CHAPTER 9

Critical Care Nursing's Role in Prevention of Harm: Going Back to the Basics with Evidence

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LEARNING OUTCOMES: After completing this e-chapter you will be able to:

1. Explain the Interventional Patient Hygiene Care Model as a framework in redesigning how we approach nurse sensitive care practices and patient outcomes
2. Describe how Sustaining Nursing Clinical Practice framework helps to ensure reintroduction and valuing of evidence basic nursing care in conjunction with the right resources and systems to sustain practice.
3. Identify various evidence based strategies to reduce pressure, shear, friction and moisture injuries.
4. Describe the effect of healthcare-associated infections on mortality, morbidity, and cost of health care
5. Define key care practices based on the evidence that can reduce bacterial load and/or prevent the development of health care acquired infections.
6. Describe ICU acquired weakness and delirium and the impact on short and long term outcomes for critically ill patients
7. Discuss early key in bed and out of bed mobility research findings, their application to practice and the patient focused outcome.
8. A step by step approach to help move evidence-based fundamental care practices into acute and intensive care environments.

CHAPTER OVERVIEW

In today's critical care environment, we face a difficult but essential task: to provide comprehensive, compassionate, complex, technological care without causing harm to our patients. To foster a safe patient environment it is our task to examine care practices and processes to identify and attenuate potential for error. This chapter presents the challenges with our current practice of basic nursing care and describes an Interventional Patient Hygiene Care Model for use by nurses in redesigning how we approach nurse sensitive care practices in the future to impact patient outcomes. A change framework is critical to ensure reintroduction and valuing of evidence basic nursing care in conjunction with the right resources and systems to sustain practice. Area's where critical care nurses can significantly reduce harm include preventing; skin injury, health care acquired infections, deconditioning and cognitive decline. While the list in not all inclusive, knowledge of assessment and evidence based nursing care practices will help the nurse significantly impact both short term and long term outcomes for critically ill patients

FORCES DRVIING NURSING PRACTICE CHANGE

A significant force driving change is the evidence based practice movement. Evidence based practice (EBP) is the conscientious explicit and judicious integration of the best available evidence from systematic research.[1] The challenge nursing faces in our current culture is often the misrepresentation of evidence-based practice. EBP is often considered only to be practices derived and validated with RCTs. This limited interpretation may lead to our failure to consider evidence that is better than tradition based care.

Strong forces of change include those that are driven by organizational and regulatory bodies. In the US the Institute of Medicine (IOM), the Joint Commission, the Agency for Health Care

Regulatory & Quality issues (AHRQ), National Quality Forum, the Institute for Health Care Improvement (IHI) have aligned their visions to make health care environments safer and improve the quality of patients' lives.[2-5] The American Hospital Association (AHA)/Health Research & Educational Trust (HRET) Hospital Engagement Network (HEN), comprised of 31 participating states and U.S. Territories and over 1,500 hospitals. As part of the Partnership for Patients Campaign to reduce patient harm by 40 percent and readmissions by 20 percent, the AHA/HRET HEN have resulted in over 69,000 patients who had harm prevented and an estimated cost savings of over $200 million within a two year period.[6] Similar quality and financial forces exist and spread to other part of the world, the Singapore Healthcare Improvement Network (SHINe) is one of the Institute of Healthcare Improvement's (IHI) Quality and Innovation Centers (QIC). IHI described a QIC as "a leading resource and driving force for system-wide, transformative health care improvement in a system or region committed to better health, better care and lower costs.[7] SHINe is an umbrella group composed of member healthcare organizations which are collectively committed to better health, better care and lower cost care to patients. The Network aims to accelerate the pace and scale of improvement, leading to system-wide, transformative healthcare in Singapore.[8]

The Centers for Medicare and Medicaid's and third party payers are changing reimbursement structures and limiting or eliminating reimbursement for preventable errors. In the US, the economic ramifications of these changes have helped to focus the momentum on safety and avoiding preventable hospital acquired conditions.[9]

With patient safety serving as the overriding goal, there is a positive movement within the profession of nursing to "get back to the basics" or "fundamentals of care" to improve care and prevent nurse associated errors/harm such as: health care acquired infections, development

of pressure ulcers and failure to rescue.[10] When basic nursing care is missed, negative patient outcomes occur.[11] Missed nursing care is defined as any aspect of required patient care that is omitted (either in part or in whole) or delayed is a worldwide issue.[12] When we examine these basics of care these nursing care practices fall into two major categories; hygiene and mobility interventions. So if nursing's fundamentals of practice are not routinely being employed as suggested by data on nurse sensitive outcomes, what are the reasons and what can we do about them?

One theory suggests that the basics of care may be absent or devalued because of limited structures that assure reinforcement of the importance of the basics, reward/recognition for doing them, or failure to hold nurses accountable.[13] The theory may be used by nurses to examine the value of these care practices within their work culture.[14] This may help identify the need for a change in culture that stresses the importance of basic nursing care functions as supported by the best evidence.[15] For example, many nurses are able to identify or know when they make a medication error or failed to follow a physician's order. However, prior to the current world wide patient safety movement, most frontline critical care nurses were unaware of data related to nurse sensitive outcomes such as ventilator associated pneumonia, blood stream infection; pressure ulcer incident and urinary tract infection. These indicators are all considered nurse sensitive outcomes for the quality of nursing care delivered.[16] As noted by BF Skinner "behavior that is reinforced continues behavior that is not reinforced stops".[17] In essence, care practices, and their value, may have been "conditioned" out of the nurse. The disease focused model of diagnosis and treatment has been the dominant care delivery model within most of our acute care environments.[14] Unfortunately, prevention of complications has been less so. It is time for our

profession and each individual nurse to reclaim the fundamentals of nursing that are essential to positive patient outcomes and use evidence-based practice to drive the transformation.

Interventional Patient Hygiene: Building a Usable Model

This transformational journey is similar to launching a campaign and therefore may benefit from a recognizable name and model to help ensure the transformation. Use of a model may help clarify and provide a means to articulate nursing's unique contributions to healthcare. Two categories, evidence-based interventional hygiene and mobility strategies, if placed within the context of a comprehensive program for reducing error, may help prioritize a list of care activities for critical care nurses. Positive outcomes may follow.

Webster's dictionary defines hygiene as the science of prevention of illness and the maintenance of health.[18] The goal of basic nursing care is to proactively intervene with nursing interventions that focus on using evidence-based hygiene and mobility strategies to reduce health care acquired infections and skin injuries. These hospital-associated conditions are linked to increases in patient morbidity and mortality as well as significant cost burden to our health care systems. The term "Interventional Patient Hygiene" (IPH) was created as a model for a systematic approach using evidence-based nursing care interventions to prevent health care acquired conditions.[19] The components of the model include oral cleansing, patient mobility, maintenance of a central line, urinary catheter care, bathing to reduce bacterial load and skin prevention strategies.[15] Figure 1. McGuckin et al expanded the IPH model to incorporate hand hygiene and skin antisepsis.[20]

A survey was conducted to determine the knowledge base of infection preventionists and nurses related to the components of the interventional patient hygiene model. Surveys were sent to a random sample of 1178 nurses at the American Association of Critical Care Nurses National Teaching Institute and 1776 infection perventionist attending the Association of Professionals in

Infection Control and Epidemiology. The response rate was 15%, representing 31% infection preventionists, 42% RN's and 37% certified critical care nurses. Results of the survey revealed an excellent knowledge base of five major components of the model; hand hygiene (96%), oral hygiene (95%), early pre-op skin prep (70%), bathing/skin care (94%), incontinence care (93%); the mobility component was not evaluated. However, the group demonstrated less knowledge about nursing interventions, as delineated in the IPH model, to prevent untoward patient outcomes.[20]

Respondents reported that they were aware of the scientific evidence supporting IPH interventions as follows: incontinence care-75%, surgical site infections -66% and ventilator-associated pneumonia-86%. Additional questions included whether the institution had an IPH policy, whether IPH information was included in orientation, and if education about the topics had been provided to all staff within the previous year. Between 35 to 49% stated their institution had an IPH policy, 42% stated it was included in orientation and that they had received education within the previous two years. The survey results suggest we have a way to go to improve the culture of nurses as it relates to "owning and acting" on IPH components that are within our scope of practice.

Securing Successful Integration of the Basics

Success in nursing's journey will be fleeting if the fundamentals are reintroduced as the basic care nurses has been performing for years or initiated as a process followed by audits alone. Instead, successful transformation begins with developing a culture that values the importance of these care practices and the evidence that supports them. While providing evidence based education, frequent motivational reminders may be inserted that reinforce the understanding that fundamental/basic care practices are core to the profession of nursing, are

independent in scope and if not performed or delegated by us, may cause patient harm. This is authentic patient advocacy.[15]

However, patient advocacy by nurses is often articulated and performed within a narrow window of a single incidence where the nurse serves as the voice for the patient to ensure 'the right thing happens" and/or application of evidence based care. Nurse advocacy must reach beyond that view to encompass preventing harm within the context of all clinical practice. For example, use of a valid and reliable risk screen that is acted upon by the nurse, is an evidence based way to prevent harm. Unfortunately, often the screens are viewed as required documentation to fulfill criteria for a regulatory body versus essential to the nurses' independent role in evidence-based application of care assessment and intervention.

