Guideline for Prevention of Infection in Intensive Care Unit

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1. List of Abbreviations

- **AIIRs:** Airborne Infection Isolation Rooms
- **AMS:** Antimicrobial Stewardship
- **CAUTI:** Catheter associated Urinary Tract Infection
- **CDC:** Centers for Disease Control and Prevention
- **CLABSI:** Central Line associated Bloodstream Infection
- **COVID-19**: Coronavirus Disease 2019
- **HAI:** Healthcare Associated Infection
- **HICPAC:** Healthcare Infection Control Practices Advisory Committee
- **HPSC:** Health Protection Surveillance Centre
- **ICU:** Intensive Care Unit
- **IPC:** Infection prevention and control
- **KPIs:** Key Performance indicators
- **MDROs:** Multidrug-resistant Organisms
- **PEP:** Post Exposure Prophylaxis
- **PPE:** Personal Protective Equipment
- **VAP:** Ventilator associated Pneumonia
- **WHO:** World Health Organization

2. Glossary

- **Standard Precautions:** A group of infection prevention practices that apply to all patients, regardless of suspected or confirmed diagnosis or presumed infection status. Standard Precautions are a combination and expansion of Universal Precautions and Body Substance Isolation. Standard Precautions are based on the principle that all blood, body fluids, secretions, excretions except sweat, nonintact skin, and mucous membranes may contain transmissible infectious agents. Standard Precautions includes hand hygiene, and depending on the anticipated exposure, use of gloves, gown, mask, eye protection, or face shield. Also, equipment or items in the patient environment likely to have been contaminated with infectious fluids must be handled in a manner to prevent transmission of infectious agents, (e.g. wear gloves for handling, contain heavily soiled equipment, properly clean and disinfect or sterilize reusable equipment before use on another patient).
- **Healthcare-associated infection (HAI):** An infection that develops in a patient who is cared for in any setting where healthcare is delivered (e.g., acute care hospital, chronic care facility, ambulatory clinic, dialysis center, surgicenter, home) and is related to receiving health care (i.e., was not incubating or present at the time healthcare was provided). In ambulatory and home settings, HAI would apply to any infection that is associated with a medical or surgical intervention performed in those settings.

3. Executive Summary

These recommendations are designed to describe the core set of infection prevention and control (IPC) practices in intensive care unit (ICU) to prevent transmission of infectious agents among patients and healthcare personnel regardless the type of procedure provided.

Recommendations
Nurse to patient ratio must be at least one nurse to two patients **(Strong Recommendation)**
Use Standard Precautions as recommended for all patient interactions **(Strong Recommendation)**
Provide supplies and equipment necessary for the consistent observance of Standard Precautions, including hand hygiene products and personal protective equipment **(Strong Recommendation)**
In addition to Standard Precautions, use Transmission-Based Precautions for patients with documented or suspected infection or colonization with highly transmissible or epidemiologically-important pathogens. **(Strong Recommendation)**
During the delivery of healthcare, avoid unnecessary touching of surfaces in close proximity to the patient to prevent both contamination of clean hands from environmental surfaces and transmission of pathogens from contaminated hands to surfaces. **(Strong Recommendation)**
Monitor the incidence of epidemiologically-important organisms and targeted HAIs that have substantial impact on outcome and for which effective preventive interventions are available; use information collected through surveillance of high-risk populations, procedures, devices and highly transmissible infectious agents to detect transmission of infectious agents in the healthcare facility. **(Strong Recommendation)**

4. Introduction

The Critical Importance of ICU Infection Control

Intensive Care Units (ICUs) are epicenters for managing critically ill patients who are uniquely vulnerable to healthcare-associated infections (HAIs). ICU patients face a **5–10 times greater risk** of HAIs compared to general ward patients due to a confluence of factors:

- **Patient Vulnerabilities:** Underlying immunocompromising conditions (e.g., diabetes, immunosuppression) and frequent, prolonged antibiotic use.
- **Invasive Devices:** Ventilators, central lines, and urinary catheters breach natural anatomical barriers.
- **Environmental & Operational Factors:** High concentration of high-touch surfaces, frequent staff-patient interactions, and potential for understaffing or overcrowding.

Consequently, approximately **30% of all HAIs** in high-income countries occur in ICUs, significantly increasing patient morbidity, mortality, and healthcare costs.

5. Scope and Purpose

A Multifaceted Framework for Protection

The scope of ICU infection control is comprehensive, integrating procedural, structural, and human elements into a unified defense system. Key domains include:

- **Core Protocols:** Hand hygiene, use of Personal Protective Equipment (PPE), and transmission-based precautions (Contact, Droplet, Airborne).
- **Environmental & Engineering Controls:** Routine disinfection of high-touch surfaces, single-patient rooms, Airborne Infection Isolation Rooms (AIIRs), and optimized ICU layouts.
- **Surveillance & Stewardship:** Active monitoring of device-associated infections (CLABSI, CAUTI, VAP) and multidrug-resistant organisms (MDROs), coupled with antimicrobial stewardship to curb resistance.
- **Education & Leadership:** Role-specific staff training, dyad leadership between clinicians and infection preventionists, and patient/family engagement.

