

The Q-Net™ Monthly

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July-August 2007

What's News

➤ The Association for the Advancement of Medical Instrumentation (AAMI) will soon publish a technical report on the quality of water used to rinse reusable medical instruments. This would be an important report, but the final document is to omit the obvious and important recommendation to monitor the rinse water *inside* automated endoscope reprocessors and liquid processing systems. This report is also expected not to disclose potential financial conflicts of interest.

Editor-in-Chief

All of the articles published in this newsletter are written by: **Lawrence F. Muscarella, Ph.D.**, Chief, Infection Control at Custom Ultrasonics, Inc. Ivyland, PA.

What is 'Q-Net'?

Q-Net is a technology-assessment, Internet-based network of questions and answers. Its newsletter is *The Q-Net™ Monthly*.

The main goal of **Q-Net** is to encourage the infection control, endoscopy, and OR communities not only to ask good questions but also to demand well referenced responses.

Q-Net addresses the needs of both the health care provider whose goal is to provide the best care possible and the patient who deserves affordable quality health care.

Serratia infections in NICUs

Recommendations to prevent the spread of Serratia

❖ A recent infection and potential outbreak of *Serratia* in the neonatal intensive care unit (NICU) of a medical facility in Toronto are discussed.

❖ **Standard Precautions and Contact Precautions** are also discussed.

❖ The importance of proper reprocessing of reusable medical instruments including endoscopes to the prevention of transmission of *Serratia* is emphasized.

QUESTION: "Please discuss the epidemiology of *Serratia* infections and provide recommendations to prevent the transmission of *Serratia* in a NICU. Please also discuss Contact Precautions."

ANSWER AND BACKGROUND: A bacterial infection and potential outbreak were identified last May (2007) in the neonatal intensive care unit (NICU) of a medical facility in Toronto (Canada).¹⁻⁴ A two-week old prematurely born infant weighing between 1 and 3 pounds was infected with *Serratia* and died of bacteremia (or an infection of the blood). Four other "palm-sized" infants

receiving treatment in this NICU also tested positive for *Serratia*, but none has displayed symptoms of infection, suggesting colonization (or a pseudo outbreak of *Serratia*).^{3,4}

Among other infection-control measures, the medical facility temporarily closed its NICU as part of an aggressive strategy to prevent additional infections. Newspaper reports indicate that this infection and potential outbreak were identified at a time when the medical facility has acknowledged that its NICU is overcrowded and in need of renovation.^{1,4}

Many aspects of this NICU's infection and potential outbreak are unclear and have not been published, but a number of newspaper articles that discussed this incident reported that: (a) *Serratia* are often found in the intestinal flora of adults and sometimes infants; (b) proper hand hygiene is important to prevent the nosocomial transmission of *Serratia*; and (c) the medical facility's NICU is reportedly overcrowded and provides insufficient space between incubators, increasing the risk of disease transmission.¹⁻⁴

To date, however, the cause of this infection and potential outbreak of *Serratia* has not been determined. It is unclear whether the strain of *Serratia* responsible for this incident is multidrug-resistant, or whether any of the infants in this NICU were suffering from acute diarrhea.

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METHODS: This article reviews the epidemiology of *Serratia* and provides recommendations to control and prevent the transmission of *Serratia* in a NICU. This article also discusses the potential contribution of inadequate reprocessing of endoscopes and other types of reusable medical instruments to the transmission of *Serratia*.

DISCUSSION: *Serratia* is a genus of opportunistic gram-negative (non-spore-forming) bacteria classified in the tribe *Klebsielleae* of the family *Enterobacteriaceae*. Members of this genus, among other species, include *Serratia marcescens*, *S. liquefaciens*, and *S. odorifera*.⁵ Most healthcare-acquired infections of *Serratia* are caused by *S. marcescens*, suggesting that this may be the species of *Serratia* responsible for this recent infection and potential outbreak in a NICU in Toronto.⁶

Serratia are transmitted through direct and indirect contact, as opposed to via large-particle droplets or airborne droplet nuclei, and ordinarily do not cause infection in healthy patients. (See **Box A** for a discussion of *Standard Precautions* and *Transmission-Based Precautions*.) As this recent infection and potential outbreak in a NICU demonstrate, infections of *Serratia* and other types of opportunistic bacteria can be associated with significant morbidity and mortality among premature infants (and other immuno-compromised or critically-ill patients).^{1-4,7-12} The symptoms of *Serratia* infection include fever, shock, and respiratory distress.