Numerous studies have shown that education/skill building is not enough to effect sustainable change.[21,22] Multimodal strategies that evaluate the available nursing resources and systems in order to effect change, make it easier for the clinician to achieve an effective and consistent practice. Such initiatives have shown greater success.[23-25]

Once the resources are present and systems designed to deliver the care and evaluate effectiveness, then we can truly hold the individual nurse accountable for the practice. Figure 2 illustrates the three components just described in a framework entitled "Sustaining Nursing Clinical Practice".[15] It may be used for any change in clinical practice but its application is critical for reintroduction and valuing of evidence based fundamental/basic nursing care practices. In the following sections we will be addressing nursing care practices that are independently own that have an impact on skin, infections and preventing the complications of immobility. This include skin prevention, hand hygiene, bathing, oral care, and early mobility.

Bullets of Key Points:

- There is a positive clinical and economic impact to performing evidence based nursing care practices and a negative impact to missed nursing care
- The Interventional Patient Hygiene model connects evidence based nursing care practice to nurse sensitive outcomes creating a framework for the impact of basic nursing care
- Changing routinize behavior requires a revaluing of the care, evidence based skill and knowledge, the right resources and systems to make it easy to provide the care and then nurse can be held accountable for the practice of basic nursing care.

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections

1. The Interventional Patient Hygiene model was design to;
    a. provide additional tasks for nurses to complete
    b. strengthen the connection between nursing care & outcomes
    c. outline a structure to measure the impact of medical care
    d. demonstrate a link between infection and hand hygiene
2. Resources and systems help the nurse;
    a. function more efficiently
    b. practice using the evidence
    c. provide the right care at the right time
    d. all of the above
3. Professional practice flourishes in an environment that is structurally empowered due to;
    a. innovative leadership
    b. solid structures

c. solid processes

d. all of the above

Answers: 1. b 2. d 3. d

Fundamental Nursing Care Practices for Patients at Risk for Skin Injuries

Pressure ulcer injuries are the fourth leading preventable medical error in the United States. Pressure ulcers cause extreme discomfort, and often lead to serious life-threatening infections. In addition to pain and suffering, one pressure ulcer results in adding four days to the length of stay independent of other risk factors. Pressure ulcers increase a patient's risk of developing a hospital-acquired infection by 25%. In-hospital death occurred in 11.6% of hospital stays with pressure ulcers noted as a secondary diagnosis, as compared to 4.2% of stays with a principal diagnosis of pressure ulcers and 2.6% of stays for all other conditions. Based on a recent systematic review of the literature, hospital acquired pressure ulcers for critically ill patients' worldwide range from 3.3% to 53.4%.[26] Is nurses knowledge regarding prevention strategies a factor in the inability to reduce hospital acquired pressure ulcers? Critical care nurses from an urban teaching hospital were administered a reliable and valid 47 item true false test to assess their knowledge level of pressure ulcer prevention and staging. Test scores were not affected by experience, educational level, or when nurses last read an article on pressure ulcers. Six-seven percent of the nurses scored below 90% on items focused on prevention.[27.28]

At Risk Population

The two major factors impacting pressure ulcer development are the intensity and duration of the pressure and the ability of the skin and supporting tissue to tolerate the pressure. As the body comes in contact with a support surface normal pressure and shear forces are

generated on the skin and supporting structures below. If excessive load occurs in a short period or a lower load occurs during a longer period, a pressure ulcer will developed. In addition, there are a number of contributing or predisposing factors that are associated with pressure ulcers. At risk patients include the elderly, stroke victims, underweight patients, and patients with diabetes, dementia, wheelchair use, low perfusion states, receiving catecholamines or any patient with impaired mobility or sensation.[26] Patients with inadequate intake or an impaired nutritional status correlate well with the development of a pressure ulcer or a delay in wound healing. Moisture contributes to a weakening of the skin structure. Exposure to urinary or fecal material contributes to the development of incontinence-associated dermatitis (IAD), a potential precursor to a pressure ulcer.[29] In a large epidemiological study on IAD, rates were on average 21% and up to 36% for patients in the ICU.[3]. IAD is an inflammatory response to the injury of the water-protein-lipid-matrix of the skin that is caused by prolonged exposure to urinary or fecal incontinence. Physical signs on the perineum and buttocks include erythema, swelling, ozzing, vesiculation, crusting and scaling. Patients who experience fecal incontinence have a 22 times higher risk for the development of pressure ulcers than patient who are not. When you add immobility into the equation the risk increases to 37.5 times higher.[31] Injury from friction caused by movement against a fixed surface is exaggerated if the skin is moist. Vigorous scrubbing used to remove fecal material can create friction and further injury to the skin. However, the significance of these various confounding factors has yet to be determined.[26]

Assessing Risk

Most healthcare institutions around the world perform daily systematic risk assessment for skin breakdown using such tools as the Braden and Norton scales or Waterlow scores.[26] If risk is identified, the nurse is directed to initiate evidence-based strategies to minimize or

eliminate the risk. The current validated tools do not always capture all the risk factors of critically ill patients. Additional risk factors in critically ill patients are low perfusion states, receiving catecholamines, hemodynamic instability with turning, greater number of tubes and lines, severe agitation, and longer periods on non-pressure reducing surfaces while in the field, operating room or emergency room. In a recent large retrospective study, subscales of the Braden tool had greater correlation than the total Braden score (0.83 vs. 0.71).[32] Use of subscales may help in directing the clinician to evidence based strategies specific to the risk factor.[32,33] Evidence based knowledge and process change around hygiene related activities that protect the patient's skin against pressure and exposure to caustic substances are key in reducing the incidence of pressure ulcers.

General Skin Care

Caring for the patients skins during routine hygiene practices is more than just an opportunity to clean the patient. It can serve as an early warning system to identify injury to skin; a chance to assess progress in the patients healing process, improve tone and elasticity of the skin while potentially reducing the spread of microorganisms.[15,34] When you consider that aging dries skin, roughens the texture and reduces the tone and elasticity, the average hospitalize patient skin is at risk on admission. By identifying skin problems during the bath, they were able to apply prevention strategies more quickly and prevent skin problems from progressing.[34] The registered nurse needs to consider performing the bathing process with nursing personnel in order to perform additional assessments and not rob the patient of our professional expertise in identifying problems early and begin finding solutions. In addition to cleaning and assessment of the skin, the bath is an opportunity to examine a patient's muscle tone and strength, fatigue factor, range of motion and ability to participate in activities of daily living both from a physical

and psychological perspective.[35,36] When we bathe another person, it allows us to cross the intimacy barrier. The registered nurses can assess a patient's pain level during activity/rest and perform active listening to explore the patient's ability to cope with their illness. These assessments are lost when assistive nursing personal performs the bath alone.[15]

The bath process should not compound that risk. Washcloths industrially washed and re-used become rough in texture and may cause injury by increasing the transepidermal water loss of the skin.[37] Current soaps used with the traditional bath such as Dial, Ivory and even Septi-Soft have a pH greater than 8.5. Cleansing products should have a pH as close to natural's skins at 4.5 to 5.5 pH because this acid mantle helps reduce the potential for pathogen invasion or environmental irritants.[38-40] Natural or synthetic surfactants in soap remove the lipid layer during cleansing, compromising the natural infection barrier. In addition, bar soaps may harbor pathogenic organisms.[41,42] The traditional bath using tap water and a basin requires moisturizing after completion making it a two-step process. With a basin bath there is a potential for the basin to become a reservoir for microorganisms and cross contamination of the immediate environment and healthcare personnel.[39] Both gram-negative, gram-positive and resistant organism were identified in patient's bath basins after receiving a soap and H_20 basin bath.[44-46] The bacteria release from the biofilm lining the pipes and facets may be the contributing factor to the contamination of the water.[47-48] The use of pre-packaged disposable bathing products with soft cloths, a pH balanced cleansing agent with gentle surfactants, no rinse with lotion provides a method to bath without injury and the risk for microorganism spread.[49]

Since moisture and shear/friction are two of the most significant risk factors in the development of pressure ulcers, addressing them significantly reduce the number of hospital acquired pressure ulcers seen in critically ill patients.[31,32,51] Cleansing and protecting after an

incontinence episode is critical to maintaining intact skin. Incontinence can be managed effectively by following evidence based strategies that include; cleansing of the skin as soon as soiling occurs, the use of a protective cream or barrier on the skin with every soiling episode and use of incontinent pad and/or brief to absorb wetness away from the skin.[52] The ideal cleansing solution should lift irritants from the skin without damaging the acid mantle. Moisture barriers are creams or ointments alone or in combination have the following active ingredients; petroleum, dimethicone or zinc. Petroleum alone is ineffective against fecal incontinence. Dimethicone, when in combination with zinc or petroleum, serves as an effective barrier against both urine and stool. The consensus panel on assessment and management of IAD recommend a skin protectant or disposable cloth that combines a cleanser, emollient-based moisturizer, and skin protectant for prevention of IAD in persons with urinary or fecal incontinence and for treatment of IAD, especially when the skin is denuded.[51] Simplifying the care process to ensure that every incontinence episode has a barrier application is key to meeting the guidelines of barrier application with each incontinent episode.[26] If frequent soiling occurs, initiate care strategies for controlling the source of the moisture. External management of diarrhea can be achieved through the use of a fetal containment device or bowel management system.[52-54]

