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SOCIAL SERVICES, HEALTH AND SPORTS

ROLE OF NURSES IN PREVENTING AND CONTROLLING RISKS OF ACQUIRING HEALTHCARE-ASSOCIATED INFECTIONS FROM COMMON TOUCH SURFACES

An Instructional Video

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Abstract

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Abstract

Healthcare-associated infections (HAIs) are undesirable aftermath of medical examinations, treatments and patient care practices. Consequences of HAIs are multiple and include increased morbidity, mortality, treatment costs, prolonged treatment time and sometimes, permanent disability in the patient. HAIs are a global health issue for which the World Health Organization (WHO) indicated that 1 in 10 patients get infected while receiving care. In most of Asia's developing countries, there is lack of national surveillance on HAIs. Some countries in South-East Asian region either have total lack of IPC programmes or deficient plans. Prevalence of HAIs in the Asia-Pacific region is estimated to be 2–20 times higher than in developed countries, and affects about 25% of hospitalized patients. Reasons attributed to prevalence of HAIs include failure to adhere to basic aseptic practices in caring for and treating patients stemming from lack of proper knowledge, poor attitudes of healthcare workers (HCWs) toward infection prevention protocols and suboptimal availability of healthcare supplies which necessitates sharing of devices among patients.

This thesis was accomplished as a development work with the purpose of producing an educational video centered on preventing and controlling the risks of acquiring HAIs from common touch surfaces. The aim of the development work was to contribute to the development of Asian HEIs current nursing curriculum in HAIs prevention and control through the PrevInf project. This development work thesis focused on the roles of nurses in preventing and controlling HAIs from common touch surfaces. Common touch surfaces in healthcare settings include fixtures and fittings which form part of the built environment within which patients are cared for, and medical devices with which treatments or interventions are administered. An instructional video was produced using the OSVE tool to guide nursing students in protocols necessary for prevention of HAIs. The pilot-testing of this product was done with the international nursing students at Savonia University of Applied Sciences.

The instructional video produced in this development work was of very high-quality in terms of picture, sound, communication, language, subtitling and duration. The video supported the students' learning about preventing and controlling HAIs from common touch surfaces. The nursing instructions displayed in the video would help to eliminate HAIs when applied. Applicability of the product of this development work is universal. Asian HEIs would greatly benefit from this product in the development of their current nursing curriculum. Further research may focus on measures to boost healthcare workers' compliance with evidence-based guidelines to minimize or eradicate HAIs from common touch surfaces.

Keywords

Common touch surfaces, fomite, infection prevention and control (IPC), Healthcare-associated infections (HAIs), contamination, transmission, objective structured video examination (OSVE)

CONTENTS

1 INTRODUCTION

Infection prevention and control (IPC) refer to the consistent implementation of evidence-based practices aimed at avoiding or stopping occurrences of infections. The purpose of IPC in healthcare settings is to eliminate or minimize the risk of transmission of pathogenic microorganisms to healthcare workers (HCWs), patients and visitors. (World Health Organization 2021.) Patients in various healthcare settings have often had to grapple with unwanted and unexpected adverse health conditions, not as a sequela of the underlying conditions for which they got admitted for treatment, but as a result of pathogens, they got exposed to in the course of receiving treatment. This phenomenon is referred to as healthcare-associated infections (HAIs). (Sharpe & Schmidt 2011, 95.) HAIs are also designated as healthcare-acquired infections or nosocomial infections.

In Europe, HAIs incidences are high. Estimated annual occurrences of HAIs are over 4.5 million within the European Union, leading to about 37,000 deaths and extended hospitalization periods plus increased costs. (Zingg et al. 2015, 212.) Statistics from the World Health Organization (WHO) indicate that 1 in 10 patients get an infection while receiving care (World Health Organization 2021). Surgical site infection is frequently reported and constitutes about 20% of HAIs. Based on WHO estimations, about 32% of surgical patients get a post-operative infection. (World Health Organization 2021). The importance of HAIs is emphasized in a finding that on average, an individual patient is at risk of acquiring more than one HAIs during hospitalization. (Zarb et al. 2012, 1 & 5.) The Finnish Institute for Health and Welfare posits that approximately 100,000 HAIs occur annually in Finland, across hospitals, and in long-term care facilities, resulting in between 1,500 and 5,000 deaths (THL 2021). In most of Asia's developing countries, there is lack of national surveillance on HAIs (Ling, Apisarnthanarak & Madriaga 2015, 1690). Some countries in South-East Asian region either have total lack of IPC programmes or deficient plans (World Health Organization 2022, 98). Prevalence of HAIs in the Asia-Pacific region is estimated to be 2–20 times higher than in developed countries, and affects about 25% of hospitalized patients (Apisarnthanarak et al. 2017, S49). In most instances HAIs occur for reasons which include suboptimal immune response, exposure to an extensive number of virulent microorganisms and performance of invasive procedures. Also, patients contract a fraction of HAIs directly through contact with HCWs during care delivery. (Perry, Potter & Ostendorf 2014, 166.) The focus of this development work is on the nurse's role in preventing and controlling HAIs that result from human contact with healthcare devices and built surfaces in healthcare settings.

