original article

Frequency and Nature of Infectious Risk Moments During Acute Care Based on the INFORM Structured Classification Taxonomy

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objective. In this study, we sought to establish a comprehensive inventory of infectious risk moments (IRMs), defined as seemingly innocuous yet frequently occurring care manipulations potentially resulting in transfer of pathogens to patients. We also aimed to develop and employ an observational taxonomy to quantify the frequency and nature of IRMs in acute-care settings.

design. Prospective observational study and establishment of observational taxonomy.

setting. Intensive care unit, general medical ward, and emergency ward of a university-affiliated hospital.

participants. Healthcare workers (HCWs).

methods. Exploratory observations were conducted to identify IRMs, which were coded based on the surfaces involved in the transmission pathway to establish a structured taxonomy. Structured observations were performed using this taxonomy to quantify IRMs in all 3 settings.

results. Following 129.17 hours of exploratory observations, identified IRMs involved HCW hands, gloves, care devices, mobile objects, and HCW clothing and accessories. A structured taxonomy called INFORM (INFectiOus Risk Moment) was established to classify each IRM according to the source, vector, and endpoint of potential pathogen transfer. We observed 1,138 IRMs during 53.77 hours of structured observations (31.25 active care hours) for an average foundation of 42.8 IRMs per active care hour overall, and average densities of 34.9, 36.8, and 56.3 IRMs in the intensive care, medical, and emergency wards, respectively.

conclusions. Hands and gloves remain among the most important contributors to the transfer of pathogens within the healthcare setting, but medical devices, mobile objects, invasive devices, and HCW clothing and accessories may also contribute to patient colonization and/or infection. The INFORM observational taxonomy and IRM inventory presented may benefit clinical risk assessment, training and education, and future research.

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Healthcare-associated infections (HAIs) remain a major threat to patient safety. A significant proportion of such infections are likely preventable through the application of infection prevention measures,[1–4] such as those aiming to reduce the transmission of pathogens that may lead to patient colonization or infection.[5] Hand hygiene, for example, is widely recognized as one of the most effective practices to reduce infection rates and patient colonization with multidrug-resistant bacteria by reducing the transmission of microorganisms.[6] Strong evidence also suggests that environmental contamination of surfaces and objects contribute to HAI,[7–12] yet the behavioral focus of such studies is often limited to hand hygiene and environmental cleaning. While the practice of hand hygiene has been increasingly studied over the last decade for its role in infection prevention, considerably less knowledge exists regarding other important infection-related behaviors.

A growing body of evidence suggests that practices beyond those addressed by hand hygiene may be relevant in the transmission of microorganisms that results in patient colonization and infection, such as handling of mobile objects,[13,14] healthcare worker (HCW) private[15] and professional attire,[16,17] and medical devices.[11,14,18] Therefore, we hypothesize that an important portion of infectious risks lie in infectious risk moments (IRM), defined as seemingly innocuous, yet frequently occurring care manipulations that potentially result in the transfer of pathogens. Such IRM include yet go beyond existing indications for hand hygiene.[13]

The design of infection prevention strategies that consider a broad range of infectious risks must begin with systematic identification and classification of IRMs. In a 2-part project, we conducted (1) exploratory observations to establish a comprehensive inventory of potential IRMs, which served as

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a basis for developing a taxonomy for structured observations and (2) structured observations to quantify the frequency and nature of IRMs in 3 distinct typical healthcare settings.

METHODS

Design

We conducted a prospective observational study in 2 parts. First, we conducted live exploratory observations to identify a wide range of potential IRM and to establish a structured taxonomy called INFORM (INFectiOus Risk Moment) for identifying and classifying IRMs. Second, we conducted live structured observations based on the INFORM taxonomy. Parts of this methodology have been pilot tested previously.[13] The observations reported in the current manuscript do not include the pilot observations.

Setting

An intensive care unit (ICU), general medical ward, and emergency ward, including trauma unit, located at a 900-bed, university-affiliated, tertiary-care hospital were purposefully sampled to represent a broad range of care activities and potential infectious risks. All healthcare workers (HCWs) from the participating wards were included in the study. The study hospital has a well-established infection prevention and control (IPC) group with extensive state-of-the-art, written IPC standard operating procedures, weekly IPC rounds, and a designated IPC nurse consultant for each hospital ward.

