

ANTIMICROBIAL COMPOSITION INCLUDING A RESIDUAL BARRIER FILM

CROSS REFERENCE TO RELATED APPLICATION

5 [0001] This claims priority to U.S. Provisional Patent Application No. 61/564,206
filed on November 28, 2011, entitled “Medical Devices and Techniques for Antiseptic,
Immunomodulatory and Antineoplastic Therapies,” which is hereby incorporated by
reference in its entirety.

10 BACKGROUND

[0002] Infection remains a real problem in the medical industry today. Infections
are often caused by contamination of intravascular (IV) lines (e.g., intravenous, intra-
arterial, etc.), contamination of an injection site or blood draw site (e.g., from a vein,
artery, or capillary), urinary catheters, wound sites, incision sites, and numerous other
15 sources of infection in healthcare facilities. For example, in United States hospitals
alone, central venous catheters cause an estimated 250,000 blood stream infections per
year, which result substantial costs, both in terms of financial resources consumed and in
patient morbidity. O'Grady, MD, et al., *Guidelines for the Prevention of Intravascular
Catheter-Related Infections, 2011*, Center for Disease Control, Department of Health and
20 Human Services. These numbers do not include infections caused contamination of
injection sites, blood draw sites, non-venous catheters, or any of the other numerous
sources of contamination in healthcare facilities. Infection is even more of a problem in

developing nations, where syringes, IV lines, and other equipment routinely are used and re-used for multiple different patients.

BRIEF DESCRIPTION OF THE DRAWINGS

5 **[0003]** The detailed description is set forth with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different figures indicates similar or identical items or features.

[0004] FIG. 1 illustrates an example port cleaning system that may include a
10 cleaning cap having an applicator material carrying an antimicrobial composition.

[0005] FIGS. 2A-2C illustrate example port cleaning and disinfection system where the antimicrobial composition may give a visual indication of contaminants.

[0006] FIGS. 3A-3C illustrate example protective cap where the antimicrobial composition may give a visual indication of contaminants.

15 **[0007]** FIG. 4 illustrates an example nasal decolonizer device that may be used to deliver a antimicrobial composition.

DETAILED DESCRIPTION

OVERVIEW

20 **[0008]** This application describes approaches to reducing and/or preventing infections. In one aspect, the application describes example antimicrobial compositions that may be used alone or in combination with one or more medical devices to clean

and/or disinfect intravascular (IV) line ports, other IV components (e.g., syringes, lumens, valves, etc.), injection sites, blood draw sites (e.g., from a vein, artery, or capillary), catheters and/or catheter insertion sites, wound sites, incision sites, peritoneal dialysis sites, bladder or nephrostomy sites, other drainage sites, or any other site that is susceptible to infection.

EXAMPLE ANTIMICROBIAL COMPOSITION

[0009] In one example implementation, antimicrobial compositions that may be used in connection with the approaches described herein may include those described in, for example, U.S. Patent Application No. 12/874,188, filed September 1, 2010, to Tennican et al., which is incorporated herein by reference. In that case, the antimicrobial compositions may include water (H₂O), a strong and non-toxic chelating agent such as ethylenediaminetetraacetic acid (EDTA)(e.g., disodium EDTA, calcium disodium EDTA, magnesium EDTA, gallium EDTA) or sodium citrate (or acids, salts, derivatives, or other forms of EDTA or sodium citrate), a short-chain monohydric alcohol (e.g., ethanol with a molecular formula of C₂H₅OH and an empirical formula of C₂H₆O), and a strong, small molecule oxidizing agent such as hydrogen peroxide (H₂O₂). In one specific example, the compositions may consist essentially of water, EDTA, ethanol, and hydrogen peroxide. However, in other examples, other antimicrobial compositions may be used in combination with the devices described in this application.