Touch surfaces belong to the environmental aspect of nursing care which connotes built surfaces and all devices used in patient care. These patient care devices whether classified as non-critical medical devices or critical medical devices, constitute part of the touch surfaces which studies have found to contribute to infection transmissions and antimicrobial resistance in healthcare settings. Additionally, biofilms that form and accumulate on surfaces of care devices also pose risks for HAIs. (Alfa 2019, A44; Wolfensberger et al. 2018, 1105; Uneke 2014, 22.) The protocols of hand hygiene and personal protective equipment among HCWs have been instituted across the globe to help win the fight against infection transmissions in the healthcare sector, in particular (CDC 2021; THL 2021; World Health Organization 2021).

The purpose of this development work is to produce an educational video centered on preventing and controlling the risks of acquiring HAIs from common touch surfaces. The aim of the development work is to contribute to the development of Asian HEIs current nursing curriculum in HAIs prevention and control through the PrevInf project. This development work is part of a project themed "Capacitating Asia's Nursing Students on Innovative and Sustainable Prevention and Control of Healthcare-associated Infections (PrevInf)". The work seeks to update and improve the curriculum of higher education institutions (HEIs) in Vietnam and Cambodia. To this end, an instructional video would be produced using the OSVE tool to help undergraduate nursing students gain an understanding of preventing and controlling HAIs from common touch surfaces. Ideas for innovative learning methods, which would contribute to sustainable and improved IPC strategies among nursing students, would be proffered in accordance with the PrevInf project objective of strengthening HAI prevention and control education (Silén-Lipponen, Koponen, Myllymäki & Korhonen 2021). The OSVE tool is a video-based teaching and learning method which integrates the benefits of simulation-based learning and helps to objectively assess the students' knowledge, skills and attitudes while enabling peer- and self-assessments as well as feedback (Raurell-Torredà et al. 2018, 10; Wikander & Bouchoucha 2018, 43; Selim & Dawood 2015, 92; Henderson et al. 2013, 1459).

2 ENVIRONMENTAL INFECTION RISKS TO PATIENTS AND PERSONNEL

The nursing environment consists of built structures, surroundings or conditions and devices within which and with which nursing work is done. The health of the environment affects everyone connected to it. Scientific evidence confirms that pathogenic microorganisms contaminate the nursing environment. As healthcare workers and patients are in regular contact with surfaces in the environment and with care devices, they inadvertently contribute to transmissions of HAIs by their hands and fomites. (Phan et al. 2019, S178; Muller et al. 2016, S447.) The environment plays a huge role in incubating and transmitting disease-causing agents thereby increasing morbidity and mortality in hospitalized patients, endangering healthcare workers and visitors to health institutions. Increases in morbidity, mortality and incidences of antimicrobial-resistant microorganisms in addition to patients' sufferings and care costs all demand strict adherence to IPC protocols in the healthcare sector. (Burnett 2018, 68; Chemaly et al. 2014, 80.)

2.1 Healthcare-associated infections

HAIs refer to infections originating in a hospital or other healthcare settings, which were not present nor incubating before the admission of the patient. HAIs usually present within 48 hours or more after admission into the healthcare setting or within 30 days after discharge. (Sikora & Zahra 2021; Revelas 2012, 59.) According to a point prevalence survey in the year 2016 by the government of the United Kingdom, it is estimated that over 4 million people contract HAIs in Europe annually, whereas about 37,000 lose their lives as a direct consequence (GOV.UK 2016). In the USA, HAIs affect nearly 1.7 million patients yearly across different hospitals (Magill et al. 2014, 1199).

HAIs aggravate the already challenged health conditions of hospitalized patients and residents living in long-term care facilities or nursing homes (Uchida et al. 2013, 2). HAIs leave in their wake severe health concerns such as pneumonia, bacteremia, diarrhea, surgical site, urinary tract and gastrointestinal infections, inflammation, and a host of other disease conditions. Patient care devices were observed to contribute over 25% of HAIs. (Magill et al. 2014, 1201 & 1206.) Microorganisms that cause HAIs also mutate and result in antimicrobial resistance mechanisms by which treatments are rendered ineffective. (Burnett 2018, 69; Magill et al. 2014, 1204.) The Centre for Disease Control (CDC) listed 20 common sources of HAIs which include bacteria, fungi and viruses. Of the different species of bacteria, some migrate from their original habitats (soil and water) to care units where critically ill patients are treated. Others relate to the natural human microbiota and colonization, which may become active and infectious through direct contact with broken skin. Fungi have been noted to cause invasive infections in hospitalized persons. By the same token, some viruses emanating from healthcare settings have been found to not only invade the patients, but also the healthcare personnel. (CDC 2020.) HAIs have implications for additional distress to the patient, elongated hospital stays and increased treatment costs (ECDC 2021).