When using an under pad to contain moisture, the wick away properties and breathability are critical. There is no reusable pad on the market that wicks away moisture or has sufficient breathability to allow maximum benefit of airflow depending on the bed surface. Examine the type of product in use to ensure maximum protection.[55-56] Pads are not the only material we place under patients. In a study, looking at independent risk factors for pressure ulcer development in critically ill patients, mobility and the number of layers of linen on the bed were found to be significant.[57] More than four layers of linen were associated with an increase risk. This may be

attributable to loss of pressure reducing or relieving effect of the mattress. The surface supporting the patient is an important component to reducing the risk for pressure ulcers. There are many types of pressure reducing/relieving surfaces. The clinical trials examining their efficacy are inconclusive as to the type of surface that provides the best benefit for the cost. They are more effective than standard mattresses in reducing pressure. A best practice recommendation is to select a support surface that meets the patient's needs. Consider the patients need for pressure redistribution based on their level of immobility, moisture control, shear management, size and weight and the presence of existing pressure ulcers.[26] When risk is assessed systematically, skin care prevention strategies protocolized, the support surface improved, enhancements in documentation and a comprehensive staff education program there were significant reductions in the incidence of pressure ulcer development seen.[58] Table 2 provides key evidence based prevention strategies to significantly reduce the risk for development of a pressure ulcer in a hospitalized patient.

Table 1. Key Pressure Ulcer Prevention Strategies[26] Evidence Based Prevention Strategy
Nutrition: 1. Screen nutritional status for each individual at risk or with a pressure ulcer at admission, with each significant change, when lack of healing of pressure ulcer is seen 2. Perform using a reliable and valid tool. 3. Refer patients at nutritional risk to registered dietitian or a multidisciplinary team that manages nutrition.

4. Provide individualized energy intake based on underlying medical condition.

Positioning:

1. Reposition of all individuals at risk of or with existing pressure ulcers unless contraindicated.
2. Repositioning frequency will be influenced by the individual's condition and the support surfaces in use.
3. Establish pressure relief schedules that prescribe frequency and duration.
4. Reposition the patient in such a way that pressure is relieved or redistributed and avoid positioning directly onto medical devices.
5. Foam wedges may be superior to pillows in maintaining a patient in a side lying position.
6. Use shear/friction aids for in-bed reposition and transferring to a stretcher. Inspect the skin with each repositioning event.
7. Do not leave moving and handling equipment under the individual after use unless the equipment is superficially design for that purpose
8. Avoid positioning on bony prominence as with existing non-blanchable erythema.
9. Repositioning, using the 30° semi fowlers or the prone position or the 30° tilted side lying positions if the individual can tolerate these positions, and the medical condition allows.

10. If sitting in bed is necessary, avoid greater than 30° head of the bed elevation and/or a slouch position that places pressure and shear on the sacrum and coccyx for greater than 60 minutes. Positioning with pillows under the arms may help slouching.
11. Limit the time a patient spends seated in a chair without pressure relief. (<2 hours)
12. Document the repositioning schedule including the frequency position and evaluation the outcome.

Support Surface: Is a specialized device for pressure redistribution design for the management of tissue load, microclimates and other therapeutic functions.

Support Surface and Heels

1. Select a support surface that meets the individuals needs based on immobility/inactivity, microclimate management and shear reduction, size and weight, risk of development of new pressure ulcers and number of current pressure ulcers
2. Use a higher specification foam mattress (Visco-elastic polymer foam) rather than the standard hospital foam mattress for patients assessed at risk for pressure ulcer development.
3. There is no evidence to support that one high specification foam mattress vs. another is better.
4. Use an active support surface, whether it is an overlay or mattress, for patients at higher risk of pressure ulcer development, where frequent manual turning is not possible.

5. The overlay or mattress replacement with alternating pressure active support surfaces has similar benefits in terms of pressure ulcer incidence.
6. Continue to turn and reposition whenever possible for all patients at risk for pressure ulcer development regardless of the support surface in use.
7. Choose positioning devices and incontinence pads, clothing and bed linen that are compatible with the support surface
8. Consider using a high specification reactive foam mattress or non-powered pressure redistribution support surface with individuals with Stage I, II pressure ulcers
9. Use pressure redistributing seat cushions for patients in a chair whose mobility is reduced.
10. Avoid synthetic sheep skin but natural sheep skin may help in prevention.
11. Ensure the heels are free of the surface of the bed.
12. Use a pillow under the legs to elevate the heels. This is a short term strategy for patients who are alert and cooperative.
13. For patients who are not alert & cooperative or long term care required, use a heel protecting device. The device should elevate the heel completely off the bed and distribute the weight of the leg along the calf without putting additional pressure on the Achilles tendon. For completely immobilized patients consider a device that incorporates prevention of external rotation of the legs to prevent plantar flexion contractures.

Bullets of Key Points

- The major risk factors for pressure ulcers are pressure, shear and moisture
- Assessing risk should be done daily using a reliable and valid tool
- If using Braden Scale, the subscales are more predictive of risk and can help drive the most effective prevention strategies
- General skin care should involve us of a no-rinse pH balance cleanser.
- If a patient is at risk for heel ulcer development, use of an apparatus that distributes the weight up the calf and suspend the heel is necessary. Consider choosing a device that also address external rotation of the leg.
- For in-bed mobility, consider looking at strategies that address not only the risk factors for the patient (shear, pressure and moisture) but also reducing the risk of staff injury during repositioning techniques.
- Incontinence-associated dermatitis is best prevented when cleaning incontinence with products that clean, moisture and protect

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections

1. A good way to assess your patient's pressure ulcer risk is to use

    a. The RISK scale

    b. empirical knowledge & clinical judgment derived from your experience with other patients with pressure ulcer.

    c. a review-of-body-systems approach.

    d. the Braden Scale

2. Which of the following interventions is most appropriate for preventing excessive heel damage in immobile patients after 8 hours?

a. placing a doughnut-shaped cushion under the feet

b. device that suspends the heel & redistributes pressure up the calf

c. suspending the heels with a pillow ensuring calf support

d. flexing the knees

3. Minimally, a patient in the acute care setting should be assessed for pressure ulcer risk at least every:

a. 48 hours

b. 24 hours

c. 8 hours

d. 4 hours

Answers 1.d 2.b 3.b

Fundamental Nursing Care Practices to Prevent Healthcare Associated Infections

A national healthcare-associated infection (HAI) prevalence survey provides an updated estimate of the overall problem of HAIs in U.S. hospitals.[59,60] Based on a large sample of U.S. acute care hospitals, when comparing data from a 2011 survey, they found a 22% low risk in 2015 of having a health care associated infection.[60] There were an estimated 687,200 HAIs in U.S acute care hospitals in 2015. More than half of all HAIs occurred outside of the intensive care unit. HAI's result in significant increases in patient morbidity, mortality, length of stay, and use of health care resources.[61-63] Health-care-associated infections are deemed the most frequent adverse event threatening patients' safety worldwide.[63,64] The systematic review and meta-analysis conducted by Benedetta A. et al [65] has shown that endemic health-care-associated

infection represents a major burden and safety issue for patients in the developing world, with an even greater epidemiological relevance than in developed countries.

Nursing Practice Change in the Prevention of Healthcare-Associated Infections

Nurses play a pivotal role in preventing healthcare-associated infections (HAIs), and are in the unique position to effect change to improve patient care standards. In all essence nurses should continuously re-examine care management based on new and best evidence that would result in improved patient outcomes. In fact nurses in all roles and settings can demonstrate leadership in infection prevention and control by researching for and applying evidence-based healthcare-associated infection prevention measures to reduce patient harm.

Moving the Evidence into Practice in the HAIs Prevention

In the past, infection control prevention has largely used the valid methods of applied epidemiology-active surveillance testing of specific pathogen, benchmarking, intervention, evaluation in reducing the incidence of health care-associated infections. However, the field of infection control can re-examine and translates evidence-based management strategies into clinical practice to achieve better care outcomes by selecting intervention that target a boarder array of pathogens that cause HAIs. Two global strategies, horizontal and vertical have been discussed extensively in the literature.[66,67] A horizontal approach to infection prevention and control measures refers to broad-based approaches attempting reduction of all infections due to all pathogens, while a vertical approach refers to a narrow-based program focusing on a single pathogen.[66] Horizontal approach aims to eliminate all infections and is population-based; while the vertical approach is selective of the specific multidrug-resistant organisms (MDROs).