An epidemiologic understanding of *Serratia* is required both to determine the likely source and cause of an infection or outbreak of *Serratia* and to prevent additional infections. Outbreaks of *S. marcescens* in NICUs have been associated with significant morbidity and mortality, including septicemia, pneumonia, meningitis, urinary tract infection, and conjunctivitis.⁸⁻²⁴ Investigations of the causes of these and other

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Box A. Standard Precautions: *The Centers for Disease Control and Prevention's "Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007"* was published this past June (2007) and recommends a two-tiered approach to the prevention of disease transmission.^{28,29} *Standard Precautions* are the first-tier of isolation precautions and are intended as the primary strategy to prevent the transmission of infectious agents through exposure to blood; all body fluids, secretions and excretions (except sweat); non-intact skin; and mucous membranes. *Standard Precautions* are sufficient to interrupt the spread of most infectious agents.

Standard Precautions, a key component of which is the use of physical barriers to prevent disease transmission, apply to *all* patients, regardless of their diagnosis or presumed infection status, and include: hand hygiene; the use of gloves, masks, and gowns; respiratory hygiene/cough etiquette and safe injection practice;^{28,29} and reprocessing reusable instruments and equipment.

Transmission-Based Precautions: *Transmission-Based Precautions* are the second-tier of isolation precautions and are performed when *Standard Precautions* alone are insufficient to prevent disease transmission.^{28,29} These additional control measures are intended only for the care of patients known or suspected to be infected or colonized with epidemiologically important infectious agents transmitted by: (a) direct or indirect contact, (b) large-particle droplets, or (c) airborne droplet nuclei. The three types of *Transmission-Based Precautions* that correspond, respectively, to these three are: *Contact Precautions*, *Droplet Precautions*, and *Airborne Infection Isolation Precautions* (previously known as *Airborne Precautions*).^{28,29}

The infectious agent's mode(s) of transmission and empirical data including the patient's symptoms determine which one (or more) of these three types of precautions is used to interrupt disease transmission. Whereas one infectious agent, such as *Serratia* in a NICU, may require *Contact Precautions* to prevent additional infections, another infectious agent, such as *Mycobacterium tuberculosis*, may instead require *Airborne Infection Isolation Precautions*.^{28,29}

Contact Precautions are intended to prevent infections of epidemiologically important infectious agents transmitted by direct or indirect contact with an infected or colonized patient or the patient's potentially contaminated surrounding environment. Skin-to-skin contact is an example of direct contact, and contact with items in the environment is an example of indirect contact. These precautions include cohorting patients if single-patient private rooms are unavailable and wearing gloves when entering the patient's room or area.^{28,29} *Serratia marcescens* is an example of an infectious agent for which *Contact Precautions* may be indicated to interrupt its transmission and prevent additional infections.

Droplet Precautions are intended to prevent infections transmitted by large-particle droplets (i.e., > 5 µm in size). Infected patients may produce large-particle droplets during coughing, sneezing, talking, or during, among other types of procedures, endotracheal intubation and bronchoscopy. Large-particle droplets do not remain infectious over long distances and, therefore, generally require close contact (i.e., < 3 feet) for transmission. *Haemophilus influenzae* is an example of an infectious agent spread by large-particle droplets. *Droplet Precautions* include the cohorting of patients separated by at least 3 feet if single-patient private rooms are unavailable.^{28,29}

Airborne Infection Isolation Precautions are intended to prevent infections transmitted by airborne droplet nuclei or small particles 5 µm or smaller in size. Infected patients may produce these airborne particles during coughing, sneezing, talking, or during, among other procedures, endotracheal intubation and bronchoscopy. These airborne particles can remain infectious in the air for several hours and can travel over long distances.^{28,29} *Mycobacterium tuberculosis* is an example of an infectious agent spread by airborne droplet nuclei. *Airborne Infection Isolation Precautions* include placing patients in private rooms with negative air pressure (whenever possible) and healthcare personnel wearing respiratory protection (e.g., N95 or higher level respirators, or masks if respirators are unavailable).^{28,29} ●

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outbreaks of *Serratia* often conclude that poor hand hygiene of healthcare staff members was most likely responsible for disease transmission.^{16,17,19-22,24}

It would not be surprising to learn, therefore, that officials investigating this recent infection of *Serratia* in the NICU of a medical facility in Toronto determined that the hands of the healthcare staff members were transiently colonized and responsible for the transmission of the infectious strain of *Serratia* among the infants.¹⁻⁴ The newspaper articles that first reported this incident would appear to agree, having implied that, first, the reservoir of this infection of *Serratia* was likely the intestines of one or more of the infants (and/or staff) and, second, the hands of healthcare staff members were likely responsible for transmission of the infectious strain of *Serratia* in this reportedly overcrowded NICU.¹⁻⁴