2.2 Chain of infection and risk factors for HAIs

Chain of infection refers to the 6 sequential events that would occur for infection transmission to be successful. These interlinked events that would facilitate the occurrence of an infection begin first from the existence of a pathogen or infectious agent. Secondly, availability of a conducive

environment or reservoir for the now existing infectious agent to thrive, which in the healthcare setting may be care devices, dirty surfaces colonized or infected people. Portal of exit is the third chain and refers to channels by which the pathogen leaves the reservoir. These could mean a splash of body fluids, aerosols or open wounds through which the infectious agent escapes the host's body. Having left the host, the infectious agent may by direct or indirect mode of transmission transfer to a suitable portal of entry which includes broken skin, tubes, catheters and other care devices. After successfully entering a susceptible individual (new hosts, who could be patients or HCWs) with sufficient pathogenic load to cause an infection then, a clinically relevant disease condition may ensue. (CDC 2012.) The interplay of pathogen, host and environment ultimately results in infection. Direct transmission occurs by one-on-one contact and by droplet spread. Indirect transmission can be by airborne, vehicles which include fomites and ingestible substances, and vectors whether biological or mechanical. (CDC 2012.) Figure 1 below illustrates the chain of infection with additional information on how the chain may be broken at any point in the course of the 6 sequential events.