Exploratory Observations

Observers with backgrounds in nursing (C.D.A. and V.G.) and human factors/psychology (L.C.) and extensive experience conducting observations for patient safety research carried out exploratory observations in all 3 settings. Field notes documented the care processes observed and any potential IRMs, which were operationally defined as behaviors potentially resulting in the transmission of pathogens that may result in patient colonization or infection. The observers discussed all identified potential IRMs regularly throughout the exploratory observation period together with a senior infection prevention physician (H.S.) and all potential IRM were collected in a database.

Based on the definition of IRMs and following the hand hygiene literature, IRMs were limited to moments resulting in potential transfer of pathogens to patients and their immediate surroundings (eg, bedding), rather than the larger translocation of microorganisms throughout the healthcare environment. For example, an HCW entering a patient room then, without doing hand hygiene, touching the patient's bedside monitor to silence an alarm (a behavior that occurs often and may introduce nonpatient flora to the patient environment) was not considered an IRM. Only behaviors that resulted in potential transfer of pathogens directly to the patient were considered. We distinguished between noncritical patient sites (eg, intact skin, intact dressings, patient clothing), critical patient sites, defined as "body sites or medical devices that have to be protected against microorganisms potentially leading to HAI"[19] (eg, mucous membranes, catheter insertion sites, or open wounds), and patient bedding. Exploratory observations were conducted until saturation was achieved in each setting, that is, until no new IRMs were observed.

Structured Observation Taxonomy and Mobile Observation Tool Validation

Following exploratory observations, all IRMs were extracted from field notes and were systematically coded according to the source, vector, and endpoint from, through, and to which pathogens were transferred, respectively. This structure was used to establish the INFORM classification taxonomy, on which structured observations were based (Figure 1). A mobile observation tool based on the INFORM taxonomy was programmed with Filemaker 14 (FileMaker, Santa Clara, CA). To ensure the quality of observations, 2 observers (L.C. and S. P.) validated the mobile observation tool during a 1-month test period. The percentage of agreement between the 2 observers was calculated to measure sensitivity (detection of the same IRM) and Cohen's κ was calculated to determine interobserver agreement (ie, consistent classification of IRM) using STATA version 14 software (StataCorp, College Station, TX).

Structured Observations

Structured observations were carried out in the same 3 clinical settings using the mobile observation tool. Two observers (L.C. and S.P.) conducted live, structured observations in parallel to ensure systematic documentation of all IRMs. Structured observations targeted periods of active patient care, and both observers focused on the same HCW at once. Observation sessions of 30–60 minutes were deliberately conducted at different times throughout the workday to include many different HCWs who performed a diverse range of care tasks for multiple patients during each session. During live observations, both observers independently noted the source, vector, and endpoint of pathogens for each IRM according to the observational taxonomy as well as demographic information about the HCW being observed (ie, gender and professional category) and contextual information (ie, date, time, ward name, and patient isolation status) using the mobile observation tool (Appendix 1). No identifying patient or HCW data were collected during observations. For each observation period, we recorded the total amount of observation time, as well as the amount of active patient care time to calculate the density of IRMs per setting. Following each structured observation session, all observed IRMs were compared between the 2 observers, and any discrepancies were discussed until a consensus agreement was achieved. Frequent discussion among researchers to achieve consensus after each observation period was maintained throughout the study to ensure quality and to avoid drift between observers.

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Ethics

The Cantonal Ethics Committee of Zurich formally waived the ethics requirement for this study (KEK-StV-Nr.73/14). Participation in observations was voluntary, and HCWs were free to opt out or stop observations at any time without providing justification.

RESULTS

Exploratory Observations

A total of 129.17 hours of exploratory observations resulted in the identification of 292 unique IRMs. Identified IRMs included moments of potential direct contact transmission (potentially infected or colonized HCW to patient) as well as potential indirect contact transmission via vectors such as care devices, mobile objects, and HCW clothing and accessories. Following exploratory observations, IRMs were systematically coded according to the source, vector, and endpoint of potential pathogen transfer, and these codes formed the basis of the INFORM structured taxonomy (Figure 1).