A “misdiagnosis”? Whether improper hand washing or poor hand hygiene was responsible for transmission of *Serratia* in this NICU in Toronto remains unclear. But, it would be shortsighted, and could result in “misdiagnosis” of the true source and mode of transmission of the *Serratia* in this NICU, if the investigation limited consideration of the reservoir of *Serratia* to the intestines of neonates (or staff) and the spread of the *Serratia* to the hands of healthcare staff members. **The intestines are not *Serratia*'s only nosocomial source or reservoir, and, to be sure, transmission of *Serratia* is not restricted to the hands of healthcare staff members.** In addition to their intestines, *Serratia* may colonize the respiratory and urinary tracts of hospitalized patients, and *Serratia*—namely, *S. marcescens*—are ubiquitous in the environment and have been found in soil and water and on moist surfaces.^{6,7,20,24}

Potential sources and reservoirs of *Serratia*: These findings highlight important characteristics of *Serratia* and raise the possibility that a source other than the hands of health staff members—namely, a reusable medical device—may have been responsible for this recent infection and potential outbreak of *Serratia* in a NICU. Although infected or colonized infants are often identified as sources for horizontal transmission of *Serratia* via the (transiently colonized) hands of healthcare staff members,^{16,17,19-21,22,24} failure to consider potential sources other than infants' intestines and vehicles for the transmission of *Serratia* other than the hands of healthcare staff members might delay, if not prevent, the identification of the source and cause of an outbreak of *Serratia*. It might also prevent the timely implementation of infection-control measures crucial to interrupt the transmission of *Serratia* among infants in a NICU.

In addition to the hands of healthcare staff members, outbreaks of *S. marcescens* in NICUs have been linked to contaminated rigid laryngoscopes and incubators, as well as to contaminated sinks, water faucets, and other wet environmental surfaces.^{6-12,14-16,20,23} Moreover, the consumption of contaminated tap water during the administration of an oral

medication has been linked to the infection and colonization of patients with multidrug-resistant *S. marcescens*.⁷ Disease transmission was not controlled until a contaminated water faucet was replaced. Outbreaks of *Serratia* have also been linked to the administration of contaminated intravenous (IV) fluids, solutions, and medications including propofol.²⁵⁻²⁷ (➔ Refer to the February 2002 and March 2002 issues of this newsletter for a detailed discussion of aseptic technique and the safe administration of intravenous medications.)

Infections and outbreaks of *Serratia* in NICUs

- ◆ **Background:** *Serratia* are opportunistic bacteria that have been linked to outbreaks in NICUs.
- ◆ **What to do?** In addition to *Standard Precautions*, the implementation of *Contact Precautions* is recommended to prevent the spread of *Serratia* and other epidemiologically important infectious agents in NICUs.
- ◆ **What's learned?** Proper reprocessing of reusable medical devices, including rigid laryngoscopes, is as important to the prevention of transmission of *Serratia* as proper hand hygiene and the routine cleaning and disinfection of environmental surfaces.

If the source of the *Serratia* in the NICU of this medical facility in Toronto were a contaminated rigid laryngoscope or incubator, or a contaminated sink or tap water, then the implementation of special infection-control measures in addition to *Standard Precautions*—specifically, gloving and hand hygiene per *Contact Precautions* (**Box A**)—might do little to prevent additional infections. For example, if a faucet were colonized with *Serratia* and contaminating rigid laryngoscopes during washing and terminal water rinsing, then implementation of *Contact Precautions* would not be expected to prevent the spread of *Serratia*.⁷ The prompt determination of the cause of an infection or outbreak of *Serratia* requires consideration of *all* of the possible sources of *Serratia*.

Rigid laryngoscopes, incubators: *Improper reprocessing of rigid laryngoscopes has been linked to outbreaks of *Serratia* in NICUs.* Cullen *et al.* reported that inadequately reprocessed laryngoscope blades (and possibly an incubator) were likely the source of an outbreak of *S. marcescens* in a NICU.¹³ Four infants were infected, two of whom died. Similarly, Jones *et al.* reported an outbreak of *S. marcescens* in two NICUs caused by a contaminated laryngoscope blade (and expressed breast milk).¹⁴ Seventeen neonates were colonized, three developed septicemia, and two died. In addition to *S. marcescens*, outbreaks of *Pseudomonas aeruginosa* in NICUs have been linked to contaminated rigid laryngoscopes. **A recent public health notice provides instructions for reprocessing**

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rigid laryngoscopes (see: **Box B** on page “16S”).¹¹ (➔ *The reprocessing of rigid laryngoscopes is discussed in the September-October 2004 issue of this newsletter.*)