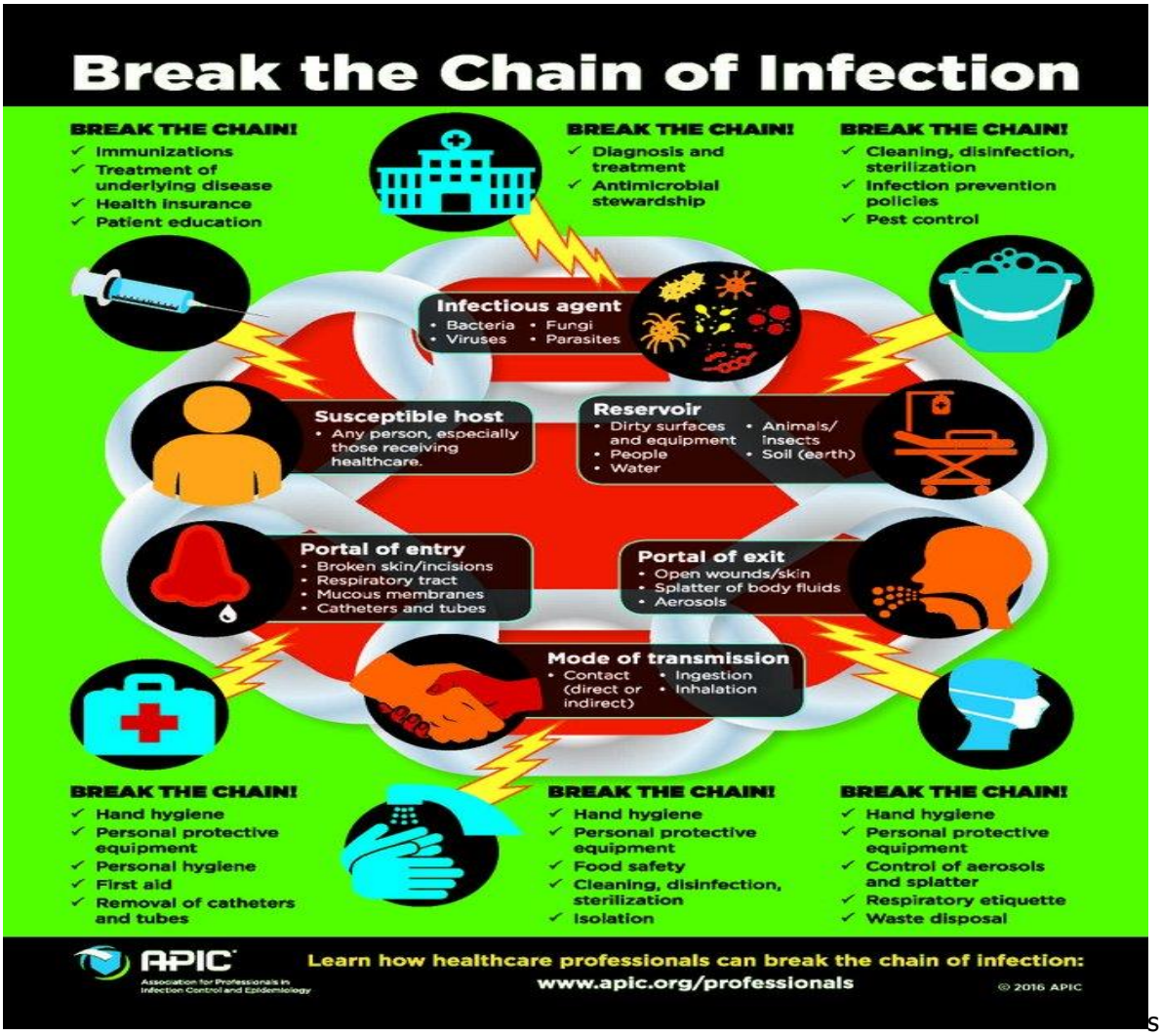

FIGURE 1. Breaking the chain of infection (APIC 2016, CC BY-SA)

Risk factors predisposing patients to contracting HAIs may be classified into intrinsic and extrinsic. Intrinsic factors refer to physiological attributes which make a person susceptible. Examples include age, level of immunity, comorbidities and medications in use, usually steroids and antibiotics. The age of a person is a nonmodifiable intrinsic factor. Neonates, children and the elderly may be more vulnerable to infections due to immunocompromised status. People with weak body defences may

be more predisposed to HAIs. The impaired immune response may result from underlying diseases, medications such as corticosteroids and lifestyle such as smoking. (Rodríguez-Acelas et al. 2017, 3; Wang et al. 2016, 204.)

Extrinsic risk factors for HAIs relate to human actions, devices used in care, and the environmental conditions of healthcare settings. It follows that treatment procedures, behaviours of healthcare providers and the environment within which care is given, all contribute directly to the prevalence of HAIs. These factors constitute both modes of transmission and the portal of entry in the chain of infection. Incidences of HAIs have been mostly associated with device use in healthcare and with invasive procedures. (Rodríguez-Acelas et al. 2017, 6.) HAIs often result from contact with inanimate items like medical devices and built surfaces which are frequently touched. These become prone to contamination and thus contribute to the risks of HAIs. (Kanamori et al. 2017, 1412.) The prevalence of HAIs are also related to complex and invasive procedures. Devices like catheters which pass through soft tissues, mechanical ventilators and nasogastric tubes that come in contact with mucosal membranes increase the risk of HAIs, especially among immunocompromised persons. (Sydnor & Perl 2011, 144.)

2.3 Infection risks from environmental surfaces

Zhao et al. (2012, 1) modeled two routes of fomite-mediated virus transmission as droplet-contaminated-fomite route and the hand-contaminated-fomite route. In the former, the surfaces near an infected person are contaminated by the settlement of large droplets from that person while in the latter, the infected person deposits the pathogen on the surrounding surfaces through touch with contaminated hands. It has been demonstrated that common touch surfaces in the environment play important roles in infection transmission. Frequently touched surfaces become prone to contamination and thus contribute to risks of HAIs. (Cobrado et al. 2017, 2053; Kanamori, Rutala & Weber 2017, 1412; Dancer 2014, 666.) Scientific evidence has proven that environmental surfaces contribute significantly to the incubation and transmission of HAIs in healthcare settings (Weber, Anderson & Rutala 2013, 338). Certain species of pathogenic microorganisms thrive on dry surfaces after falling off their hosts' bodies. When touch surfaces become contaminated, they pose risks of infection to susceptible individuals that may contact them. (Kraay et al. 2021, 1230; Zhang et al. 2018, 9; Otter et al. 2011, 696.) Spores produced by bacteria, especially bacillus and clostridium, are able to withstand unfavourable environmental conditions after dropping off from an infected host's body. Also, viruses and fungi from colonized and infected persons in hospital environments contaminate common touch surfaces, which HCWs and patients frequently come in contact with. (Dancer 2014, 666; Otter et al. 2011, 688.) A study by Nseir et al. (2011, 1204) aimed at determining the risk of contracting multidrug-resistant Gram-negative bacteria (MDR-GNB) from hospital rooms previously occupied by critically ill patients. This study found the occupation of a room by a carrier of specific bacteria as an independent risk factor for transmission of the same bacteria to subsequent occupants of the room. This finding was corroborated by the works of other researchers who also found multi-drug resistant pathogens, norovirus and clostridium difficile to persist and remain infective on environmental surfaces. (Dancer 2014, 666; Weber et al. 2013, 339; Desai et al. 2011, 221).