Structured Observation Taxonomy and Mobile Observation Tool Validation

The 3-level taxonomy begins with classification of surfaces (loci) involved in the observed IRM according to source, vector, or endpoint of potential pathogen transfer (level 1: locus), then assigns each source, vector, and endpoint to a main category (level 2: surface), and specifies the exact nature (level 3: surface detail). Each observed IRM is then represented as a transmission chain composed of 3 loci (source, vector, and endpoint), with each locus having 2 levels of detail (surface and surface detail). Table 1 lists examples of archetypal observed and classified IRMs for each of the observed vectors.

During the 1-month test of the taxonomy using the mobile observation tool (5.5 hours of active patient care), observers 1 and 2 detected 123 (78.9%) and 118 (75.6%) of all observed IRMs, respectively. Based on this detection rate, the decision was made to have 2 observers present for all structured observations to ensure the highest possible sensitivity. For moments identified by both observers during the pilot test, the Cohen's κ measure of interobserver agreement was 0.75, indicating substantial agreement between individual observers.[20]

Source →

(Source)	(Source detail)
Environment	Bedside Table, Curtains, Floor, Lamp, Outside Patient Room, Paper Patient Records, Partition Walls, Patient Bed, Trolley, Other
Gloves	HCW Gloves
Hands	HCW Hands
Healthcare Worker	Body, Clothing, Face, Hair, Other
Invasive Device	IV Tubes, Mechanical Ventilator, Suction Catheter, Other
Medical Device	Bedside Monitor, Blood-Pressure Cuff, Blood-Pressure Monitor, ECG, Infusion Pump, Non-Invasive Ventilator, Stethoscope, Thermometer, Ultrasound, Ventilator Monitor, X-Ray, Other
Mobile Object	Flashlight, Mobile Phone, Pen, Secretions, Tape Dispenser, Toilet Brush, Washcloth, Other
Other Patient	Critical Site, Environment, Intact Skin
Patient Critical Site	Airways, Bloodstream, Mucous Membrane Face, Mucous Membrane Genitals, Mucous Membrane Rectum, Open Wound, Uncapped CVC Hub, Uncapped IV Line, Urethra, Other
Patient Intact Skin	Contaminated Skin, Head, Lower Limbs, Trunk, Upper Limbs
Unknown Status	No Disinfection Observed

Vector →

(Vector)	(Vector detail)
Gloves	Don Gloves Without HH, Non-Sterile Gloves, Remove Gloves Without HH, Sterile Gloves
Hands	HCW Hands, Patient Hands
Healthcare Worker	Badge, HCW Private Clothing, HCW White Clothing, Watch
Invasive Device	Arterial Catheter Tip, CVC Tip, Invasive Ventilator, IV Tubes, Needle/Cannula, PVC Tip, Suction Catheter, Thoracic Tube, Uncapped Hub, Urinary Catheter Tip, Ventilation Filter, Other
Medical Device	Blood-Pressure Cuff, ECG, Infusion Pump, Non-Invasive Ventilator, Stethoscope, Thermometer, Ultrasound, X-Ray, Other
Mobile Object	Bedding, Dressing or Bandage, Flashlight, Medical Tape, Mobile Phone, Pen, Secretions, Tape Dispenser, Tourniquet, Transfer, Board, Transfer Cannula, Washcloth, Wristwatch, Other

Endpoint

(Endpoint)	(Endpoint detail)
Critical Site	Airways, Arterial 3-Way Valve, Arterial Insertion Site, Arterial Lumen Port, Bloodstream, CVC Insertion Site, CVC Line 3-Way Valve, CVC Line-Infusion Connection, CVC Lumen Port, Feeding Tube, Mucous Membrane Face, Mucous Membrane Genitals, Mucous Membrane Rectum, Mucous Membrane Urethra, Open Wound, PVC Insertion Site, PVC Line 3-Way Valve, PVC Line-Infusion Connection, PVC Lumen Port, Urinary Catheter, Other
Non-Critical Site	Head, Lower Limbs, Trunk, Upper Limbs, Catheter Dressing, Patient Clothing, Wound Dressing, Other
Patient Bed	Bedding, Pillow