Outbreaks linked to contaminated incubators have also been published. *Jang et al.* reported an outbreak of *S. marcescens* linked to the doors of incubators and contaminated hand-washes.²⁰ The potential for outbreaks of *P. aeruginosa* as a result of contaminated incubators also has been discussed.³⁰

RECOMMENDATIONS: *The following recommendations are provided to control and prevent the transmission of Serratia in a NICU.* Many of these recommendations—which are key components of *Contact Precautions*—also apply to other healthcare settings (e.g., ICUs) and to other epidemiologically important infectious agents transmitted by direct or indirect contact (review **Box A**, p. 14). ➔ *The importance of properly reprocessing bronchoscopes and gastrointestinal (GI) endoscopes is underscored, because these type of flexible endoscope—like rigid laryngoscopes and incubators—have been linked to outbreaks (and pseudo-outbreaks) of Serratia.*³¹⁻³⁷

1. Quality Assurance:

A. Develop and implement a surveillance program that monitors patients to **promptly identify** infections or colonizations of *Serratia* and other infectious agents.²⁰ *Prompt identification of infected or colonized patients is the first step to controlling and preventing the spread of Serratia.*

- a. If a patient infected (or colonized) with *Serratia* is identified in the NICU, monitor the other patients to identify additional infections and to evaluate the effectiveness of any control measures implemented to prevent disease transmission, such as *Contact Precautions*. Update managers and administrators on the effectiveness of any implemented control measures.³⁸
- b. Surveillance of environmental surfaces may be necessary to identify the source or reservoir of *Serratia*.²⁹
- c. Consider monitoring for *Serratia* and other gram-negative bacteria the tap water used in the NICU to wash healthcare staff members' hands, for patient care and treatment, and to rinse reusable medical instruments terminally.⁷ (➔ *Refer to the February 2001 issue of this newsletter for more information.*)

2. Contact Precautions:

A. For patients known or suspected to be infected or colonized with *Serratia*, **promptly implement *Contact Precautions*** as dictated by published guidelines and the medical facility's infection-control policies and procedures.^{28,29} *Contact Precautions*, which are to be implemented when *Stan-*

dard Precautions alone are insufficient to control and prevent disease transmission, include the following measures:^{23,28,29}

- a. **Cohort** (segregate) patients in a designated area (e.g., multi-patient room) if single-patient private rooms are unavailable for isolation.^{4,17-19,22,23,28,29,39} Physically separate the beds of cohorted patients by at least 3 feet.²⁹ Dedicating specific healthcare staff members to care for these cohorted patients may be necessary.⁴⁰ (*Contact Precautions* apply only to the isolated patients and their immediate environment; therefore, these measures may no longer be necessary in the NICU once the infected and colonized patients have been removed and isolated.)
- b. **Perform proper hand hygiene** in accordance with *Contact Precautions* and hand hygiene guidelines.^{16,17,19,21,22,28,29,38-41} For example, wash hands immediately after gloves are removed, before having direct contact with patients, and after contact with potentially contaminated environmental surfaces in close proximity to isolated patients. It is recommended that healthcare staff with direct or indirect contact with infected or colonized patients not wear artificial fingernails.^{29,41}

This article continues on the next page (page 16S).

All of this newsletter's back issues from 1996 to the present are available at Q-Net's website—www.myendosite.com. In addition to other features and important articles, this website now features an important “How to Reprocess ...” page.

Thank you for your interest in this newsletter. I have addressed each issue and topic to the best of my ability. Respectfully, *Lawrence F. Muscarella, Ph.D.*
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Box B: Outbreaks of *P. aeruginosa* linked to contaminated rigid laryngoscopes. In addition to *Serratia*, outbreaks of *P. aeruginosa* have been linked to contaminated rigid laryngoscopes. Foweraker investigated an outbreak of *P. aeruginosa* in a cardiac ICU involving four pediatric patients, one of whom died of pneumonia and septicemia.⁸ This investigation linked this outbreak to a rigid laryngoscope blade contaminated with *P. aeruginosa*. Neal et al. reported the colonization of eight infants with *P. aeruginosa* in an ICU, four of whom died and one of whom had clinical evidence of septicemia.⁹ Two inadequately reprocessed neonatal laryngoscope blades were found to be contaminated with the outbreak strain of *P. aeruginosa*.