Opportunities for pathogenic transfers between persons have been observed in shared spaces in nursing homes. Common touch surfaces and devices were found to be reservoirs for microorganisms that may contribute to HAIs. (Gontjes et al. 2020, 6.) Viruses responsible for severe acute respiratory syndrome and Middle East respiratory syndrome were noted to remain viable on common surfaces, having the ability to infect anyone that touches the contaminated surfaces (Warnes et al. 2015, 2). Severe acute respiratory syndrome coronavirus has been detected on different environmental surfaces and found to remain infective over different time frames, ranging from 5 minutes to 7 days (Chin et al. 2020, e10). A study by Huang et al. (2021, 1) found a direct relationship between environmental contamination of public areas and positive anal swabs taken from patients asymptomatically infected with Covid-19. Results of another study indicated that MRSA, which is mainly a HAI, was found on surfaces in high schools, exposing the students to a greater risk of MRSA infection (Ibrahim et al. 2018, 197). The risk of infection transmission through contact with touch surfaces has also been demonstrated across other institutions of learning, from daycares to universities, and in public locations. Playgrounds, toys, countertops, door handles, elevator buttons, sinks and light switches were found to be contaminated and to constitute active fomites. (Scott 2013, 1089-1090.)

The Centers for Disease Control and Prevention, CDC, estimates that annually clostridium difficile causes up to 500,000 infections in the United States out of which 1% of the infected people aged 65 die within a month. This bacteria is found in the environment and more commonly in healthcare settings, where it easily spreads from one person to another. (CDC 2022.) Following an evidence-based practice initiative, it was found that high-touch surfaces namely bedside tables, bed rails, telephones, television and nurse call remote controls in the patient's environment have high potential to be imbued with clostridium difficile bacteria (Nielsen, Sanchez-Vargas & Perez 2019, 482). Prior antibiotic treatment has implications for infections of viral and bacterial origins in the community. Likely communal infections arising from antibiotic treatments include respiratory infections and diarrhea, and quite rarely, meningitis. (Malik et al. 2018, 294.) Antimicrobial toxicities have the potential to cause an outbreak of HAIs and subsequent spread of infections in the community (Effah et al. 2021, 14). In determining the relationship between HAIs and community-acquired infections, the result of a 6-year study of clostridium dificile in the Finnish population found approximately 68% of the cases in the community to be of healthcare origin (Kotila et al. 2016, 1748).

Candida auris, a multi-drug resistant pathogen, has been found to thrive on hospital surfaces and be transmitted around the environment, often leading to outbreaks. Candida auris persists in the environment for protracted time periods, facilitating its transmissions in healthcare settings. (Eyre et al. 2018, 1330.) Varona-Barquin et al. (2017, 70) conducted a study to determine surface contamination in emergency ambulances and observed 73% microbial growth on the door handles, steering wheels and stretchers. A review by Obenza et al. (2022, 44) concluded that disease-causing microorganisms were present within the ambulance compartments where patients were treated, and also across different surfaces within the ambulance.

Human papilloma virus (HPV) is commonly known as a sexually transmitted disease which causes most cervical cancers. The HPV deoxyribonucleic acid (DNA) was found on hospital surfaces both in

wet and dry environments during a study that sought to determine the transferability of this disease via fomites. The study concluded that HPV survival rates on environmental surfaces was high with an infectivity duration of about 7 days. (Ding et al. 2011, 148-151.) Similarly, toilet seats in a clinic and in some airports in 13 countries including Finland were found to have HPV DNA. The suspected primary sources of contamination of these surfaces were human genitals through the hands of HPV-positive persons. (Liu, Rashid & Nyitray 2016, 1.)

Most authors that have researched fomite transmission route of HAIs and other infections presented a general consensus about the cogency of the possibility of susceptible individuals contracting these infections, including respiratory viruses, from contaminated surfaces (Duval et al. 2022, 6-10; Ribaric et al. 2022, 16-17; Huang et al. 2021, 1). However, there was a dissent that considered this possibility exaggerated, especially for a severe acute respiratory virus, namely SARS-CoV 2. This notwithstanding, conceded that fomite transmission of the virus could occur but with negligible level of incidence. (Goldman 2020, 892-893.)