The Vertical Approach

Multidrug-resistant organisms (MDROs) such as Methicillin-resistant Staphylococcus Aureus (MRSA), Vancomycin-resistant Enterococci (VRE) and Clostridium Difficile (C-diff) share several epidemiological features. Such MDROs transmission can occur by direct patient contact or indirect contact with contaminated equipment or environmental surfaces. As the number of colonised patients are largely asymptomatic and greatly exceeds the number of infected patients, these asymptomatic carriers can serve as the reservoir for spread to other patients. Active Surveillance Testing is used to identify patients who are carriers of these target pathogens so that these patients can be isolated from non-carriers and, in some situations, can undergo decolonization in order to eradicate pathogen carriage. The vertical approach aims to reduce colonization, infection, and transmission of specific pathogens, largely through use of active surveillance testing (AST) to identify carriers, followed by implementation of measures aimed at preventing transmission from carriers to other patients.[67] Wenzel and Edmond in the case for horizontal rather than vertical interventional programs observe a very important point as that no hospital with a vertical (MRSA) approach has shown a major reduction in the rate of all infections or of all bloodstream infections.[68] A recent analysis suggested why the MRSA (vertical) program is a flawed approach: the favourable outcomes of a horizontal program dwarf the vertical program in terms of reduced mortality, years of life lost, and costs.[69]

The Horizontal Approach

Septimus et al believes that the horizontal approach to infection prevention is still the best tactic as it benefits many pathogens and sites, especially considering the evolution of bacterial and viral strains in an age of inappropriate antibiotic prescribing.[67] In this mode of infection

prevention, the type of approach can be decided on the local level. He emphasizes that if a facility has sporadic HAIs and are not experiencing high endemic or outbreaks, then a horizontal approach provides greater value, however if rates are high with a specific pathogen, then a vertical approach short-term may be preferable.[67]

Table 2. Differences between Vertical and Horizontal Approaches in Infection Prevention[69]

CRITERIA	**HORIZONTAL APPROACH**	**VERTICAL APPROACH**
Approach to infection prevention & control measures	Attempting reduction of all pathogens	Narrow based program focusing on a single pathogen
Goal	Aims to eliminate all infections (population-based)	Reduce infection or colonization due to specific pathogen (pathogen-based)
Application	Generally universal	Selective and /or universal
Resource utilization	Usually lower	Typically high
Philosophy	Exceptionalism (some organisms are more important than others)	Utilitarian
Values favors	Hospital	Patient
Temporal orientation/perspective	Both for the present & future /long-term	Present/short-term
Interventions	Multipotent (Modification of HCW behavior) embraces hand hygiene, CHG	Unipotent (Application of a technology) encompass active surveillance

	bathing, care bundles and activities that reduce presentism among healthcare workers	and vaccination of healthcare workers

Table 3: Evidences in the Vertical and Horizontal Approaches in Infection Prevention[67]

CRITERIA	HORIZONTAL APPROACH	VERTICAL APPROACH	EVIDENCES
Aim	To reduce the risk of infections due to a broad array of pathogens of pathogens through implementation of standardized practices.	To reduce colonization, infection, and transmission of specific pathogens through the use of active surveillance testing (AST) to identify carriers, followed by implementation of measures aimed at preventing transmission from carriers to other patients.	1) Septimus, et al.[67] "More than 100 observational studies have evaluated the use of MRSA AST to target MRSA carriers for contact precautions, with or without supplemental decolonization". 2) Huskins, et. al.,[70] a multicenter cluster-randomized, controlled trial in intensive care units (ICUs) -- demonstrated that an intervention involving MRSA AST plus universal gloving until a patient's colonization status was known to be negative - did not impact rates of MRSA colonization or infection.
HAIs Preventive Measures	Prevention strategies include : 1) Minimizing the unnecessary use of invasive medical devices 2) Enhancing hand hygiene 3) Improving environmental cleaning	Used in prevention of MRSA transmission and infection	2) Jain et.al.,[71] described a nationwide intervention with Veterans Affairs acute care hospitals that included MRSA AST and contact precautions for MRSA carriers, improved compliance with hand hygiene, and an institutional culture change that was temporarily association with a large decline in infections cause

	4) Promoting antimicrobial stewardship 5) Decolonization of all patients in high-risk settings using topical Chlorhexidine Gluconate (CHG)		by MRSA as well as other pathogens.
Endemic situations	Offers best overall value target all organisms (diversity of microorganism)	Selected organism	Septimus et. al.,[67] explain that vertical approach often based on the results of AST, the rationale being that multi-drug resistant organisms (MDROs) such as MRSA, VRE, Multidrug-resistant (MDR) Gram-negative Organisms, and Clostridium Difficile (C diff) share several epidemiological features.
Mortality	Reduced	Greater	Wenzel RP et al[68]
Years if life lost	Reduced	Greater	Wenzel RP et al [69]

Decolonization of the hands of the health care worker and the skin of the patient and are two global strategies to reduce overall bacterial burden in the environment and has the potential to significantly reduce health care acquired infection.

Hand Hygiene

Human hands are the number one transmitter of healthcare-associated infections (HAIs), and effective hand hygiene is the best way to prevent infections from spreading[72,73] In a healthcare setting, practicing hand hygiene is everyone's responsibility including staff, patients, and visitors. Alcohol based hand hygiene is the first line unless the hands are visible soiled. Placement of dispensers is an important component in helping to ensure compliance of hand hygiene. Patient involvement in hand hygiene is critically important because while healthcare

workers understand how hand hygiene can impact the spread of infections, it may not be as obvious for patients. WHO first global patient safety challenge, Clean Care is Safer Care is a campaign launched in 2009.[72] The goal of Clean Care is Safer Care is to ensure that infection control is acknowledged universally as a solid and essential basis towards patient safety and supports the reduction of health care-associated infections and their consequences. The Clean Care is Safer Care advocates the need to improve and sustain hand hygiene practices of health-care workers at the right time and in the right way to help reduce the spread of potentially life-threatening infections in health-care facilities. In addition to ensuring that nursing practice is evidence-based, engaging patients through education will promote better partnership in the improving care outcomes. An awareness campaign that encourages healthcare workers and patients to work together for better hand hygiene helps highlight the importance of it for everyone and keep hand washing opportunities fresh in everyone's mind. Bridging the gap between evidence and practice, and engaging health professionals and senior leadership in evidence-based infection-control practices remains an ongoing challenge. Anderson et. Al.[74] give five common reasons for hand hygiene behaviors not being adequately adhered to. (Table 4); these provide a solid starting point to explain the complexity of hand hygiene. Vincent believes that infection prevention and control and hand hygiene are a matter of common sense and has encourages those working in this area to consider human factors when developing approaches to educate health professionals to improve compliance with guidelines and recommendations.[75]

Table 4: Common Reason for Lack of Hand Hygiene

	Hand Hygiene Challenge	**Rationale**

1	Health professionals are asked to perform hand hygiene practice but the action does not have a direct and immediately observable result	Infections that are preventable through hand hygiene often occur days after the absence of hand hygiene. There is, on the whole, no obvious cause and-effect relationship. This affects health professionals' motivation
2	The desired outcome of appropriately timed hand hygiene action is only the lack of an undesirable outcome –infection – and this outcome is not immediately noticeable	Similarly to the point made above, as there is often no obvious positive result due to hand hygiene, it is difficult to connect action and outcome therefore impacting on health professionals' motivation
3	Tasks such as hand cleansing are sometimes perceived as not convenient	Hand cleansing is likely to be dropped or forgotten in a busy working environment. This challenge should be addressed through knowledge enhancement and "cues" to action
4	Concurrent clinical activities demand immediate cognitive and physical energy and hand hygiene is often seen as separate, not integral, to the main task	Other demanding tasks do not have delayed feedback and are often more strongly associated with positive results than hand hygiene. Again, the inability to observe the "initiation" of an infection in relation to a particular clinical task, and the invisibility of microbes, makes it difficult to keep hand hygiene part of everyday practice. This

		means the importance of hand hygiene must be raised on an ongoing basis
5	There are very few naturally embedded cues to prompt health professionals to perform hand hygiene within their routine workflow	A naturally embedded cue occurs during the course of a task and signals what to do next. In relation to hand hygiene, there is no physical barrier to prevent a practitioner touching a patient if a hand hygiene action has not occurred. Additionally, if hand hygiene is seen to disrupt the workflow, health professionals may purposefully skip it. Effective cues must be manufactured, tested and strategically placed
Source: Adapted from Anderson J, et. al.[74]		

Recent evidence has shown the effectiveness of clinical interventions in controlling the spread of infection can be enhanced by moving beyond conventional approaches to other aspects, such as psychology, neurosciences and ergonomics.[76] Such multifactorial approach to improving hand hygiene is grounded in behavioral and human factor science which was pioneered by the World Health Organization, 2009.[73]

Multimodal approach towards improving hand hygiene

Considering the factors summarized in Table 4, the WHO cautioned an approach that focuses solely on education and training, without taking into account constraints that affect appropriate placement of hand cleansing solutions, beliefs and perceptions of health professionals, and the

real-life practicality. To avoid single-focused approaches, WHO has listed the following five inter-related parts of the multimodal hygiene improvement strategy and they include system change, training and education, evaluation and feedback, reminders and organizational safety climate.[73] For system change to take place it is necessary to put in place an infrastructure that allows health-care workers to practice hand hygiene successfully. It includes; access to a safe, continuous water supply as well as to soap and towels and readily accessible alcohol-based handrub at the point of care. Providing regular training on the importance of hand hygiene, based on the "My 5 Moments for Hand Hygiene" approach, and the correct procedures for hand rubbing and hand washing, to all health-care workers is critical. Monitoring hand hygiene practices and infrastructure, along with related perceptions and knowledge among health-care workers, while providing performance and results feedback to staff will help sustain improvement. Prompts as well as reminders for health-care workers about the importance of hand hygiene including appropriate indications and procedures for performing it are part of any successful plan. The most significant component for sustainable effective hand hygiene is creating an environment that facilitates awareness-raising about patient safety issues while guaranteeing consideration of hand hygiene improvement as a high priority at all levels. Active participation at the institutional and individual levels is critical. Having an awareness of individual and institutional capacity to change and improve (self-efficacy); and actively partner with patients and patient organizations will help ensure success.