A recent outbreak of *P. aeruginosa* in a NICU was linked to inadequate reprocessing of rigid laryngoscopes.¹⁰⁻¹² Several infants were infected with the outbreak strain of *P. aeruginosa*, at least two of whom died.¹¹ Among other environmental sites, all five sink basins and one of two laryngoscope blades were found to be contaminated with the outbreak strain of *P. aeruginosa*. This outbreak was in part the impetus for the issuance this past spring (2007) of a safety notice written by the California Department of Health Services.^{10,12} This safety notice—which can be read at: www.myendosite.com/states/AFL_07-09.pdf—discussed the potential for disease transmission as a result of inadequate reprocessing of the rigid laryngoscope's blade and handle (and other types of reusable semi-critical medical instruments).¹¹ ●

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- c. Use **personal protective equipment (PPE)** in accordance with *Contact Precautions*.^{28,29} For example, don a new gown and gloves for all types of physical contact or interactions with infected or colonized patients (and potentially contaminated environmental surfaces). Perform these measures before or upon entry into the patient's room or cohorted area, and discard the gown and gloves before leaving.³⁸
- d. Whenever possible, use **disposable non-critical patient-care items** (e.g., blood pressure cuffs); or, **dedicate reusable non-critical items** for use on a single patient (or cohort of patients). Otherwise, clean and disinfect between uses these reusable items shared by patients.^{28,29}
- e. **Clean and disinfect frequently touched and potentially contaminated environmental surfaces in patient-care areas**, including sinks, bedrails, and doorknobs. Perform these measures at least daily using an EPA-registered cleaner/disinfectant in accordance with manufacturers' instructions. In general, no additional cleaning measures other than those prescribed by *Standard Precautions* are required for isolated patients.^{28,29}

B. Implement *Contact Precautions* until patients are no longer infected or colonized, or as determined by the facility

through consultation with infection control staff.^{28,29,38}

3. Education, Administration:

A. Develop and implement an educational program that teaches healthcare staff about the epidemiology of *Serratia* and the principles of and rationale for *Contact Precautions*.

- a. This educational program should stress a thorough understanding of the sources, reservoirs, and mode of transmission of *Serratia*, as well as the risk factors for transmission of *Serratia* in NICUs. This educational program should also stress the criteria required for implementation of *Contact Precautions* (see: **Box A**).^{28,29}

B. Use this educational program to **develop and write infection-control policies and procedures** designed to prevent transmission of *Serratia* in NICUs.

- a. These policies and procedures should include instructions for the proper cleaning and disinfection of rigid laryngoscopes, bronchoscopes, GI endoscopes and other types of endoscopes, incubators, and environmental surfaces. ...

Article to be continued in next issue.

✓ **ADDITIONAL RECOMMENDATIONS** and the conclusion of this article on *Serratia* in NICUs are provided in the next issue of this newsletter.

✓ The **REFERENCES** to this newsletter's article on *Serratia* (pp. 13 - 16S) are available at:

www.myendosite.com/refs070807.pdf

Thank you for your interest in this newsletter. I have addressed each issue and topic to the best of my ability. Respectfully, *Lawrence F. Muscarella, Ph.D.*
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The Q-Net™ Monthly

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September-October 2007

What's News

● In the September 2007 issue of *Materials Management in Health Care*, I provide responses to three instrument reprocessing questions. I respond to three additional reprocessing questions, for a total of six, in the November 2007 issue of this same magazine.

● An article I wrote entitled "Prevention of disease transmission during flexible laryngoscopy" was published in the October 2007 issue of APIC's *American Journal of Infection Control*.

Editor-in-Chief

All of the articles published in this newsletter are written by **Lawrence F. Muscarella, Ph.D.**, Chief, Infection Control at Custom Ultrasonics, Inc. Ivyland, PA

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Serratia infections, Part 2

THIS ARTICLE:

- **is the final in a series of two articles that discusses the epidemiology of Serratia;**
- **reviews reports of the transmission of Serratia during flexible and rigid endoscopy;**
- **complements the first article in this series published in the July-August 2007 issue of this newsletter; and**
- **provides additional recommendations to control and prevent the transmission of Serratia in NICUs, with focus on instrument reprocessing.**

and mortality, were reviewed to evaluate effective measures for the prevention of transmission of *Serratia* in neonatal intensive care units (NICUs).^{1-4,7,9-25,27,31-38} Some recommendations for the control and prevention of the transmission of *Serratia* in a NICU were developed and provided in the first article in this series.

In particular, the details of a recent infection, colonization and potential outbreak of *Serratia* identified last May (2007) in the NICU of a medical facility in Toronto (Canada) were studied.¹⁻⁴ Many aspects of this case remain unknown, such as the source and mode of transmission of the *Serratia*, and whether the species of *Serratia* responsible for this infection was *S. marcescens*.