2.4 Patient care devices as fomites for healthcare-associated infections transmittal

Fomites are inanimate objects that are capable of harboring and transferring pathogenic organisms from one person to another. The availability of fomites and infectious agents in healthcare settings represents a huge risk for infection transmission. (Akinbobola et al. 2022, 755.) Devices used in patient care have been identified as sources, reservoirs and vehicles for the transmission of HAIs. For example, respiratory care devices have been identified in pneumonia outbreaks through inhalation of pathogens when oxygen or medications were administered. Whereas thermometers, stethoscopes and ultrasound probes are associated with the high significance of HAI incidences via contact. (Kanamori, Rutala & Weber 2017, 1413.) Surgical marking pens used to mark incision sites after sterilization of the proposed skin area for surgery were found to be contaminated by staphylococcus species which may give rise to surgical site infections (Ridley et al. 2018, 1). Blood pressure cuffs, telemetry leads and call buttons were shown to be contaminated by micro-organisms in the course of patient care (Risteen et al. 2018, 324). Also of note is that fabrics used in patient care such as protective wear, bandages, pressure garments and hygiene textiles have been implicated in the spread of HAIs. (Akinbobola et al. 2022, 755).

Viral and bacterial pathogens can be directly transmitted between persons via aerosols when coughing, talking or sneezing. These can also be transmitted indirectly, that is fomite transmission, when droplets are deposited on contact surfaces and subsequently acquired by a susceptible individual. (Jones & Brosseau 2015, 505.) Fomite transmission has also been implicated in many infection scenarios outside of healthcare settings. Workplaces have been identified as venues that may facilitate fomite transmission of infectious pathogens, especially respiratory and gastrointestinal infections (Hovi et al. 2015, 8). Shared areas and work equipment such as desks, phones, computer mouse and keyboards have been associated with contamination resulting in infections and cross-infections of people at work (Zivich et al. 2018, 448). The coronavirus designated as SAR-CoV-2 has been noted to remain infective on surfaces for up to 28 days. This is suggestive of infection risk from common touch surfaces (fomite transmission) such as patient care devices and environmental surfaces. The viability of deposits of viral agent on surfaces made of glass, paper, polymer and

stainless steel has also been noted. (Riddell et al. 2020, 3.) HPV DNA has been found on laser plumes, gloves and other medical instruments (Ding et al. 2011, 148-151). Another study sought to determine if HPV could be found on sonography probes and if barrier method and disinfection could prevent contamination of the probes. It was found that 7.5% of the probe samples tested positive for HPV before disinfection out of which 21% remained contaminated after disinfection. HPV had earlier been found on instrument handles, examination beds and in the patients' washrooms. Furthermore, sterilized medical devices which were hitherto used on HPV-positive patients still had HPV DNA of uncertified infectivity. (Ma et al. 2013, 1 & 3.) It may be possible for HPV DNA to be transmitted to patients' upper respiratory tract mucosa during procedures that require use of the laryngoscope or endotracheal tube. In a study that sought to determine infectivity of HCWs from HPV positive patients during procedures, the oral mucosa specimens from patients that previously tested negative to HPV turned positive after procedures involving laryngoscope or endotracheal tube. (Ilmarinen et al. 2012, 2370.)

Surfaces and items made of cloth, plastic, laminate and stainless steel have been found to incubate microorganisms. These microorganisms transfer between surfaces and human skin. (Kraay et al. 2021, 1230; Wißmann et al. 2021, 28 & Ren et al. 2020, 1397.) Common touch surfaces may inadvertently become reservoirs for pathogens to incubate in their dormant state while mundane human activities of touch may potentiate transmissions of infections through the fomite route. Device and built environmental surfaces may be contaminated by touch from contaminated hands, droplet settlement or airborne deposition of pathogenic particles. Unsuspectingly, hands may touch these already corrupted or impure surfaces and become contaminated. The hands that are contaminated in this manner may inoculate the mucous membrane, inadvertently creating conditions for infection to thrive as well as transferring the infection to other persons and locations. (Zhang et al. 2018, 2.) Modes of transmission are illustrated in figure 2 below.