Bullets of Key Points

- There are two board categories of approaches to significantly impact the spread of MDRO's within the hospital; a Vertical or Horizontal approach

- The horizontal approach is reduce the risk of infections due to a broad array of pathogens through implementation of standardized practices.
- Human hands are the number one transmitter of healthcare-associated infections (HAIs), and effective hand hygiene is the best way to prevent infections from spreading
- The WHO believe that a comprehensive approach to address hand hygiene is critical for a successful campaign.

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections

1. When would I consider using the vertical approach for reducing health care acquired infections?
    a. to reduce line and tube infections
    b. an acinetobacter outbreak
    c. to reduce C. difficile
    d. transmission of VRE
2. Wearing gloves eliminates the need to wash hands.
    a. True
    b. False
3. Which of the following agents used for routine decontamination of the hands in health care settings is most bactericidal and least irritating to the skin?
    a. alcohol-based hand rub
    b. antimicrobial soap and water
    c. chlorhexidine and wash

d. plain soap and water

e. triclosan handwash

Answers; 1.b 2.b 3. a

Patient Decolonization

The second global strategy for reducing infection prevention is the horizontal approach of decolonizing the patient through a different bathing process. Patients in intensive care units (ICUs) are at greater risk for skin colonization and infection with MDROs because of the presence of significant comorbidities, immunodeficiency's, exposure to antibiotics, and breaks in skin integrity related to the use of invasive devices. In addition, the hospital environment surfaces, tap water, sinks, and patient themselves are recognized as a significant source of transmission of bacteria and the potential spread of infection [77.78]

In most acute care facilities, nursing personnel provide baths using a basin of warm tap water, soap, and washcloths for patients who are bed bound and unable to provide self-care. The evidence supports changing the way we bathe in the intensive care environment to the use of Chlorhexidine, which is associated with significant reductions in central line-associated bloodstream infections (CLABSIs), vancomycin-resistant enterococci (VRE), methicillin-resistant Staphylococcus aureus (MRSA) colonization, and infections with MDROs.[79-86]

Why reconsider the use of soap and tap water to bathe? The development of bacterial biofilm in the hospital water distribution system and its association with cases and outbreaks of HAI is well documented.[44,47,48,87-93] In a review of the literature, 10 serious outbreaks of P aeruginosa pneumonia showed molecular ties to the water.[47] Another literature review found

9.7% to 68.1% of ICU water samples positive for *Pseudomonas aeruginosa*. When examining genotypes, 14.2% to 50% of patients' infections were found to be due to bacteria in the water at the tap versus the main supply.[48] The basin itself may serve as a reservoir. Both gram-negative and gram-positive organisms at 105 cfu/mL were identified in bath water sampled after patients received a soap-and-water basin bath.[44] The mechanical friction of bathing results in the large removal of surface epithelial cells that are released into the bath water. The skin flora of hospitalized patients differs with a larger presence of gram-negative bacilli and more antibiotic-resistant organisms.[43,49,50] In a multicenter basin sampling study in 88 hospitals in the United States and Canada, 62.2% of 1103 basins sampled were contaminated with common hospital-associated pathogens. The highest contamination rate was for gram-negative bacilli (44.9%) followed by VRE (34.9%). The lowest was MRSA with a 3.3% rate.[46] Contamination occurs through many sources, including the patient's skin flora, bacterial biofilm in the tap water, basins used for incontinence cleansing, storage of hygiene products, or emesis.[45-46,88,93]

Daily Bathing With Chlorhexidine

In 2006, a comprehensive study examined VRE colonization rates with 3 types of bathing; soap and water, non-medicated cloth basinless bathing, and 2% CHG-cloth bathing (off label use in USA only) [50] The CHG-impregnated cloths produced a 2.5 $\log_{10}$ colony count reduction on the skin when compared with soap-and-water bathing. The incidence of VRE acquisition was 26 per 1000 patient days with soap and water, 15 per 1000 patient days with non-medicated cloths, and a statistically significant reduction to 9 per 1000 patient days with the 2% CHG cloths. When load reduction occurred on the patients' skin, a corresponding reduction occurred on the hands of the health care worker and in the environment.[50] When evaluating the skin in the CHG group, no adverse events were found compared with patients who received soap-and-water baths which

showed the highest rate of skin deterioration. A follow-up study was conducted to evaluate the impact of 2% CHG-impregnated cloths versus soap and water on CLABSI rates. A significant reduction in CLABSIs was demonstrated with CHG bathing.[43] In addition, when a 2% CHG-impregnated cloth was used for bathing, a single daily application reduced gram-negative counts for 24 hours. Soap and water bathing was an independent predicator for the development of a CLA-BSI.[43]

Numerous before and after studies have been conducted to examine the impact of CHG bathing on bacteremia's. Two meta-analyses and one systematic review of the literature on the impact of CHG bathing on CLABSI, VRE, and MRSA colonization's and infections have been conducted.[80-82] The findings show a statistically significant reduction in CLABSIs using either the 2% CHG cloth or 4% CHG diluted was found. There were demonstrated reductions in MRSA and VRE carriage and reductions in infection using mixed methods of CHG bathing.

Both methods of application demonstrated a small number of skin reactions attributable to the CHG bathing and disappeared when CHG bathing was stopped. In two of the five studies where 4% CHG bathing was used, other methods of reducing bacterial burden were studied.[94-98] Camus et al was the only study using 4% CHG method of bathing that was an RCT.[94] They used a multicenter, placebo controlled, randomized double blind study with a 2x2 factorial design. The groups included topical administration of polymyxin/tobramycin or placebo and nasal mupirocin with 4% CHG bathing or nasal placebo with liquid soap. The patients received polymyxin/tobramycin alone, mupirocin/4% CHG alone, either regimens or all placebos. They measured impact on all types of ICU acquired infections. The results showed a significant reduction in infections when the combine regimens were used. There was no difference in

infections between each regimen alone. Gould et al used 4% CHG bathing in combination with nasal anti-MRSA preparations.[95] Overall MRSA infections decreased by 3-fold but no difference in MRSA bacteremia's were seen. There was a significant decrease in coagulase-negative staphylococcal bacteremia's during the intervention period. Seven studies used a 2% CHG-impregnated cloths for bathing demonstrating significant reductions in CLABSIs in the ICU and one study demonstrating reduction in CLABSI's outside the ICU. [80]

Prospective Cluster Randomized Trails with CHG Bathing

To date there have been 3 large clustered randomized controlled studies examining the impact of no-rinse 2% CHG cloths in comparison to soap and water bathing or no-rinse non-medicated basinless bathing. Two of the studies were conducted with adults and one with children greater than two months of age. Two focused strictly on the type of bathing and impact on colonization, infection and reduction in bacteremia's. The most recent study examines the impact of different isolation and clinical management methodologies on MRSA infection and CLA-BSI's. Milstone and colleagues [84] using a cluster randomize 2-period cross over trial in 10 pediatric ICUs in five hospitals measured bacteremias during 2% CHG cloth bathing compared to routine bathing with either a non-medicated bath cloth or soap and water bathing with 4947 pediatric ICU patients greater than two months of age. They found the protocol population had a 36.5 lower risk of developing a bacterima when bathed with 2% CHG cloth versus standard bathing practices. There were no study related adverse events and the incidence of skin reactions was 1-2 per 1000 patient days with a greater number in the treatment group. Upon examination treating clinicians only attributed 12 skin reactions to the CHG bathing.[84] Climo and colleagues [85] performed a cluster-randomized cross over study comparing 2% CHG cloth

bathing with non-antimicrobial basin-less cloth bathing with 7727 patients in 9 ICU's and a bone marrow transplant area. The results demonstrated an overall rate of MDRO acquisition was 5.10 cases per 1000 patient days with CHG cloth bathing and 6.60 cases per 1000 patient days with nonantimicrobial cloth bathing ($P = 0.03$).[85] These rates are comparable to a 23% reduction in new acquisition of MDROs in patients bathed with a CHG cloth. The rate of hospital-associated bloodstream infections decreased 28% using CHG bath cloths. The effect was greater in patients who were in the unit longer. For the first time, the incidence of primary bloodstream infections caused by fungi was reduced by 53% with a trend toward significance. The incidence of skin reactions in both groups was monitored daily. In the patients receiving 2% CHG cloth bathing 78 patients out of 3870 experienced a skin reaction whereas 130 out of 3842 experience a reaction with the non-medicated cloth. All were considered to be unrelated to the bathing intervention. MRSA and VRE isolates did not show any high level resistance to CHG during the study. It has been suggested that the reduction in BSI's was solely due to a lower frequency of positive blood cultures due to skin organisms. However, this does not explain the reduction in fungal CLA-BSI.