Discussed in the first article in this series, investigations of infections and outbreaks of *Serratia* in NICUs routinely focus on neonatal patients and their intestines as the likely source of the disease. This strategy is warranted, because *Serratia*, which is ubiquitous in the envi-

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Background: The first article in this series, published last month in the July-August 2007 issue of this newsletter, emphasized that improper reprocessing of reusable medical instruments is a risk factor for the transmission of *Serratia*—a genus of gram-negative (non-spore-forming) bacilli that has been linked to disease transmission during flexible and rigid endoscopy.^{8-14,31-37} This series of two articles provides a response to a question about *Contact Precautions* and the epidemiology of *Serratia*.

Several reports of healthcare-acquired infections (HAIs) and outbreaks of *Serratia*, with associated morbidity

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ronment, has been identified in the intestinal flora of neonates.^{1-4,6,20,24} Moreover, reports have described infected or colonized neonates as sources of *Serratia* infections and outbreaks in NICUs.^{16,17,19-22,24}

The hand washing practices of healthcare staff members treating neonates in a NICU are also typically scrutinized, to determine whether these caretakers' hands are transiently colonized with the outbreak's strain of *Serratia* and, therefore, most likely responsible for disease transmission. This too is a valid strategy, because reports have linked poor hand hygiene of healthcare staff members to outbreaks of *Serratia*.^{16,17,19-22,24}

Indeed, it is essential to investigate the intestines of neonates and the hands of healthcare staff members as the possible source and mode of transmission, respectively, of an infection or outbreak of *Serratia* in a NICU. It is equally important, however, also to investigate the potential contribution of other sources to disease transmission, including contaminated rigid laryngoscopes, incubators, sinks, tap water, water faucets, and other wet environmental surfaces.

These reusable medical instruments, inanimate and environmental surfaces, and water sources have been linked to infections and outbreaks of *Serratia* (and other types of gram-negative bacilli) in NICUs.^{7-14,20,23,30,45} Therefore, failure during an outbreak investigation to consider each as a potential source and/or vehicle for transmission of *Serratia* could prevent implementation of infection-control measures crucial to the control and prevention of disease transmission.

Standard Precautions, Transmission-Based Precautions: Also discussed in the first article of this series, *Standard Precautions* are the first and most important level of precautions, or practices, to prevent disease transmission. These precautions apply to *all* patients, regardless of their illnesses, the status of their immune systems, or the healthcare setting. For most types of infectious agents, such as HIV and the hepatitis B and C viruses, *Standard Precautions* are ordinarily sufficient to prevent disease transmission. But, for some other types of infectious agents, *Standard Precautions* are inadequate, requiring the additional implementation of *Transmission-Based Precautions*—the second level of isolation precautions.

Contact Precautions, *Droplet Precautions*, and *Airborne Infection Isolation Precautions*—the three types of *Transmission-Based Precautions*—are intended only for the care of patients known or suspected to be infected or colonized with certain epidemiologically important, or targeted, infectious agents. These targeted agents are, in general, readily transmissible, associated with significant morbidity and mortality, and sometimes antibiotic-resistant.

Whether implementation of any one or more of these

three types of transmission-based precautions is required to control and prevent disease transmission depends on the targeted infectious agent and its mode of transmission. *Contact Precautions* (in addition to *Standard Precautions*) are typically indicated to control and prevent nosocomial transmission of infectious agents, like *Serratia*, that are transmitted by direct or indirect (physical) contact. (Review **Box A** on p. 14 of the first article in this series for more information.)

Recommendations: Several important (although incomplete) recommendations for the control and prevention of transmission of *Serratia* in NICUs were provided in the previous issue of this newsletter. The following additional recommendations, which complete this previously published set, focus on water quality and instrument reprocessing. Rigid laryngoscopes, bronchoscopes and gastrointestinal (GI) endoscopes have been linked to outbreaks (and pseudo-outbreaks) of *Serratia*.³¹⁻³⁷ Although generally specific to NICUs and *Serratia*, these recommendations can be also applied to other healthcare settings, such as adult ICUs, and to other epidemiologically important infectious agents, like *Clostridium difficile* or “*MRSA*,” that are transmitted by direct or indirect contact.

Poor hand hygiene of healthcare staff members has been linked to outbreaks of *Serratia*.^{16,17,19-22,24}

Contaminated rigid laryngoscopes, incubators, and wet environment surfaces have been linked to the transmission of *Serratia* and other gram-negative bacilli in NICUs.^{7-14,20,23,30,45}

4. **Quality Assurance, Part 2 (continued):**

A. Review the recommendations provided in *Section 1*—Quality Assurance, Part 1—on p. 16 of this series' first article.

B. Develop and implement a comprehensive quality assurance program that **supervises and monitors healthcare staff members** to ensure their strict compliance with *Standard Precautions* and, as warranted, *Contact Precautions*.

a. Require healthcare staff to attend as often as possible educational programs that discuss *Standard Precautions*, *Contact Precautions*, *Serratia*, and the principles of disease transmission. (Refer to *Section 3* on p. 16S of this series' first article.)