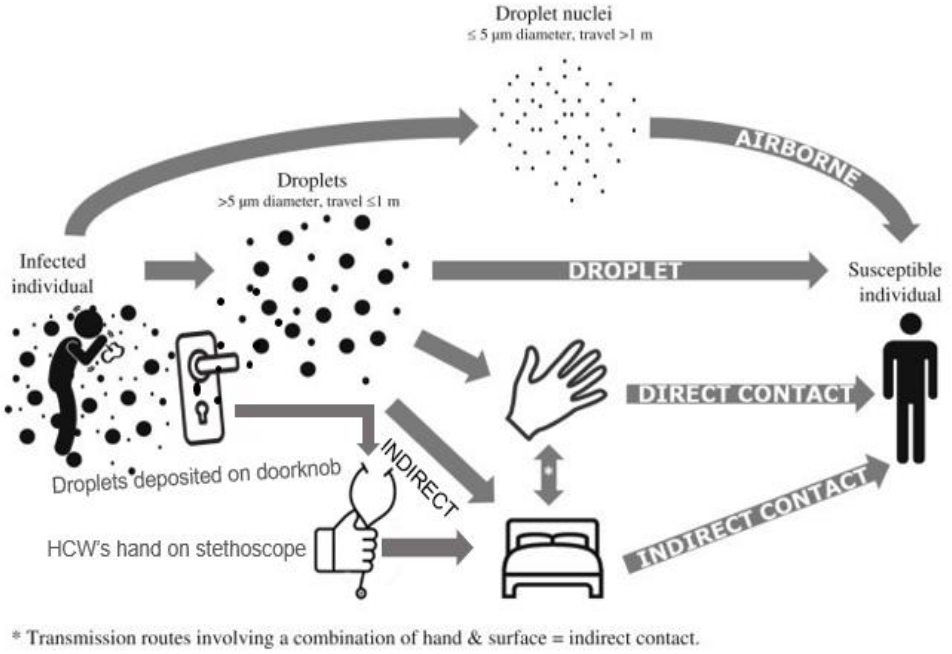

FIGURE 2. Direct and indirect droplet infection transmission routes (Modified from Otter et al. 2016, 236)

Contact surfaces in healthcare facilities play critical roles in the transmission of HAIs. Touching contaminated surfaces and devices with bare or gloved hands has the likelihood of transferring infections from one person or location to another, similar to direct contact with an infected person. (Weber et al. 2013, 338). Some pathogens have been identified as fomite-mediated causes of HAIs and antimicrobial or multidrug resistance, MDR (CDC 2021). These are listed in the table below.

TABLE 1. Fomite-assisted infective microorganisms in healthcare settings (CDC 2021; Kritsotakis & Groves-Kozhageldiyeva 2020, 553; Caceres et al. 2019 111; Otter et al. 2016, 245; Bitler et al. 2013, 1563)

Pathogen	**Effects**	**Transmission mode**
Acinetobacter baumannii	Infections are wound, blood, lungs and urinary tract, MDR	Directly and indirectly by contact with contaminated surfaces and equipment
Burkholderia cepacia	Immunodeficiency or chronic lung disease hospitalized patients	Directly and indirectly via contaminated surfaces
Candida auris	Severe invasive infections in hospitalized patients, MDR	Directly and indirectly via care devices such as ventilator tubes, feeding tubes and central venous catheters
Clostridioides difficile (C. difficile)	Colon inflammation, causing healthcare-associated diarrhea and fever	Directly via contact with an infected person and indirectly by touching contaminated surfaces
Enterobacterales (Esherichia coli (E. coli) and Klebsiella pneumoniae)	Antibiotic resistance, especially to carbapenem, produce extended-spectrum beta-lactamase (ESBL), and the mortality rate is up to 50%.	Directly and indirectly via HCW's hands and by contact with contaminated medical equipment and devices
Influenza	Respiratory symptoms, fever, chills, sore throat, fatigue, aches, cystic fibrosis	Inhalation of aerosols and direct contact with an infected person and indirectly from large droplets on touch surfaces
Norovirus	Inflammation of the viscera leads to diarrhea, vomiting and general unwellness, the outcome could be fatal	Directly by oral-fecal routes and indirectly from deposits on touch surfaces
Pseudomonas aeruginosa	Infections in blood and lungs contaminate care devices such as catheters and ventilators.	Directly from contaminated hands of HCWs and patients and indirectly from environmental surfaces and care equipment like ventilators and catheters
MRSA and VRE	Pimples and boils, pneumonia, infections including surgical site, bloodstream and urinary tract	Directly between persons and indirectly via contact with contaminated surfaces and care equipment

2.5 Healthcare Workers as unintentional vectors of infection transmissions in healthcare settings

Across the globe, HAIs continue to pose a major threat to life and wellness irrespective of the level of HCWs compliance with hand hygiene (Greene et al. 2018, 624). This observed discrepancy accounts for the role of fomites in infection transmission with the healthcare worker being in the middle, always being exposed to a certain amount of contamination coming from the patient and surface contamination, examples of which include the bed rails, care devices and countertops. The

environment and HCWs assume important roles in the transmission of HAIs in healthcare settings. (Greene et al. 2018, 620-624.) Evidence shows that white coats worn by some HCWs serve as fomites, transferring infectious agents, including multidrug-resistant organisms around the healthcare environment (Sajdeya et al. 2022, 364-365).