FIGURE 1. The INFORM (INFectious Risk Moment) structured taxonomy used to classify surfaces involved in the observed infectious risk moment according to source, vector, and endpoint of potential pathogen transfer. Note: HCW, Healthcare worker; IV, Intravenous; ECG, electrocardiography; CVC, Central-venous catheter; PVC, Peripheral-venous catheter

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TABLE 1. Example Coding of Archetypal Infectious Risk Moments Using the INFORM Structured Taxonomy

Gloves: An HCW wearing gloves removes and discards the dressing from a patient's open wound, his gloves contact the open wound, then, without changing gloves, he touches the insertion site of the same patient's urinary catheter.			
Level 1: Locus	Source	Vector	Endpoint
Level 2: Surface	Patient critical site	Gloves	Critical site
Level 3: Surface detail	Open wound	Nonsterile gloves	Urinary catheter
Healthcare worker: While adjusting the electrocardiography suction nodes to a patient's upper limbs, an HCW leans over the patient and his badge touches the intact skin of the patient's arm.			
Level 1: Locus	Source	Vector	Endpoint
Level 2: Surface	Unknown status	Healthcare worker	Noncritical site
Level 3: Surface detail	No disinfection observed	Badge	Upper limbs
Invasive device: An HCW inserts an arterial catheter without having disinfected the skin of the insertion site.			
Level 1: Locus	Source	Vector	Endpoint
Level 2: Surface	Patient intact skin	Invasive device	Critical site
Level 3: Surface detail	Contaminated skin	Arterial catheter tip	Bloodstream
Medical device: An HCW carries a stethoscope around her neck and the chest piece comes into contact with her own skin, then, without disinfection, she uses the stethoscope to auscultate the patient.			
Level 1: Locus	Source	Vector	Endpoint
Level 2: Surface	Healthcare worker	Medical device	Noncritical site
Level 3: Surface detail	Body	Stethoscope	Trunk
Mobile object: Medical-grade adhesive tape is attached to bedrails prior to being used to secure the gauze of a wound dressing onto the patient's skin.			
Level 1: Locus	Source	Vector	Endpoint
Level 2: Surface	Environment	Mobile object	Noncritical site
Level 3: Surface detail	Patient bed	Medical tape	Wound dressing

Structured Observations

Following validation of the taxonomy using the mobile observation tool, 53.77 hours of structured observations (31.25 hours of active care) were conducted, during which 1,338 IRM were identified. The average densities of IRMs per active care hour were 42.8 overall, and 34.9, 36.8, and 56.3 in the intensive care, medical, and emergency wards, respectively. We identified 566 unique IRMs, which fell into 71 main categories according to level 2 of the structured taxonomy. A comprehensive inventory of observed IRMs appears in Table 2.

The vectors in the identified IRMs included hands (n = 596; 44.54%), gloves (n = 457; 34.16%), medical devices (n = 115; 8.59%), mobile objects (n = 102; 7.62%), invasive devices (n = 53; 3.96%), and HCW clothing and accessories (n = 15; 1.12%). Overall, 25.8% of IRM concerned moments of potential transmission of pathogens to a critical site, described in detail in Table 2A. Among the 217 IRMs dealing with medical devices and mobile objects as vectors, 143 IRMs (65.90%) involved the lack of disinfection of a device or object prior to patient contact. The 3 most frequently occurring IRMs per clinical setting are described in detail in Table 3.