C. Use this quality assurance program to **supervise and monitor staff members responsible for cleaning and disinfecting** (or sterilizing) **rigid laryngoscopes, bronchoscopes, gastrointestinal (GI) endoscopes** and other types of reusable instruments, as well as incubators and environmental surfaces, to ensure strict compliance with published guidelines and manufacturers' instructions. (Refer to *Section 5*, below.)

D. Monitor the number of neonates and healthcare staff members in the NICU, and the number of medical instruments and equipment in inventory to ensure the NICU:

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- ✓ is not **understaffed**. An adequate number of healthcare staff members is required to provide quality care;
- ✓ is not **overcrowded** with neonatal patients, which, along with understaffing, has been linked to an increased risk of disease transmission;^{1-4,13,19,41,43} and
- ✓ has in inventory a sufficient number of reusable medical instruments—including rigid laryngoscope blades and handles—to permit ample time for each to be thoroughly reprocessed between uses. An inadequate inventory of available instruments has been linked to outbreaks of *Serratia* and other types of microorganisms.^{8,9,13,14} *The purchase of additional reusable medical instruments may be necessary.* (Refer to the article about *flash sterilization* on p. 19 of this newsletter).

5. Reprocessing Endoscopes, Incubators:

A. Properly clean and disinfect rigid laryngoscopes,

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~ Flash sterilization ~ A Q-Net position statement

Also known as “flashing,” flash sterilization is a rapid, thermally-based sterilization process originally used only for *emergency situations* as instructed by *The Joint Commission on Accreditation of Healthcare Organizations* (JCAHO) and others⁴⁶⁻⁵⁴—for example, to quickly *re-sterilize* an instrument that accidentally dropped on the operating room floor prior to use.⁴⁶⁻⁴⁹ Primarily because of the significantly shorter time of its cycle, however, flash sterilization has evolved for many applications and healthcare facilities from a rare, controlled practice into a replacement for traditional, or conventional, steam sterilization. Flash sterilization is now routinely used, or arguably misused, to sterilize instruments, not only for emergency situations, but also for immediate use.^{49,50} The popularity of flashing has grown in many medical fields, including orthopedic surgery and ophthalmology.^{46,47,51-54}

The time savings and convenience associated with flashing can be significant. Whereas a traditional steam sterilization cycle may require as long as 30 minutes at 121° C to process pre-washed, wrapped instruments followed by time for instrument drying and cooling, a flash sterilization cycle may require only 3 minutes at 134° C, with no drying time. And, with shorter cycle times typically comes lower costs. Deciding whether to flash instruments may be reduced to the following choice: contraindicate its routine use and purchase additional expensive instrument sets to meet patient demand and accommodate the longer cycle times associated with traditional steam sterilization processes; or, expand the applica-

tions of flash sterilization and limit purchase of additional instrument sets, reducing costs and patient turnaround times.

Like with several other aspects of medicine, however, potential risks may accompany such types of shortcuts, and flash sterilization is no exception. Although it is bactericidal, flash sterilization requires close monitoring and is associated with an inherently narrower margin of safety compared to traditional steam sterilization. Although its methodology has some limitations, one study found a statistically significant higher incidence of nosocomial infection associated with flash sterilization.⁴⁶

Flash sterilization is also associated with several additional potential shortcomings that may call into doubt the quality of care it provides. First, unlike cleaned instruments processed by a traditional steam sterilizer, flashed instruments are unwrapped, typically have not been first washed or inspected, and often are wet when transported to and handled in the operating room, posing an increased risk of re-contamination and nosocomial infection.⁵⁵ Second, whereas traditional steam sterilization is typically performed by experienced reprocessing staff members in a dedicated centralized department, flash sterilization is instead performed near (or in) the operating room by staff whose primary focus is patient care—not instrument sterilization.⁴⁶ Third, wet, unwrapped flashed instruments may be used more frequently during one time of the day (e.g., morning) than dry, wrapped instruments processed by a traditional steam sterilizer, raising additional concerns about whether flashing introduces two different standards of patient care.

