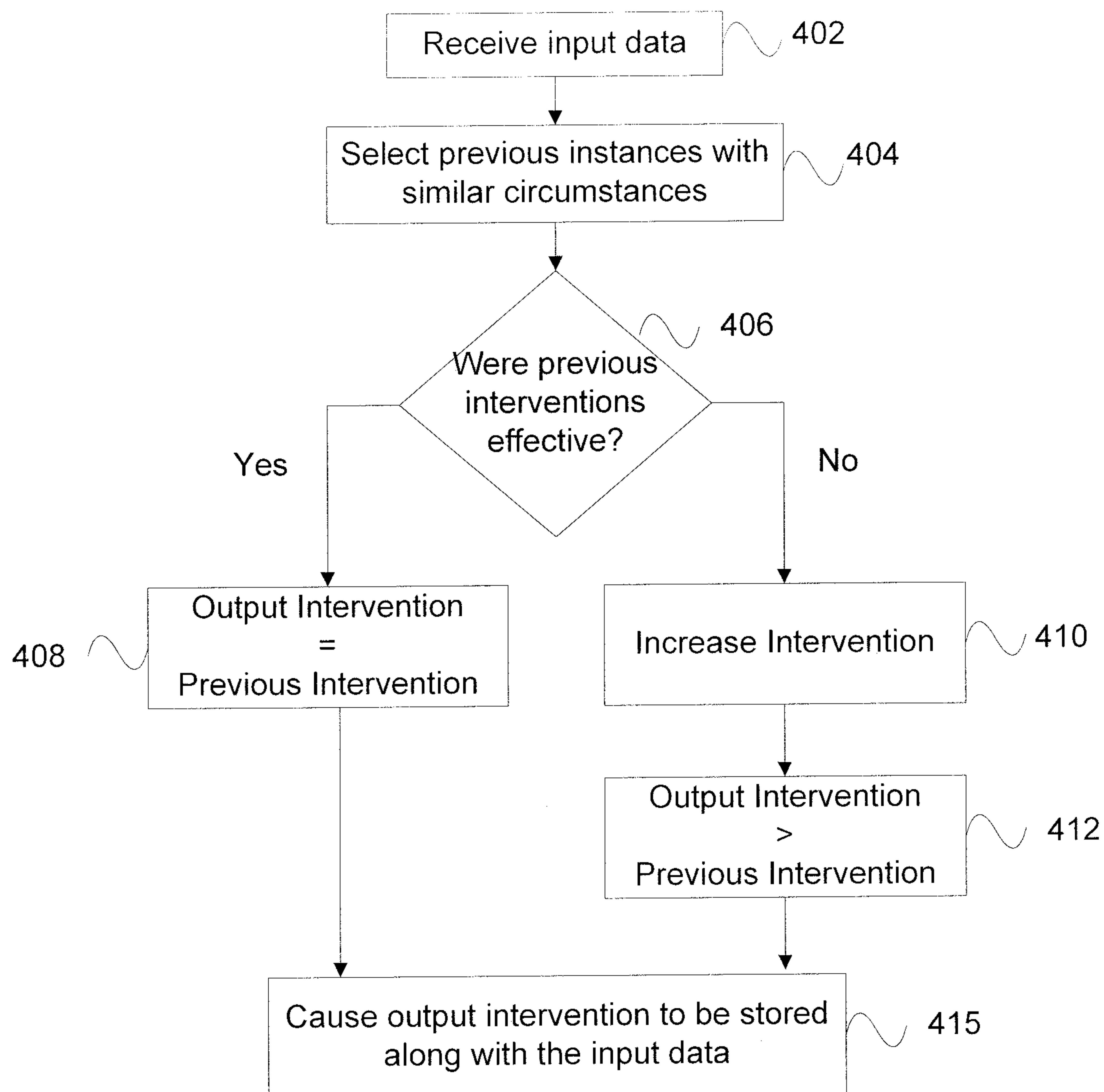


FIG. 4