[0010] The antimicrobial compositions may be in a liquid form, a gel form, or a foam form, for example, and may be combined with one or more carriers or diluents,

depending on the needs of a specific application. For example, in applications in which the antimicrobial composition is used as a hand sanitizer, the antimicrobial composition may be in a gel form. As another example, if the antimicrobial composition is used as a cleaning agent, a flush solution, or an irritant, the antimicrobial composition may be in a liquid form. In that case, the concentration of the various constituents may depend on, for example, a desired level of disinfection, whether the composition is being applied directly to living tissue or to a medical device, and/or to avoid irritation of tissue to which the composition will be applied directly or indirectly (e.g., via a medical device to which the composition is or was applied). In another example, a liquid form of the antimicrobial compositions may be vaporized or sprayed for application to nasal passages or other airways of a patient. In yet another example, the antimicrobial compositions may include or be combined with a lubricant (e.g., glycerin), surfactant or emulsifier (e.g., glycerol monolaurate (GML)), or the like and may be applied to a catheter, tracheal tube, scope, instrument, or other device that is to be inserted into a patient's body.

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EXAMPLE FILM OR BARRIER LAYER

[0011] In addition to providing disinfection at the time of the application, the antimicrobial compositions may also provide a lasting barrier against contamination. For example, even after volatile constituents of the composition (e.g., water, alcohol, hydrogen peroxide, etc.) have evaporated, the chelating agent may remain on the treated surfaces (e.g., port, port cleaning/protecting device, fingers, surrounding tissue, etc.) as a barrier that will provide antibacterial, antifungal or sporicidal (e.g., preventing

germination of the spores), anti-parasitic, and antiviral qualities. By robbing the environment of components (e.g., iron, magnesium, and manganese) that are needed for the bacterial, spores, parasites, and viruses to reproduce, the chelating agent provides a lasting defense to contamination even after other constituents of the antimicrobial composition have evaporated. Furthermore, the hydrogen peroxide in the antimicrobial compositions may induce a charge on a surface of materials (e.g., silicone materials) to which the antimicrobial compositions are applied, which make the materials more resistant to bacteria or other microorganisms.

[0012] FIG. 1 illustrates an example IV port cleaning system 100 including a cleaning cap 102 having an applicator material 104 carrying an antimicrobial composition, such as those described above. The cleaning cap 102 may be used to clean an IV port 106. In the illustrated example, the IV port comprises a female Luer® connector. However, in other embodiments, such IV port cleaning systems may be used or adapted for use in cleaning male Luer-Lok® or Luer® connectors, as well as other types of IV and non-IV ports and/or lumens. The cleaning cap 102 may be used to disinfect the IV port 106, for example, prior to connecting the port to a complimentary port, injecting a medication, drawing blood, or otherwise using the IV port 106. After being disinfected, volatile constituents of the antimicrobial composition may evaporate over time, leaving a film or barrier layer 108 of EDTA or other chelating agent that, as described above, provides a lasting defense to contamination.

[0013] Once disinfected, a protective cap (not shown in this figure) may be applied to the IV port 106 to provide a physical barrier against recontamination. The

protective cap may contain a same or different antimicrobial composition or other composition. In some implementations, the protective cap may securely couple to the IV port 106 and may seal the IV port. In the event that the antimicrobial composition in the protective cap dries out over time, the protective cap may still include a residual barrier
5 layer of EDTA or other chelating agent that will provide further defense to contamination. In other embodiments, instead of one of the antimicrobial compositions described above, the protective cap may simply be coated with a film or barrier layer of EDTA or other chelating agent over all or part of the interior and/or exterior surfaces of the protective cap.

10 **[0014]** While FIG. 1 illustrates an embodiment of an IV port cleaning system that includes a cleaning cap 102, in other embodiments, other cleaning devices may be used to carry and apply antimicrobial compositions according to this disclosure. By way of example and not limitation, other cleaning devices that may be used include pads, swabs, wipes, sponges, or any other material capable of carrying an antimicrobial composition.
15 Further, while FIG. 1 illustrates the antimicrobial composition and cap system being used to clean an IV port, antimicrobial compositions and cleaning devices according to this disclosure may be used to clean and/or disinfect other IV components, injection sites, blood draw sites, catheter and/or catheter insertion sites, wound sites, incision sites, peritoneal dialysis sites, drainage sites, or any other sites that are susceptible to infection.