The Core Purpose of the Guidelines

The primary purpose of these guidelines is to mitigate the elevated risks in the ICU through evidence-based frameworks designed to:

1. **Protect Vulnerable Patients:** Directly prevent device-related infections and shield immunocompromised patients from environmental pathogens through strict aseptic techniques and disinfection protocols.
2. **Contain Pathogen Transmission:** Standardize responses to contain outbreaks of MDROs and high-consequence infectious diseases (e.g., COVID-19, tuberculosis) via isolation, screening, and PPE.
3. **Translate Evidence into Practice:** Operationalize research into actionable clinical steps, such as implementing care bundles for antibiotic use and device management.
4. **Ensure Compliance and Preparedness:** Align ICU operations with regulatory standards (e.g., The Joint Commission, center of disease control (CDC), The World Health Organization (WHO)) and build surge capacity for pandemic response.

6. Target Audience

- Infection Prevention and Control Team
- All Healthcare Workers in ICUs: Including Clinicians, Nurses, Head Nurses
- HAIs Surveillance Officers

7. Methodology

A comprehensive search for guidelines was undertaken to identify the most relevant guidelines to consider for adaptation.

Inclusion/ exclusion criteria followed in the search and retrieval of guidelines to be adapted:

- Selecting only evidence-based guidelines (guideline must include a report on systematic literature searches and explicit links between individual recommendations and their supporting evidence)
- Selecting only national and/or international guidelines
- Specific range of dates for publication (using Guidelines published or updated in 2023 and later)
- Selecting peer reviewed publications only
- Selecting guidelines written in English language

- Excluding guidelines written by a single author, not on behalf of an organization to be valid and comprehensive, a guideline ideally requires multidisciplinary input.
- Excluding guidelines published without references as the panel needs to know whether a thorough literature review was conducted and whether current evidence was used in the preparation of the recommendations.

The following characteristics of the retrieved guidelines were summarized in:

- Developing organization/authors
- Date of publication, posting, and release
- Country/language of publication
- Date of posting and/or release
- Dates of the search used by the source guideline developers.

All retrieved Guidelines were screened and appraised using AGREE II instrument (www.agreetrust.org) by at least three members. The panel decided on a cut-off point or ranked the guidelines (any guideline scoring above 50% on the rigor dimension was retained). The committee decided to adapt from:

- Centers for Disease Control and Prevention. (2023, November 27). Guideline for isolation precautions: Preventing transmission of infectious agents in healthcare settings (2007 update). (1)
- Centers for Disease Control and Prevention, & Healthcare Infection Control Practices Advisory Committee (HICPAC). (2023, December Guidelines for environmental infection control in health-care facilities (2003 update) (2)
- Health Protection Surveillance Centre (HPSC). (n.d.; 2025. Irish infection prevention and control (IPC) guidelines. Health Service Executive, Ireland (3)

Evidence assessment

According to the World Health Organization (WHO) Handbook for Guidelines, we used the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) approach to assess the quality of a body of evidence, develop and report recommendations. GRADE methods are used by WHO because these represent internationally agreed standards for making transparent recommendations. Detailed GRADE information is available on the following sites:

- GRADE working group: https://www.gradeworkinggroup.org/
- GRADE online training modules: http://cebgrade.mcmaster.ca/

Table (1) Quality and Significance of the four levels of evidence in GRADE

Quality	Definition	Implications
High	The guideline development group is very confident that the true effect lies close to that of the estimate of the effect	Further research is very unlikely to change confidence in the estimate effect
Moderate	The guideline development group is moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibly that it is substantially different	Further research is likely to have an important impact on confidence in the estimate of the effect and may change the estimate
Low	Confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the true effect	Further research is very likely to have an important on confidence in the estimate of effect and is unlikely to change the estimate
Very low	The group has very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of the effect	Any estimate of the effect is very uncertain

Table (2) Factors that determine How to upgrade or downgrade the quality of evidence.

Downgrade in presence of	Upgrade in presence of
Study limitations. **1-** Serious limitations **2-** Very serious limitations	Dose- response gradient. +1 Evidence of a dose-response gradient
Consistency **1-** Important inconsistency	Direction of plausible bias + All plausible confounders would have reduced the effect
Directness **1-** Some uncertainty **2-** Major uncertainty	Magnitude of the effect +1 Strong, no plausible Confounder, consistent and direct evidence
Precision **1-** Imprecise data	+2 very strong, no major threats to validity and direct evidence
Reporting bias **1.** High probability of reporting bias	

The strength of the recommendations

The strength of a recommendation communicates the importance of adherence to the recommendation.