Huang and colleagues [86] conducted a pragmatic (usual conditions) cluster randomized control trail of 74,256-patients in 43 hospitals in 16 states to evaluate the best methods for reducing the spread of MRSA clinical isolates and infections within the ICU.[86] Patients were randomized to one of three study protocols; Group 1: Implementation of MRSA screening and if positive isolate the patient; Group 2: Targeted decolonization where the patients were screened for MRSA, if positive they were placed in isolation and decolonized with twice daily mupricin in the nares for five days and a 2% CHG cloth bath till discharge from the ICU and Group 3; Universal decolonization with daily bathing using 2% CHG-impregnated cloths and twice daily nasal

mupirocin ointment for 5 days. The universal decolonization resulted in significantly greater reductions in infections compared with either group. A 37% reduction in MRSA clinical cultures and a 44% reduction in blood stream infections from all pathogens was demonstrated. Seven adverse events were reported from group 2 and 3. They all involved mild pruritus or rash after CHG bathing and resolved on discontinuation of use.

While the three RCT's did not experience significant allergic reactions, a rare few have been reported in the literature.[99-101] With widespread adoption, bathing with CHG could create the development of possible resistance. Recent studies show that the resistance in the US is rare but does occur.[102-105] A study examining MRSA isolates and gene encoding were tested for CHG susceptibility. The results demonstrated a type of isolate to have a higher CHG minimum inhibitory concentration (MIC) with slower reduction rates of MRSA BSI in patients with that isolate. In vitro, resistance to CHG has been demonstrated but application to clinical relevance is not clear.[103] Potential resistance remains a concern and needs to be watch overtime as the CHG bathing practice is adopted. In addition, the ability to deliver the preventive treatment (bathing) consistently to deliver CHG and prevent skin injury, the best evidence appear to support adoption of 2% CHG cloth bathing with ICU patients. A modified protocol of the bathing procedure used in the Huang study is outlined in Table 5

Table 5: 2% CHG Cloth Bathing[106]

Bathing Procedure:
• No-rinse pH. balance cleanser to wash the face • Remove one cloth at a time (use 6 or 8)

- Warming is for patient comfort, it is not required.
- Cloths should be used to bathe the skin with firm massage.
- Do not use CHG above the jawline
- Ensure thorough cleaning, with special attention to commonly soiled areas such as the neck, skin folds, and perineal areas.
    - CHG is safe to use on perineal areas, including external mucosa.
    - CHG is also safe for superficial wounds, including stage 1 and stage 2 pressure ulcers
    - Okay to bathe over occlusive dressings
- After bathing the skin, clean 6 inches of all tubes/Foley nearest patient.
    - CHG is safe on lines, tubes, and devices
- CHG should be used for incontinence care, or for any other reasons for additional cleaning
    - If incontinence occurs, wipe the affected area with under pad. Then clean skin with CHG cloths.
    - Use CHG-compatible barrier products if needed
- Do not rinse with water or wipe off
- Dispose of all cloths in the trash. Do NOT flush.

Bullets of Key Points

- Bathing with soap and water is an independent risk factor for the development of a CLA-BSI.
- Skin decolonization is a horizontal approach to infection prevention.

- Three large cluster randomized RCT's showed that CHG bathing with a 2% cloth was safe and effective in reducing colonization of MDRO's and CLABSI infections.
- CHG should not be used above the jawline.
- As CHG bathing/decolonization is adopted in the ICU's, monitoring for potential resistance is important.

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections.

1. The decision to use 2% CHG prepackaged clothes versus 4% CHG liquid with a bath basin for bathing should include consideration of which of the following?
    a. Provides best reduction in MRSA infections
    b. Time requirements
    c. Increase of bacterial resistance
    d. Availability of a clinical support
2. What area of the body should CHG not be used on?
    a. Perineal area
    b. Buttocks
    c. Near the eyes
    d. Skin folds

Answers: 1.a 2.c

Oral Hygiene To Reduce Hospital Associated Pneumonia

Management of Oral Colonization

The oral cavity is a significant source of bacterial colonization.[107] Within 48 hours of admission to the hospital, the normal oral flora changes to a predominance of gram negative bacilli and Staphylococcus aureus which places them at risk for VAP.[108-109] In a study looking at 89 critically ill patients, microbiological colonization of the oropharynx was examined throughout the patients intensive care stay. The study compared pathogens in the oral cavity to pathogens causing VAP using pulsed field gel electrophoresis to compare chromosomal DNA. Out of thirty-one cases of VAP's, twenty-eight patients revealed an identical DNA match of the pathogen in the oral cavity to the pathogen causing the pneumonia.[110] Using a similar methodology, a recent study by El-Solh et al examined baseline dental plaque scores and microorganisms within the dental plaque of 49 elderly nursing home residents admitted to the hospital. Fourteen of the forty-nine patients develop pneumonia. Ten of the fourteen patients showed an identical match of pathogens in the oral cavity and the organism causing the pneumonia via DNA analysis[111]. Salivary flow is a natural host defense in facilitating the removal of plaque and microorganisms. Mechanical ventilation often promotes dry mouth or reduced salivary flow, contributing to plaque accumulation and decreased production of salivary immune factors.[112,113] The major immune factor in saliva is IgA. It's role is to protect the upper airway by limiting to absorption and penetration of microorganisms.[114] The equipment we used to remove oral secretions as well as suctioning of the endotracheal tube may contribute to the colonization of the oral cavity. In a study examining equipment used to suction excess secretions from the oral cavity, 94% of tonsil suction devices were colonized within 24 hours.[115] In another study, 80% of the tonsil suctions yielded cultures with 1 or more pathogens with a percentage being resistant organism. [116]

Prior to the current patient safety initiatives to reduce ventilator associated pneumonia, the routine practice of oral care in the critically ill patient was sporadic. Many nurses mixed their own solutions or used tap water or mouthwash with a sponge to clean the oral cavity. Lemon glycerin swabs in some parts of the world are still in use and have been found to damage the oral cavity by over stimulating the salivary gland and drying out the mouth.[117,118] In the past oral care was not perceived as a high priority. However, in a more recent study of 102 intensive care units looking at oral care practices, 91% of 556 respondents perceived oral care as a high priority.[119] A recent US survey showed that ICU units had oral care policies, but practices did not always match.[120]

Numerous before and after studies and randomize controlled trials have demonstrated that implementation of a comprehensive oral care program with education shows a significant reduction in ventilator associated pneumonia, however protocol variation is significant.[121-124] Cuccio and colleague designed a protocol for all vented patients that consisted of every six-hour brushing, cleansing, suctioning and moisturizing. The cleansing solution was .12% CHG. With education and compliance monitoring, VAP rates were reduced by 63%. [121]

Brushing is an essential component of effective oral care to remove plaque and prevent the development of the protective biofilm.[125] Foam swabs are limited in their ability to remove plaque from sheltered areas or between teeth. A recent systematic review and meta-analysis of RCT's on the impact of oral care with or without tooth brushing found no difference in VAP and other clinical outcomes important for ventilated patients. With limited relevant studies, the authors caution about implementing findings until a large scale RCT's are performed.[126] The use of chlorhexidine oral rinse (CHG) twice daily as a minimum should be part of a comprehensive oral care program for ventilated patients to reduce the incidence of VAP.[127,128]

It was added to the Institute for health care improvement ventilator care bundle in 2010.[129] Provodine-iodine effect as an oral cleanser to reduce VAP remains unclear.[128] CHG rinse has been shown to significantly reduce gram negative, gram positive and virus colonization of the oral cavity for a sustain period of time.[130] Evidence supports that toothpaste interferes with CHG effectiveness so a separation of 2 hours between brushing and rinsing with CHG should occur.[131] Recent data is debating the concentration of CHG to be used. 2% CHG may be superior however studies are limited to the cardiothoracic surgery patient.[125] There is no data to support the efficacy of CHG rinse as part of comprehensive oral care in ward patients and it may cause harm.[132]

Patients not on a ventilator are still at risk for pneumonia. An analysis of the Pennsylvania Patient Safety Authority shows that NV-HAP occurs more often than VAP and there is no significant difference in mortality. Therefore, NV-HAP is costing more lives and dollars than VAP.[133] In a recent multi-site study examining NV-HAP, 21 hospitals demonstrate rate between 0.12-2.28 per 1,000 patient days with an average morality rate of 18.6%.[134] Just as ventilated patients require frequent oral care to help prevent pneumonia, non-ventilated patients also require oral care. Studies in nursing homes show that oral care can reduce the incidence of pneumonia in elderly patients. Yoneyama's study included 11 nursing homes in Japan over a 2 year period of time.[135] One hundred and eighty-four residents received an enhanced oral care program that included tooth brushing after each meal and a weekly review by a dentist or hygienist while 182 residents received normal oral care. The enhanced oral care group experienced fewer febrile days ($p<.01$), fewer cases of pneumonia ($p<.05$), and lower mortality ($p<.01$) than those who did not receive the enhanced oral care program. In another nursing home study by Watando, not only did oral care reduce healthcare-acquired pneumonia, there was

also an improvement in the swallowing and cough reflex sensitivities, factors that could also help to prevent pneumonia.[136] A pilot study by Quinn, et. al. demonstrated that increased frequency of oral care for non-ventilated adult patients in an acute care hospital reduced NV-HAP by 37% over 12 months.[137] The benefits of an oral care program for all patients, oral care prior to surgery and monitoring stress ulcer medication has continued to show reduced pneumonia rates which has been sustained over a 4-year period.[138]

There are no documented studies that show the optimal frequency of oral care for non-ventilated patients. For the general public, the American Dental Association (ADA) recommends brushing twice daily with a soft-bristled toothbrush using therapeutic toothpaste and rinsing with an antiseptic rinse.[139] If the non-ventilated patient cannot manage oral secretions and is high risk for aspiration, the caregiver may consider using a suction toothbrush, like those used in the ventilated patient setting.