20 **[0015]** Furthermore, in addition to their cleaning, disinfecting, and barrier properties, the antimicrobial compositions described above may include one or more therapeutic uses, such as those described herein below, as well as those described in

International Patent Application No. PCT/US2011/022150, filed January 21, 2011, to Tennican et al., which is incorporated herein by reference.

EXAMPLE INDICATOR OF CONTAMINATION

5 **[0016]** In addition to their cleaning, disinfecting, barrier properties, and therapeutic uses, the antimicrobial compositions described above provide a visual indicator of contamination, which may allow medical providers to identify and clean or replace contaminated equipment to prevent infection. Details of this indicator functionality are described below with respect to an example IV port cap system of FIGS. 10 2A-2C and 3A-3C. However, the indicator functionality of the antimicrobial compositions is not limited to such a system and is applicable regardless of the system or procedure in which the antimicrobial compositions are used.

[0017] FIGS. 2A-2C illustrate the IV port cleaning and disinfection system 100 of FIG. 1 in more detail. Specifically, FIG. 2A illustrates the cleaning cap 102 prior to use. 15 As shown in FIG. 2A, the cleaning cap 102 may come with a protective cover 200 that maintains the interior of the cleaning cap 102 in a sterile condition. Additionally or alternatively, the cleaning cap 102 may come packaged within another sterile package (not shown in this figure) to maintain the entire cleaning cap 102 in a sterile condition prior to use. In order to use the cleaning cap 102 to clean the IV port 106, the protective 20 seal may be removed, exposing the interior of the cap 102, as shown in FIG. 2B. The cleaning cap 102 may then be placed onto the IV port 106 and twisted or otherwise used to scrub and clean the IV port 106. Specifically, the applicator material 104 carrying the

antimicrobial composition may be used to scrub the exterior surfaces of the IV port 106 by twisting and pressing the cleaning cap 102 against the IV port 106.

[0018] If the IV port 106 is contaminated with bacteria, spores, parasites, viruses, bodily fluids, or other contaminants, the antimicrobial composition will begin to bubble or foam 202, providing a visual indicator of the contamination. The bubbling or foaming action is caused by reaction of the hydrogen peroxide with the bacteria, spores, parasites, and viruses. Specifically, contaminant enzymes that cause the hydrogen peroxide in the antimicrobial compositions to foam include but are not limited to, for example, catalases, superoxide dismutases (SOD), glutathione peroxidases, peroxiredoxin, and other peroxidases. Oropharyngeal, respiratory, cervicovaginal secretions and serum would also contain hydrogen peroxide reactants or enzymes that would cause the antimicrobial compositions to foam. EDTA may attenuate these reactions somewhat. However, testing shows that the attenuation is mild and does not impair the ability of the antimicrobial compositions to visually indicate the presence of contamination. For example, staphylococcus aureus (MRSA) with catalase and Pseudomonas aeruginosa with SOD both produce vigorous bubbling on contact with antimicrobial compositions according to this application. The hydrogen peroxide will also produce bubbles or foam in response to a Fenton reaction with iron in the hemoglobin in red blood cells, or peroxidases in white blood cells and in the bodily fluids. The size and rate of bubble formation may be indicative of the level of contamination, giving the medical personnel a visual indication that the equipment is contaminated and a relative degree to which the equipment is contaminated (e.g., more or larger bubbles/foam indicates more

contamination). Based on this indication medical personnel may determine that the equipment needs further cleaning and/or replacement to avoid infection.