- **Strong recommendations**

With strong recommendations, the guideline communicates the message that the desirable effects of adherence to the recommendation outweigh the undesirable effects. This means that in most situations the recommendation can be adopted as policy.

- **Conditional recommendations**

These are made when there is greater uncertainty about the four factors above or if local adaptation has to account for a greater variety in values and preferences, or when resource use makes the intervention suitable for some, but not for other locations. This means that there is a need for substantial debate and involvement of stakeholders before this recommendation can be adopted as policy.

When not to make recommendations?

When there is lack of evidence on the effectiveness of an intervention, it may be appropriate not to make a recommendation.

8. Recommendations

Recommendations
Nurse to patient ratio must be at least one nurse to two patients **(Strong Recommendation, High Grade Evidence)**
Use Standard Precautions as recommended for all patient interactions **(Strong Recommendation, High Grade Evidence)**
Provide supplies and equipment necessary for the consistent observance of Standard Precautions, including hand hygiene products and personal protective equipment **(Strong Recommendation, Moderate Grade Evidence)**
In addition to Standard Precautions, use Transmission-Based Precautions for patients with documented or suspected infection or colonization with highly transmissible or epidemiologically-important pathogens **(Strong Recommendation, Moderate Grade Evidence)**

During the delivery of healthcare, avoid unnecessary touching of surfaces in close proximity to the patient to prevent both contamination of clean hands from environmental surfaces and transmission of pathogens from contaminated hands to surfaces. **(Strong Recommendation, Moderate Grade Evidence)**
Monitor the incidence of epidemiologically-important organisms and targeted HAIs that have substantial impact on outcome and for which effective preventive interventions are available; use information collected through surveillance of high-risk populations, procedures, devices and highly transmissible infectious agents to detect transmission of infectious agents in the healthcare facility. **(Strong Recommendation, High Grade Evidence)**

Remarks

Key Considerations for General Infection Prevention and Control in the ICU

Infection prevention and control in the ICU requires strict application of general IPC principles and close coordination with the hospital-wide IPC program. The ICU environment carries a high risk for HAIs due to frequent use of invasive devices, critical illness, and prolonged hospitalization.

The following key considerations highlight essential IPC practices in the ICU and indicate cross-reference to relevant general guideline sections.

1. Standard Precautions

All ICU care activities must comply fully with Standard Precautions as outlined in the general IPC guidelines. These include:

- Hand hygiene before and after patient contact and procedures. *Refer to chapter of hand hygiene*
- Use of appropriate personal protective equipment (PPE). *Refer to chapter of Personal protective equipment*
- Safe Injection Practices. *Refer to chapters of aseptic technique and safe injection practices*
- Respiratory Hygiene / Cough Etiquette. *Refer to chapter of Cough etiquette* and respiratory hygiene practices

- Linen and Laundry Handling. *Refer to chapter of safe management of linen in hospitals*
- Environmental cleaning and disinfection. *Refer to chapter of management of environmental safety and cleaning in hospitals*
- Waste Management. *Refer to chapter of waste management*

2. Transmission-Based Precautions

Apply Contact, Droplet, or Airborne Precautions in addition to standard precautions whenever patients are known or suspected to be infected or colonized with specific pathogens. Ensure appropriate patient placement, signage, dedicated equipment, and adherence to donning/doffing procedures.

→ Refer to *Transmission-Based Precautions chapter*

3. Device-Associated Infection Prevention Bundles

Implementation of evidence-based care bundles is essential to reduce device-associated HAIs, including:

- Ventilator-Associated Pneumonia (VAP) Prevention Bundle
- Central Line-Associated Bloodstream Infection (CLABSI) Prevention Bundle
- Catheter-Associated Urinary Tract Infection (CAUTI) Prevention Bundle

Bundle compliance should be monitored regularly and integrated into ICU quality indicators.

→ Refer to: *prevention of central line associated bloodstream infections, prevention of catheter associated urinary tract infections, Prevention of Ventilator associated Pneumonia chapters*

4. Surveillance

Conduct continuous surveillance for HAIs within the ICU using standardized definitions and methods. Monitor infection rates (VAP, CLABSI, CAUTI, SSI), device utilization ratios, and antimicrobial resistance patterns.

Provide regular feedback to ICU teams to guide improvement actions.

→ Refer to: *Surveillance of Healthcare associated Infections in Healthcare Facilities chapter*

5. Multidrug-Resistant Organisms (MDROs)

Prevent and control the spread of MDROs through:

- Early identification and screening of high-risk patients.
- Strict adherence to Contact Precautions and environmental cleaning.
- Judicious antimicrobial use.
- Communication of MDRO status during patient transfer.