Fourth, the documentation and records associated with flashed instruments—unlike instruments processed using traditional steam sterilization cycles—are typically incomplete, if not entirely lacking, preventing adequate tracking of flashed instruments. Flashing may also encourage the preoperative administration of prophylactic antibiotics.⁴⁶

Finally, some manufacturers of surgical instruments (and implants) contraindicate flash sterilization.⁵⁶ The rapid heating and cooling of its rapid, high-temperature cycle can cause chipping, flaking, and other types of damage to some types of surgical instruments.⁵⁷ Whether flash sterilization might be damaging ophthalmic instruments causing pieces of the instrument’s surface to be introduced into the eye during cataract surgery, increasing the risk for toxic anterior segment syndrome (TASS), is unclear. (Refer to this newsletter’s *January-February 2007 issue for a discussion of TASS.*)

Position statement: Q-Net recommends that flash sterilization be performed *only* in emergency situations. Admittedly, compliance with this recommendation may require a healthcare facility to purchase additional instrument sets to ensure an adequate inventory of instruments and accommodate the longer reprocessing times associated with traditional steam sterilization cycles. But, doing so will establish one safe standard of patient care, minimize potential legal exposure, and demonstrate that reducing costs at the potential expense of patient safety is not acceptable. *The End* ● LFM

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bronchoscopes, GI endoscopes, incubators, humidifiers, nebulizers, and other reusable medical instruments and equipment as recommended by their respective manufacturer's instructions and published guidelines.^{8-15,20,28-37,42}

- a. *Semi-critical* and *critical* reusable medical instruments used on isolated patients do not require any additional reprocessing steps other than those dictated by their labeling and by *Standard Precautions* (i.e., cleaning followed by high-level disinfection or sterilization).
- b. Clean and disinfect *non-critical* items and frequently touched and potentially contaminated environmental surfaces in patient-care areas. In general, no additional measures other than those prescribed by *Standard Precautions* are required for isolated patients.^{28,29} (Refer to *Section 2.A.e* on p. 16S of this series' first article.)

B. Visit the "**How to reprocess ...**" page at the website: www.myendosite.com for instructions about reprocessing rigid and flexible laryngoscopes, bronchoscopes, GI endoscopes, and other types of reusable medical instruments.

Visit: http://www.myendosite.com/how_to_reprocess.htm

6. Water Quality, Other Recommendations:

A. Wash neonates in the NICU using sterile water.^{7,45} If tap water is used, ensure that the main water supply, as well as other environmental surfaces including the faucets and sinks, have been adequately disinfected and are not colonized with *Serratia* or another type of potentially pathogenic microorganism. (Refer to *Section 5.A.b*, above.)

- a. To prevent bacterial colonization of the tap water, it may be necessary, among other measures, to periodically replace the faucets in the NICU, microbiologically monitor the tap water, and use point-of-use water filters.⁷

B. For humidification, **use only the quality of water indicated by the incubator's manufacturer** (e.g., sterile distilled water).⁴²

C. While bacteria-free filtered water is preferred, tap water may be used for rinsing reusable *semi-critical* instruments including GI endoscopes after chemical immersion, provided the instrument is rinsed with 70% isopropyl alcohol followed by forced air drying after reprocessing and also before storage. (Refer to *Section 5.A*, above.)

D. **Use sterile water in nebulizers and humidifiers** used in NICUs to treat neonates.⁵⁸

E. Ensure that the water used by neonates for drinking and to consume oral medications does not contain any opportunistic

gram-negative bacteria (i.e., use bottled or sterile water).⁵⁸

F. **Consider stopping new admissions to the NICU, or temporarily closing the unit,** until the outbreak of *Serratia* is under control, if not terminated.^{2-4,15,21,38,40} This action may be necessary to prevent additional infections of *Serratia*.

G. Depending on the strain of *Serratia*, **more judicious use of antibiotics** may be indicated to control and prevent disease transmission.

- a. Review antibiotic ordering patterns and consult with infectious disease staff to determine whether a change in policy—namely, to restrict or modify antibiotic usage (e.g., automatic stop orders)—might be necessary to control and prevent disease transmission.^{29,40}

H. The design of a medical facility's NICU should feature:

- ✓ A sufficient number of sinks in convenient locations to encourage more frequent hand washing;
- ✓ sufficient space to prevent overcrowding, including private rooms with single beds for isolated patients; and
- ✓ sufficient space between incubators (e.g., 10 feet apart) to minimize the risk of disease transmission.² ● LFM

The REFERENCES for this series of articles about the epidemiology of **SERRATIA** and **FLASH STERILIZATION** are available for downloading at:

www.myendosite.com/refs070807.pdf

Thank you for your interest in this newsletter. I have addressed each issue and topic to the best of my ability. Respectfully, *Lawrence F. Muscarella, Ph.D.*
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