[0019] FIGS. 3A-3C illustrate an example protective cap 300 that may in some embodiments be used in combination with the cleaning cap 102 of FIG. 1 and FIGS. 2A-
5 2C. After the IV port 106 has been cleaned, a protective cover 302 may be removed from the protective cap 300 to expose the interior of the protective cap, as shown collectively in FIG. 3A and 3B. As with the cleaning cap 102, the protective cap 300 may come packaged within another sterile package (not shown in this figure) to maintain the entire protective cap 300 in a sterile condition prior to use.

10 **[0020]** The protective cap 300 may then be applied to the IV port 106 to provide a physical barrier against recontamination, as shown in FIG. 3C. The protective cap 300 may contain a same or different antimicrobial composition or other composition than the cleaning cap 102. If, when the protective cap 300 is coupled to the IV port 106, bubbling or foaming 304 occurs, this bubbling or foaming will provide a visual indicator to
15 medical personnel that the IV port 106 is still contaminated and needs further cleaning and/or replacement.

[0021] In some embodiments, the antimicrobial composition in the cleaning cap 102 the protective cap 300, or both may include a dye or colorant that serves to further enhance the visual indication of contamination. When provided, the dye or colorant in
20 the cleaning cap 102 may be the same or different color than that in the protective cap 300. For example, the dye or colorant may be of a color to match the color of the

respective cap. In another example, the dye or colorant may be of a color to contrast with the color of the respective cap.

EXAMPLE NASAL/OROPHARYNGAL DEVICES

5 **[0022]** FIG. 4 illustrates a nasal decolonizer device 400 that may be used to deliver antimicrobial compositions such as those described herein to nasal passages of a patient. The antimicrobial compositions of this embodiment may include concentrations of alcohol and hydrogen peroxide that are lower than those used in the port and site cleaning and disinfecting applications due to the more sensitive nature of the nasal
10 passages. The nasal decolonizer device 400 may be used to apply the antimicrobial compositions to areas of nasal and oropharyngeal passageways of MRSA, or other resistant bacteria, carriers and/or prior to elective surgical implants. The antimicrobial compositions may be dispensed as a spray or gel.

15 **[0023]** As illustrated in FIG. 4, the nasal decolonizer device 400 includes a reservoir 402 to hold an antimicrobial composition and a dispensing spout 404 sized and shaped to fit at least partially into a nasal passage of a patient. The dispensing spout 404 may be made of a relatively soft, pliable material, which may serve in some implementations as an applicator or spreader of the gel or liquid to accessible inner surfaces of the nose and/or nasal passages. Prior to use, the dispensing spout 404 is
20 capped by a frangible tab 406 that hermetically seals the nasal decolonizer device 400.

20 **[0024]** The nasal decolonizer 400 or other medical device of varying size, shape, material, and configuration, with a dispensing spout for spray or gel contained in a

reservoir, may be used to deliver antimicrobial, immunomodulatory, and/or anti-neoplastic therapy to internal body sites or hard to reach sites.

CONCLUSION

- 5 **[0025]** Although the application describes embodiments having specific structural features and/or methodological acts, it is to be understood that the claims are not necessarily limited to the specific features or acts described. Rather, the specific features and acts are merely illustrative some embodiments that fall within the scope of the claims of the application.

CLAIMS

1. A method comprising:

identifying a surface to be decontaminated;

5 testing the surface for contamination, the testing including:

applying a medical applicator to the surface, wherein the medical applicator
comprises:

a cap device comprising a cylindrical cavity, the cylindrical cavity
having a foam insert or a nasal decolonizer device comprising a reservoir; and

10 an antimicrobial composition within the foam insert of the cap device
or reservoir of the nasal decolonizer device, wherein the antimicrobial
composition comprises water, an alcohol, a peroxide or peroxide-generating
agent and a chelating agent; and

receiving an indication that the antimicrobial composition has come in contact
15 with one or more contaminants on the surface, the indication including foaming or
bubbling with an appearance of a color.

2. The method as recited in claim 1, wherein the one or more contaminants
comprises at least one of one or more of a bacterium, a spore, a parasite, a virus,
20 bodily fluid or a combination thereof.