9/9

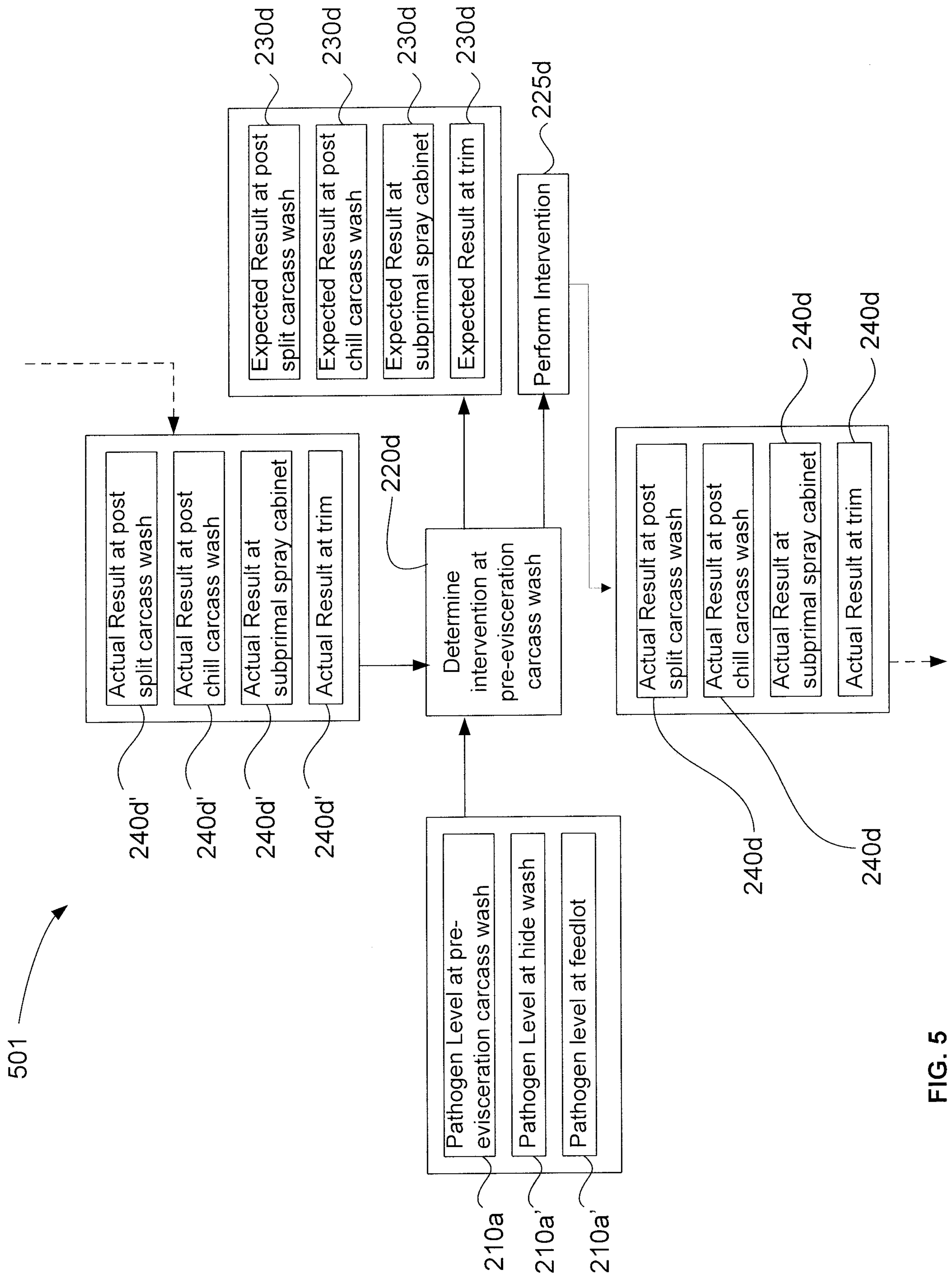


FIG. 5