→ Refer to: *Management of multidrug-resistant organisms (MDROs) and outbreak situations chapter*

6. Post-Exposure Prophylaxis (PEP) and Occupational Safety

ICU staff are at increased risk of exposure to blood and body fluids. Immediate reporting, risk assessment, and management following occupational exposure are mandatory. Ensure staff are vaccinated as per national recommendations**.**

→ Refer to: *Post-Exposure Prophylaxis Among Healthcare Workers chapter*

7. Antimicrobial Stewardship (AMS)

Rational antibiotic prescribing is a core element of ICU IPC.

- Participate in daily antibiotic review and de-escalation based on culture results.
- Limit prophylactic antibiotic use to defined indications and durations.
- Regularly review antimicrobial resistance trends.

→ Refer to: *Implementing an Antibiotic Stewardship Program chapter*

8. Education, Training, and Auditing

All ICU healthcare workers should receive regular IPC training focusing on hand hygiene, aseptic technique, PPE use, and device-care bundles. Routine auditing and feedback should be conducted to reinforce compliance and promote a culture of safety.

→ Refer to key performance indicators provided in each chapter

9. Integration with Hospital IPC Program

The ICU IPC team must work in coordination with the hospital-wide IPC Committee for:

- Data sharing and trend analysis.
- Participation in outbreak investigations.
- Implementation of corrective and preventive actions.

Rational

- Patients in the ICU are particularly vulnerable due to invasive procedures, compromised immune systems, and the increased presence of multidrug-resistant organisms.
- The patient-to-nurse ratio in the Intensive Care Unit (ICU) is a critical staffing decision with significant rationales centred on patient safety, care quality, and nurse well-being. Due to the high acuity and life-threatening nature of conditions in the ICU, a low patient-to-nurse ratio (at least 1 nurse to 2 patients) is considered the standard of care to ensure critically ill patients receive constant, specialized attention.
- The rationale for using standard precautions in the ICU is that they provide a baseline, universal approach to infection control for all patients, assuming any patient could be a carrier of an infectious agent. This approach is particularly critical in the ICU due to the high vulnerability of patients and the concentration of infectious agents.
- Minimizing unnecessary touching of surfaces in close proximity to a patient in an ICU is to reduce the transmission of hospital-acquired pathogens. These "high-touch" surfaces act as reservoirs for germs and can easily become contaminated with infectious microorganisms that can be transferred to patients, other healthcare workers, and visitors
- Using transmission-based precautions in the ICU is to add extra layers of protection against specific, highly contagious, or dangerous pathogens for which standard precautions are not enough. These measures are especially critical for ICU patients

due to their increased vulnerability and the concentrated presence of infectious microorganisms in this setting.

9. Indicators for Monitoring

To ensure the appropriate prevention of infection in ICUs in hospitals specific indicators should be monitored regularly. These are some indicators which focus on measuring and improving the prevention of infections occurring at ICUs. These key performance indicators (KPIs) help track the effectiveness of infection control measures and identify areas for improvement, ultimately aiming to reduce healthcare associated infections in ICU and enhance patient outcomes. Here are some key indicators that can be included in hospital guidelines for prevention of infections in ICUs.

- **Nurse-to-Patient Ratio**

– Definition: Ratio of nurses to patients in the ICU.
– Target: 1:1 for ventilated patients or 1:2 maximum.
– Significance: Adequate staffing is crucial for timely infection prevention interventions.

- **Hand Hygiene Compliance Rate**

– Definition: Percentage of performed hand hygiene actions over total indicated moments.
– Formula: (HH performed / HH opportunities) × 100

- **Outcome Measures of MDRO**

- **Definition:** Reduction in healthcare-associated infection rates
- **Formula:**
  - ((Baseline MDRO infection rate − Current MDRO infection rate) ÷ Baseline MDRO infection rate) × 100
  - The rate of healthcare- associated MDRO/ 1000 patient days. Example: The rate of HAI- MRSA/ 1000 patient day

- **CLABSI Rate**

– Definition: Rate of central line-associated bloodstream infections.
– Formula: (Number of CLABSI / Central line-days) × 1,000

- **CAUTI Rate**

– Definition: Rate of catheter-associated urinary tract infections.
– Formula: (Number of CAUTI / Urinary Catheter-days) × 1,000

- **VAP Rate**

– Definition: Rate of ventilator-associated pneumonia.
– Formula: (Number of VAP / Ventilator-days) × 1,000

10. Plan to Update this National Clinical Guideline

This guideline will be reviewed and updated when new evidence emerges that is likely to influence the recommendations.

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