3. The method as recited in claim 2, wherein the one or more contaminants
includes staphylococcus aureus (MRSA), Pseudomonas aeruginosa or other resistant
bacteria.

4. The method as recited in any one of claims 1 to 3, wherein the antimicrobial composition further comprises:

- about 5 to about 50 mg/ml of ethylenediaminetetraacetic acid (EDTA);
- 5 at most about 70% ethanol, by volume;
- at most about 7.5% hydrogen peroxide, by volume; and
- water.

5. The method as recited in any one of claims 1 to 4, wherein the antimicrobial
10 composition is in the form of a liquid or gel.

6. The method as recited in any one of claims 1 to 5, wherein the chelating agent is present in a quantity to remain on a surface after the water, the alcohol and the peroxide have dispersed.

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7. The method as recited in any one of claims 1 to 6, wherein receiving an indication that the antimicrobial composition has come in contact with one or more contaminant on the surface comprises foaming or bubbling.

20 8. The method as recited in any one of claims 1 to 7, wherein the surface to be decontaminated comprises human tissue or an area on a medical device.

9. A method of providing a barrier against contamination comprising:
identifying a surface to be protected;

applying an antimicrobial agent to the surface, wherein the antimicrobial agent comprises water, a low molecular weight alcohol, a peroxide or peroxide-generating agent and a chelating agent;

wherein the chelating agent is present in an amount to remain on the surface after the water, the low molecular weight alcohol, and the peroxide or peroxide-generating agent have evaporated thereby forming an antimicrobial barrier.

10. The method as recited in claim 9, wherein the surface to be protected comprises human tissue or an area on a medical device.

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11. The method as recited in claim 9 or claim 10, wherein the antimicrobial agent further comprises:

about 5 to about 50 mg/ml of ethylenediaminetetraacetic acid (EDTA);

at most about 70% ethanol, by volume;

15 at most about 7.5% hydrogen peroxide, by volume; and

water.

12. The method as recited in any one of claims 9 to 11, wherein the antimicrobial agent is in the form of a liquid or gel.

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13. The method as recited in any one of claims 9 to 12, wherein the chelating agent remaining on the surface inhibits the reproductive capabilities of bacteria, spores, fungi, parasites and viruses.

14. A method of giving a visual indication of one or more contaminants on a surface comprising:

determining one or more surfaces to be decontaminated;

testing the one or more surfaces for contamination, the testing including:

5 applying an antimicrobial agent to the surface, wherein the antimicrobial agent comprises water, a low molecular weight alcohol, a peroxide or peroxide-generating agent and a chelating agent; and

 receiving an indication that the antimicrobial agent has come in contact with one or more contaminant on the surface, the indication including foaming or bubbling
10 with an appearance of a color.

15 15. The method as recited in claim 14, wherein the surface to be decontaminated comprises human tissue or an area on a medical device.

15 16. The method as recited in claim 14 or claim 15, wherein the antimicrobial agent further comprises:

 about 5 to about 50 mg/ml of ethylenediaminetetraacetic acid (EDTA);

 at most about 70% ethanol, by volume;

 at most about 7.5% hydrogen peroxide, by volume; and

20 water.

17. The method as recited in any one of claims 14 to 16, wherein receiving an indication that the antimicrobial agent has come in contact with one or more

contaminant on the surface comprises a visual indication such as foaming or bubbling on the surface.

18. The method as recited in any one of claims 14 to 17, wherein the one or more
5 contaminants comprises at least one of one or more bacteria, one or more spores, one
or more parasites, one or more viruses, one or more bodily fluids.

19. The method as recited in claim 18, wherein the one or more contaminants
includes staphylococcus aureus (MRSA), Pseudomonas aeruginosa and other resistant
10 bacteria.

20. The method as recited in any one of claims 14 to 19, wherein the amount
chelating agent present in the antimicrobial agent does not inhibit the indication that
the antimicrobial agent has come in contact with one or more contaminant on the
15 surface.