DISCUSSION

Hands and gloves continue to be among the most important contributors to the transfer of pathogens in the healthcare setting. Nonetheless, we identified moments dealing with other vectors such as medical devices, mobile objects, invasive devices, and HCW clothing and accessories, which may also contribute to patient colonization and/or infection. While previous studies have shown that indications for hand hygiene occur between 8 per hour in pediatric wards and 30 per hour in ICUs,[21,22] we found that IRMs occurred with a frequency of 42.8 IRM per active care hour overall and up to 56.3 IRM per active care hour in emergency settings. Similar to opportunities for hand hygiene, the high frequency with which IRMs occur suggests that the cumulative risk of negative patient outcomes due to IRMs may be significant, although the risk of patient infection or colonization with multiresistant pathogens at any single IRM may be low. The fact that 25.8% of IRMs concerned moments of potential pathogen transfer to critical patient sites further highlights the clinical relevance of IRM for infection prevention.

The structured observations in this study were targeted to moments resulting in potential pathogen transfer to the patient, as opposed to movement of pathogens around the larger healthcare environment. Our exploratory observations nonetheless revealed that pathogen transfer from outside to inside the patient zone likely occurred, for example when coming from one patient to silence an alarm on another patient's monitor without hand hygiene, or when transporting mobile objects that come into contact with multiple consecutive patients during clinical rounds. These findings are

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table 2. Inventory and Observed Frequency of All Infectious Risk Moments per Care Setting by (A) Critical Site and (B) Noncritical Site

Source		Pathway		Endpoint	All	ICU	MED	ER
A. Infectious Risk Moments Involving Transfer to Critical Patient Sites								
Environment	→	Gloves	→	Critical site	99	36	35	14
Medical device	→	Gloves	→	Critical site	46	28	3	1
Mobile object	→	Gloves	→	Critical site	20	14	3	2
Patient intact skin	→	Gloves	→	Critical site	17	8	3	5
Healthcare worker	→	Gloves	→	Critical site	15	11	1	0
Invasive device	→	Gloves	→	Critical site	1	0	0	0
Other patient	→	Gloves	→	Critical site	1	1	0	0
Environment	→	Hands	→	Critical site	41	17	12	4
Medical device	→	Hands	→	Critical site	24	12	3	1
Healthcare worker	→	Hands	→	Critical site	5	2	1	0
Mobile object	→	Hands	→	Critical site	4	1	3	0
Patient intact skin	→	Hands	→	Critical site	2	0	0	0
Invasive device	→	Hands	→	Critical site	1	0	1	0
Gloves	→	Invasive device	→	Critical site	19	14	2	0
Patient intact skin	→	Invasive device	→	Critical site	13	4	1	8
Environment	→	Invasive device	→	Critical site	12	8	1	1
Healthcare worker	→	Invasive device	→	Critical site	4	1	0	0
Hands	→	Invasive device	→	Critical site	3	3	0	0
Patient critical site	→	Invasive device	→	Critical site	1	1	0	0
Gloves	→	Medical device	→	Critical site	3	0	1	2
Hands	→	Medical device	→	Critical site	1	1	0	0
Unknown status	→	Medical device	→	Critical site	1	0	1	0
Environment	→	Mobile object	→	Critical site	4	1	1	0
Patient critical site	→	Mobile object	→	Critical site	4	0	0	0
Gloves	→	Mobile object	→	Critical site	1	0	1	1
Hands	→	Mobile object	→	Critical site	1	0	0	2
Patient intact skin	→	Mobile object	→	Critical site	1	1	0	0
Unknown status	→	Mobile object	→	Critical site	1	2	2	0