Bullets of Key Points

- The oral cavity is a significant source of bacterial colonization
- Patients micro aspirate even with the head of bed elevated at 30 degrees
- Implementation of a comprehensive oral care program with education shows a significant reduction in ventilator associated pneumonia
- CHG rinse has been shown to significantly reduce gram negative, gram positive and virus colonization of the oral cavity for a sustain period of time.

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections.

1. Problems with oral health are associated with which of the following?

    a. Cardiovascular disease, poor glycemic control, and preterm delivery

    b. Upper respiratory infections, pneumonia, and gastroesophageal reflux disease (GERD)

    c. Endocarditis, arthritis, and poor glycemic control

    d. Cardiovascular disease, GERD, and endocarditis

2. Which of the following is one method to reduce microorganisms in the oral cavity?

    a. Swish and swallow with mouthwash

    b. Frequent suctioning of the oral cavity

    c. Administration of intravenous antibiotics

    d. Keeping the head of the bed at a 90º angle

Answers: 1.b 2.b

Early Mobilization to Reduce Complications of Immobility

A strong body of evidence supports the importance of early mobilization of critically ill patients to enhance recovery and to prevent significant short and long term complications. [140-144] The short term negative outcomes for critically ill patients included ventilator and hospital acquired pneumonia, delayed weaning related to muscle weakness and the development of pressure ulcers.[145] The major long term complication is the impact on quality of life after discharge are due ICU acquired weakness and delirium that frequently occurs during an ICU stay.[146-151] ICU acquired weakness (ICU-AW) is defined as a syndrome of generalized limb weakness that develops while the patient is critically ill and for which there is no alternative

explanation other than the critical illness itself.[149] The Medical Research Council Scale (MRC) score averages <4 across all muscles tested. Twenty-five percent of patients with prolonged mechanical ventilation will develop ICUAW. It is caused by critical illness polyneuropathy and myopathy or a combination of both. The major risk factors include; severe sepsis, duration of mechanical ventilation, length of ICU stay, systemic inflammatory response syndrome, multiple organ failure, immobility and use of corticosteroids/neuromuscular blockers.[149,150] ICU-AW results in prolong mechanical ventilation, reoccurring respiratory failure, ventilator associated pneumonia, increase ICU and hospital length of stay and increased mortality.[149] Up to 78% of ICU survivors experience neurocognitive impairments. A recent multicenter RCT in medical-surgical ICU's examined 821 patients with acute respiratory failure and or shock for the presence of delirium while in the hospital and the cognitive impact three and twelve months post discharge. They found 72% of patient developed delirium during their hospital stay. The duration of delirium correlated to impairment 3 and 12 month out of hospital. One out of four patients had cognitive impairment at twelve months.[151] Herridge et al looked at outcomes of Acute Respiratory Distress Syndrome (ARDS) survivors and found that they lost 18% of their body weight at discharge from the ICU and experienced significant functional limitations at one year due to muscle wasting and fatigue[152]. In a systematic review of quality of life (QOL) data on critically ill survivors when compared to population norms matched to sex and age, evidence of challenges in physical activity and physical role functions was significant and persistent. The factors contributing to negative QOL outcomes included impaired pulmonary function, loss of muscle, proximal weakness and fatigue.[153]

Impact of Immobility on Organs

During bed rest or immobility negative effects are seen on the respiratory, cardiovascular, integumentary and musculoskeletal systems.[154-158] The major consequences to the respiratory system include development of compression atelectasis from the dependent edema formation in the supine position, impaired ability to clear the tracheal bronchial tree due to position dependent changes in the muco-ciliary escalator, cough reflex and drainage thus placing the immobilized patient at greater risk for ventilator associated or hospital acquired pneumonia.[154,158] The changes in the cardiovascular system related to bed rest are significant. The act of lying down shifts 11% of the total blood volume away from the legs with the majority going to the chest. Within the first three days of bed rest there is an 8 to 10% reduction in plasma volume with the loss stabilizing to 15 to 20% by the fourth week.[154-157,159-161] These changes result in increased cardiovascular workload, elevated resting heart rate and a decrease in stroke volume with a reduction in cardiac output. Orthostatic tolerance deteriorates rapidly with immobility with the maximum effect seen at three weeks. Baroreceptor dysfunction, changes in autonomic tone, and fluid shifts are thought to be the cause. [154,162,163] The heart muscle itself becomes de-conditioned with bed rest. In healthy individuals on five days of bed rest, insulin resistance and microvascular dysfunction are seen.[159]

The skin does not normally bear weight so with bed rest, skin breakdown and delayed wound healing are frequently seen.[26] Interruptions in the skin barrier place the critically ill patient at greater risk for health care acquired infections. The musculoskeletal system is severely affected by immobility and bed rest as described above. Immobility in the critically ill patient leads to decreased muscle protein synthesis, increased catabolism of the muscle and decreased muscle mass that is more pronounced in the lower limbs.[163-167] The muscle groups that lose the most strength are those involved in maintaining posture, transferring activities and ambulation.[149]

Skeletal muscle strength may decline 1 to 1.5% per day of strict bedrest.[163] In a study, researchers found that more than one third of patients with stays in the ICU greater than two week had at least 2 functionally significant joint contractures.[168] Contractures during the ICU stay was associated with higher mortality and limited function more than three years post ICU stay. Since the consequences of immobility/bed rest are so severe, mobilizing critically ill patients early has significant merit.

Overcoming Challenges to Early Mobilization

The benefits of exercise result in improved muscle strength, evidence of reduced oxidative stress and inflammation in addition to positive mood changes, shorter days in delirium, less fatigue and a greater ability to resume activities of daily living.[170-172] However, the importance of positioning and mobility as a priority of practice can be a challenge in the ICU. One study demonstrated that during an eight-hour time frame, less than 3 % of critically ill patients were turned in accordance with the standard of practice of every two hours. Close to 50% of patients during that same time period had no body position change.[173] In a study of the positioning of critically ill patients over a 2-day period in 40 ICUs in the United Kingdom, the average time between manual turns was 4.85 hours with a standard deviation of 3.3.[174] If there are challenges with repositioning in bed, what will it take to routinely achieve walking of ventilator patients? Directors of medical and mixed medical surgical ICUs in 4 countries were randomly selected to be surveyed about early mobility (EM) practices. A total of 833 ICU's (US 396; France 151, UK 138, Germany 148) provided results. Twenty seven percent reported having a formal EM protocol, while 21% had adopted EM practices without a protocol. Over 52% of the ICU's surveyed had not adopted any EM practices. Factors associated with EM practices included presence of multidisciplinary rounds (USA), written daily goals (USA, Europe), and

sedation protocols (USA, Europe). Sites with protocols reported seeing reductions in length of stay and improved patient satisfaction.[175] In a recent one-day point prevalence study on early mobilization of mechanically ventilated patients in 116 ICU's in Germany they showed only 24% of patients were mobilized out of bed and the majority of those patients were receiving non-invasive ventilation. The major barriers included cardiovascular instability and deep sedation.[176]

Mobilizing the critically ill patient must be viewed along a progressive continuum based on readiness, specific pathology, strategies to prevent complications and ability to tolerate the activity/movement and driven by a protocol.[145,154] Progressive mobility is defined as a series of planned movements in a sequential manner beginning at a patient's current mobility status with a goal of returning to his/her baseline.[177] It encompasses a variety of positioning and mobility techniques including; head of the bed elevation; passive and active range of motion; continuous lateral rotation therapy (CLRT) and prone positioning if indicated based on protocol criteria; movement against gravity; physiologic adaptation to an upright/leg down position; chair position; dangling and ambulation.[177] We can combat the physical de-conditioning that occurs with bed rest by using a stepwise mobility progression program. Figure 3 Mobility readiness should be assessed daily to determine status for entrance into a progressive mobility protocol or advancement within the protocol.[178] Figure 4