table 2. *Continued*

Source		Pathway		Endpoint	All	ICU	MED	ER
B. Infectious Risk Moments Involving Transfer to Noncritical Patient Sites								
Environment	→	Gloves	→	Noncritical site	97	26	24	27
Medical device	→	Gloves	→	Noncritical site	61	9	3	14
Mobile object	→	Gloves	→	Noncritical site	45	8	10	10
Patient intact skin	→	Gloves	→	Noncritical site	17	7	1	4
Healthcare worker	→	Gloves	→	Noncritical site	15	4	1	4
Patient critical site	→	Gloves	→	Noncritical site	9	1	4	3
Invasive device	→	Gloves	→	Noncritical site	1	1	0	0
Environment	→	Hands	→	Noncritical site	229	34	91	90
Mobile object	→	Hands	→	Noncritical site	92	16	33	38
Medical device	→	Hands	→	Noncritical site	77	21	22	24
Healthcare worker	→	Hands	→	Noncritical site	68	9	40	13
Patient intact skin	→	Hands	→	Noncritical site	17	6	4	5
Other patient	→	Hands	→	Noncritical site	2	0	2	0
Exterior	→	Hands	→	Non-critical site	1	0	1	0
Patient critical site	→	Hands	→	Noncritical site	1	1	0	0
Unknown status	→	Hands	→	Noncritical site	1	0	1	0
Unknown status	→	HCW	→	Noncritical site	13	5	1	3
Patient intact skin	→	HCW	→	Noncritical site	2	2	0	0
Unknown status	→	Medical device	→	Noncritical site	81	0	0	1
Healthcare worker	→	Medical device	→	Noncritical site	13	2	0	1
Hands	→	Medical device	→	Noncritical site	3	0	0	1
Gloves	→	Medical device	→	Noncritical site	1	2	0	1
Patient intact skin	→	Medical device	→	Noncritical site	1	0	1	0
Unknown status	→	Mobile object	→	Noncritical site	43	1	0	0
Environment	→	Mobile object	→	Noncritical site	17	1	2	0
Healthcare worker	→	Mobile object	→	Noncritical site	6	0	0	1

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TABLE 2. *Continued*

Source		Pathway		Endpoint	All	ICU	MED	ER
Patient intact skin	→	Mobile object	→	Noncritical site	4	0	0	0
Gloves	→	Mobile object	→	Noncritical site	2	1	0	0
Medical device	→	Mobile object	→	Noncritical site	2	0	6	0
Patient critical site	→	Mobile object	→	Noncritical site	1	4	0	0
Environment	→	Gloves	→	Patient bed	7	0	0	5
Medical device	→	Gloves	→	Patient bed	5	0	0	0
Healthcare worker	→	Gloves	→	Patient bed	1	0	0	0
Environment	→	Hands	→	Patient bed	18	3	8	7
Healthcare worker	→	Hands	→	Patient bed	5	1	2	0
Medical device	→	Hands	→	Patient bed	5	3	0	2
Mobile object	→	Hands	→	Patient bed	3	0	2	1
Environment	→	Invasive device	→	Patient bed	1	1	0	0
Unknown status	→	Medical device	→	Patient bed	7	9	26	42
Healthcare worker	→	Medical device	→	Patient bed	1	2	1	9
Unknown status	→	Mobile object	→	Patient bed	10	6	12	18
Environment	→	Mobile object	→	Patient bed	5	5	5	0

NOTE. ICU, intensive care unit; MED, general medical ward; ER, emergency ward; HCW, healthcare worker.

consistent with other studies demonstrating that HCW hand hygiene compliance prior to initial contact with the patient or the patient environment is suboptimal.[23] Our results also challenge the "patient zone" concept, which defines the patient and his/her immediate surroundings (eg, bed rails, bedside table, and medical equipment) and frequently touched surfaces (eg, monitors, knobs, and buttons) as the patient zone and assumes that surfaces within the patient zone are colonized by patient flora.[19] When disinfection is omitted prior to contact with the patient or patient environment,[23] it is likely that pathogens from the healthcare environment are introduced to these surfaces. Such ambiguity is a major challenge to safe behavior.[24] For this reason, during observations, we considered that environmental surfaces could potentially harbor pathogenic bacteria regardless of their location inside or outside of the patient zone.

Similarly, our findings are consistent with multiple systematic reviews demonstrating that the frequent movement of healthcare equipment[25] and care items[14] between patients, together with suboptimal or missing disinfection of such items, result in the transfer of pathogens between patients. Potential contamination or missing disinfection of medical devices and mobile objects (classified as source = "unknown status" and source detail = "no disinfection observed") accounted for 16.2% of IRMs observed in this study (Table 2).

The transmission-based observational approach employed in this study, which sought to identify all behaviors potentially resulting in transmission pathogen, differs from traditional rule-based observations that measure compliance with existing local or national guidelines. Observations using the INFORM taxonomy could hence be employed in additional settings, regardless of local guidelines, to identify the most frequently occurring IRMs and to establish local infection prevention priorities.

This study has several limitations. It is possible that being observed influenced HCW behavior during this study.[26] It is unlikely, however, that this resulted in systematic bias because HCWs were not aware of exactly what was being observed. Observations were limited to contact transmission (ie, the most common mode of transmission[5]) and did not consider airborne and droplet transmission. Furthermore, our observations did not consider other behaviors that may also impact infectious risks, such as those interfering with the patient's defense system against infectious risks (eg, immune status, skin integrity, cough reflex, etc) because the associated HCW behavior rarely occurs at the bedside. Moreover, these observations were conducted in a single university hospital located in a high-income setting, which limits the generalizability of our findings. Further exploration of the nature and frequency of IRMs using the INFORM structured observational taxonomy is warranted to assess local priorities for infection prevention efforts in additional care settings. Finally, the risk of transmission during each type of IRM remains unknown. We aimed to bridge this gap through a modified Delphi survey with an international panel of experts in infectious diseases, infection prevention and control, and microbiology, in which experts rated the likelihood of infectious outcomes (eg, colonization, infection) following archetypical IRM.[27]

Despite these limitations, the combination of methods employed in this study was well suited to identify a wide range of potential IRMs and to systematically observe their frequency and nature in multiple healthcare settings. The resulting mobile observation tool featuring the INFORM taxonomy of source, vector, and endpoint of pathogens was useful for the systematic documentation and categorization of IRMs. Further observations based on the INFORM taxonomy may prove useful in other settings to identify the most frequently occurring IRMs, to establish educational content, and to prioritize targeted infection prevention strategies.

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TABLE 3. Three Most Frequently Occurring Infectious Risk Moments (IRM) per Clinical Setting

Source and Setting	Vector	Endpoint	Frequency[a]	Density[b]
Intensive care unit				
Environment	Gloves	Critical site	36	3.51
Example: An HCW wearing gloves touches the trolley next to the patient's bed then, without changing gloves, verifies the patient's mechanical ventilator, the gloves come into contact with the patient's mouth.				
Environment	Hands	Noncritical site	34	3.31
Example: An HCW handles the paper charts (medical records) of a sedated patient then, without hand hygiene, proceeds to touch the intact skin on the patient's upper limbs.				
Medical devices	Gloves	Critical site	28	2.73
Example: An HCW wearing gloves manipulates the interface of an infusion pump to program the delivery rate then, without changing gloves, verifies the insertion site of a peripheral venous catheter.				
Medical ward				
Environment	Hands	Noncritical site	91	8.78
Example: After touching the environment outside of the patient's room, an HCW enters a patient's room and, without doing hand hygiene, shakes the patient's hand.				
Healthcare worker	Hands	Noncritical site	40	3.86
Example: An HCW stands with arms crossed, his hands come into contact with his white professional clothing then, without performing hand hygiene, proceeds to examine the patient, touching intact skin on the patient's stomach.				
Environment	Gloves	Critical site	35	3.38
Example: While changing a wound dressing, an HCW wearing gloves touches the surface and drawers of the trolley containing dressing materials, then with the same gloves make contact with the patient's open wound.				
Emergency ward				
Environment	Hands	Noncritical site	104	9.7
Example: After touching the environment outside of the patient's room, an HCW enters a patient's room and, without performing hand hygiene, shakes the patient's hand.				
Medical devices	Gloves	Noncritical site	49	4.62
Example: An HCW wearing gloves touches the electronic interface of an electrocardiography machine (ECG), whose disinfection had not been observed prior to using, then with the same gloves touches the patient's intact skin while applying the ECG nodes to the patient.				
Environment	Gloves	Noncritical site	47	4.43
Example: An HCW wearing gloves pulls closed the curtains that divide patient rooms, then, wearing the same gloves, touches the patient's upper limbs.				

NOTE. This table presents the 3 most frequently occurring main categories of infectious risk moments (IRMs) based on level 2 of the structured taxonomy.
[a]Number of times the IRM was observed in the indicated setting.
[b]Frequency per hour of active patient care in the indicated setting.

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SUPPLEMENTARY MATERIAL

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