The challenges to mobilizing the critically ill patient include; concerns about the safety of tubes and lines, hemodynamic instability, amount of personal and equipment resources needed, current sedation practices, patient size, patient pain and discomfort and the time, valuing and priority of mobilization.[145,178-184] Safety regarding the activity event and the patient's ability to hemodynamically tolerate the movement may be the most significant.[181] Numerous studies have shown the practice of early mobility to be safe and effective.[140-144,182,184]

Hemodynamic instability can be a significant barrier in the start or progression of a mobility protocol. When individuals change their gravitational reference from a lying to sitting position the body goes through a series of physiological adaptations to maintain cardiovascular homeostasis. When the body's gravitational plane changes, the cardiovascular system normally tries to adjust in two ways: by plasma volume shifts that may cause transmission of messages to the autonomic nervous system to change vascular tone or by inner ear or vestibular response that affects the cardiovascular system during a position change.[185,186] Critically ill patients commonly have poor vascular tone, a dysfunctional autonomic feedback loop, and/or low cardiovascular reserve. Frequently, they are left in a prolonged stationary position and establish a "gravitational equilibrium" over time, making it more difficult to adapt to a position change. For patients who develop hemodynamic instability with a manual turn, the solution might be to train them to tolerate a position change versus leaving them in a stationary supine position. Rotational therapy can gradually retrain patients to tolerate turning or we can slow down the patients' movement during the mobility technique to allow adaptation.[187] Most critically ill patients take five to ten minutes to adapt to a mobility action or a position change. After the appropriate time period, the critical care nurse and/or team can safely judge pulmonary and cardiovascular tolerance to the activity and can make a determination as to whether the patient is ready to be progressed. Figure 5

Significant problems are created for ICU patients when they are not mobilized effectively. The solution rests in working as a team to increase the awareness of the importance of early mobilization and in shifting the ICU culture from one in which the patient on bed rest is the norm to one in which mobilization enables the prevention of complications and faster healing and recovery.[178,188] Mobility is a fundamental nursing activity that requires knowledge and skill to

effectively apply to critically ill patients. When mobility is a core component of care it enhances key patient outcomes.

Bullets of Key Points

- The major long term complication is the impact on quality of life after discharge are due ICU acquired weakness and delirium that frequently occurs during an ICU stay.
- Orthostatic tolerance deteriorates rapidly with immobility with the maximum effect seen at three weeks. Baroreceptor dysfunction, changes in autonomic tone, and fluid shifts are thought to be the cause.
- Progressive mobility is defined as a series of planned movements in a sequential manner beginning at a patient's current mobility status with a goal of returning to his/her baseline.
- Mobilizing the critically ill patient must be viewed along a progressive continuum based on readiness, specific pathology, strategies to prevent complications and ability to tolerate the activity/movement and driven by a protocol.
- Numerous studies have shown the practice of early mobility to be safe and effective.

CHECK YOUR PROGRESS: Assess your understanding of key points from the previous sections.

1. Factors that contribute to a patient experiencing orthostatic intolerance;
    a. Loss of autonomic tone
    b. Prolonged bed rest
    c. Diabetic neuropathies
    d. All of the above

2. What is the major long-term complication resulting from the physical deconditioning that takes place during a patient's stay in the intensive care unit (ICU)

a. Loss of orthostatic tolerance/disturbed equilibrium

b. Onset of depressive mood disorders

c. Diminished quality of life after discharge

d. Increased susceptibility to autoimmune disorders

3. Progressive mobility is defined as a series of planned movements in a sequential manner with what final goal?

a. Returning to the patient's baseline level of mobility

b. Achieving 75% of the patient's pre-ICU activity level

c. Prevention of ventilator- and hospital-acquired pneumonia

d. Patient's ability to ambulate for a distance of at least 100 feet by the time of ICU discharge

3. What was the main cause of functional limitations occurring in patients within 1 year after discharge from the ICU?

a. Heart muscle deconditioning

b. Skin breakdown/delayed wound healing

c. Joint contractures

d. Muscle wasting

Answer

1.d 2. c 3. a 4. d

Moving the Evidence into Practice

Moving the latest evidence into our fundamental nursing practices may be challenging and is best accomplished by using an organized approach. Step 1 involves performing an initial assessment of the current practices in prevention of skin injury, hand hygiene, bathing/decolonization, oral care and early mobility. Identification of practices that are not evidence based is essential. Step 2 encompasses consolidation of current hygiene and mobility practices under the framework of a comprehensive interventional patient hygiene. Measurement of baseline data using standard definitions for health care acquired pneumonia, pressure ulcer incidence rate, blood stream infection rates, symptomatic urinary catheter infection rates and incontinence associated dermatitis are key to monitoring progress or lack thereof. The value of these care practices are highlighted with the staff by sharing the scientific evidence and eliciting their participation in the establishment of protocols and guidelines. Using a shared decision-making model, step 3 contains selecting processes and products that help support compliance of the protocols and help nurses consistently do the right thing in an efficient manner.[189,190] Step 4 is implementation of the change. Post implementation rates are measured after ensuring sufficient compliance with practice changes. Results are then compared against baseline data, regional and national benchmarks if available. The final step is the continued measurement of compliance on a quarterly basis until the new practice becomes part of the routine. Essential to the success of the process is to ensure ownership and participation of all key practitioners. This will allow the change to become real and permanent. The goal is to weave the new care practices into the fabric of the unit/organization to create a safer patient environment.[191,192]

SUMMARY

We are responsible for assuring that our current nursing and unit work cultures value and incorporate hygiene care practices and mobility activities as they are fundamental and

independent care components of nursing. When implemented, using available evidence, they can significantly improve patient outcomes. The IPH model described in the paper, the change framework and the latest evidence are tools for the caregiver to begin the discussion, revaluing, education, resource attainment and systems development to ensure evidence based transformation of nursing care. It is time to reclaim and demonstrate the importance of the consistent delivery of the basics of nursing care.

End of Chapter Multiple Choice Questions

1. Fundamental nursing care practice has limited impact on patient outcomes in the ICU.
    a. True
    b. false

2. When implementing a new practice, the best strategy for success is?
    a. Education
    b. Process and product change
    c. Feedback/accountability
    d. All of the above
3. What is the most common reason a patient gets a pressure ulcer
    a. Patient is a smoker.
    b. Patient is very thin.
    c. Patient is incontinent
    d. Patient has an alter level of consciousness
4. A shearing force can occur when a patient:
    a. bumps an elbow against a hard surface

b. gets a blister on the heel from rubbing

c. slides down when sitting in bed

d. all of the above

5. Using a turn sheet to reposition or move a patient can help to prevent friction and shearing forces.

    a. True

    b. False

6. The strain at which the skin breaks when there is excess moisture is?

    a. no different

    b. 4x greater

    c. 10x greater

    d. 15x greater

7. Strategies for the prevention of IAD include all the following except?

    a. wick away incontinent pad

    b. application of a barrier

    c. a diaper

    d. cleaning quickly

8. Which of the following support best practice in reducing shear and moisture injury for bedridden patients unable to move?

    a. non-breathable turn sheet, wick away incontinent pad, pillows, incontinent barrier

    b. breathable turn sheet, wick away pad, foam wedges, incontinent barrier

    c. pillows, breathable turn sheet, incontinent barrier, reusable incontinent pad

d. foam wedges, non-breathable turn sheet and incontinent barrier, wick away incontinent pad

9. The head of the bed should be maintained at the lowest degree of elevation (no higher than 30 degrees) consistent with the medical condition.
    a. True
    b. False
10. What is the *most* important strategy the healthcare worker can use to prevent hospital-acquired infections
    a. isolation of patients with a resistant organism
    b. reduce the number of invasive lines
    c. sterilization of all patient related equipment
    d. handwashing
11. Which of the following is not a risk factor for the development of a ventilator associated or hospital acquired pneumonia?
    a. inadequate oral care
    b. immobility
    c. placement of a central line
    d. delay in feeding
12. Which of the following patient findings increases the risk of microorganisms entering the lower respiratory tract?
    a. An increased gag reflex
    b. Increased pooling of secretions in the oropharynx
    c. Increased muco-ciliary clearance of secretions

d. Increased cough

13. Immobility contributes to which of the following pulmonary complications;

    a. Pleural effusion

    b. Thin secretions

    c. Hospital acquired pneumonia

    d. Pulmonary edema

14. In the study examining position change every 15 minutes over an eight hour period, approximately what percentage of time was every 2hr turning achieved with critically ill patients?

    a. 20%

    b. 3%

    c. 10%

    d. 40%

15. Which of the following are evidence based outcomes demonstrated when successful early progressive mobility program are put in place?

    a. decrease incidence of delirium and greater ability to perform ADL's on discharge

    b. shorter ICU lengths of stay and increased incidence of delirium

    c. greater ambulation distance and longer lengths of ICU stay

    d. decreased incidence of delirium and lower patient satisfaction

16. Which of the following is considered a major barrier by nurses in performing in-bed and out of bed mobility for critically ill patients?

    a. patient refusal

    b. vasoactive drips

c. hemodynamic instability

d. patient in pain

Answers: 1.b 2.d 3.c 4.d 5.a 6.b 7.c 8.b 9.a 10.d 11.c 12.b 13.c 14.b 15.a 16.c

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