HAIs resulting from multidrug-resistant gram-negative bacteria (MDR-GNB) represent a major cause of morbidity and mortality due to growing antimicrobial resistance. Being a HCW is a risk factor among many for up to 100% hand contamination by GNB in the course of caregiving. GNB species may survive on the hands of HCWs for many hours. (Tacconelli et al. 2014, 7.) Respiratory pathogens may survive on hands for an extended period of time (Julian et al. 2013, 732). Pathogen transfer rate from surfaces to hands was successful with E. coli, Salmonella spp., S. aureus and reached the rate of 90% with candida albicans. It has also been noted that compliance with hand hygiene protocol is more adhered to in connection with patient contact than with contact with surfaces. Contaminated hands re-contaminate environmental surfaces. (Kramer & Assadian 2014, 9.) C. difficile spores have been found on HCW's hand after touching the patient's bed rails or call buttons. These spores were nearly the same as those found after examining the patient's common skin sites. HCWs' hands may serve as vectors for transferring the germs acquired from the common touch surfaces in a given patient's vicinity to other locations. (Guerrero et al. 2012, 557.)

MRSA is an important community and HAI pathogen. Its transmission and cross-contamination have been observed in many studies. HCWs' articles of clothing were found to play significant roles contributing to pathogenic transfers in healthcare facilities. (Lena, Ishak, Karageorgos & Tsioutis 2021, 8.) Alfarawi et al. (2019, 1600) emphasized that identification badges of HCWs could harbour considerable amounts of pathogens which in turn are transmitted to the environment and patients. Of utmost recognition is the presence of coagulase-negative bacteria on the identification badges, cards and lanyards. Coat sleeves and pagers of resident practitioners yielded positive cultures of MRSA, suggesting that HCWs' clothing is a potential reservoir and vector of HAIs (Arora et al. 2020, 5). MRSA colonization of HCWs may be a veritable source of transmission to patients (Papasterigiou & Tsiouli 2018, 4). Other risk factors apart from MSRA exist for the persistence of multidrug-resistant pathogens and their transmission within the healthcare environment. Acinetobacter baumannii bacteria were found to contaminate the environment secondary to contamination of protective gowns and gloves donned by HCWs and transmitted in approximately one out of three interactions with colonized patients, which also has implications for fomite transmission. (Morgan et al. 2012, 5-7).

In addition to clothing and identification items of HCWs, it has also been observed that non-critical medical devices (NCMDs), for example, stethoscopes, mobile phones and other digital gadgets used in patient care, were contaminated with antimicrobial-resistant pathogens such as MRSA and gram-negative rods. These contaminations have often resulted in patient infections. (Haun, Hooper-Lane & Safdar 2016, 1368.) NCMDs have a high potential for contamination as they are usually shared amongst different patients and are not necessarily considered unhygienic unless they are visibly dirty. This practice, even in routine non-outbreak situations, likely contributes to HAIs. (Livshiz-Riven wt al. 2015, 391.) A study conducted in India about infections originating from NCMDs posited that

half of all HAIs emanate from NCMDS (Deorukhar & Saini 2016, 1). An analysis of repeated point-prevalence survey in Canada found that medical devices accounted for approximately 36% of HAIS. This further supports the need for effectual approaches to reducing HAIs associated with NCMDs and touch surfaces. (Mitchell et al. 2019, E985.) Earpieces, bells and diaphragm of stethoscopes have been associated with different microorganisms that cause HAIs. The earpieces were found to be contaminated by HCWs' own resident flora which may potentially become pathogenic. The bell and diaphragm used on patients were also found to be contaminated and in some cases, with gram-negative microorganisms due to contact with patients' flora. (Peters et al. 2022, 2; Thapa & Sapkota 2017, 4.)

Further to the inadvertent spread of potential pathogens within the healthcare facility, touch patterns of HCWs with fomites in their environment and self-contact during patient care moments have been noted to be of interest in the control of HAIs. In the course of an HCW-patient encounter, HCWs were observed to frequently contact bedside tables, bed surfaces, bedrails, intravenous poles and computer stations, thereby risking contracting and spreading potential pathogens as they also touch their faces sometimes. This behaviour may present risks for respiratory viruses. (Phan et al. 2019. S178-S184.) Respiratory pathogens on the outer surface of face masks which HCWs use may be also a potential source of self-inoculation of respiratory viruses and subsequently, environmental contaminations. Crystallization of this risk may be associated with the length of time the mask was in use and the number of patients the HCW attended to. (Chughtai et al. 2019, 5-8.) Similarly, doctors' gloves have been implicated in the contamination of treatment rooms with HPV DNA (Liu, Rashid & Nyitray 2016, 1).

3 NURSES' ROLES IN REDUCING HEALTHCARE-ASSOCIATED INFECTIONS FROM TOUCH SURFACES

According to the International Council of Nurses (ICN), the nursing code of ethics stipulates the nurse's basic responsibilities to include the promotion and restoration of health, prevention of illness and alleviation of suffering (Stievano & Tschudin 2019, 155; ICN 2012, 2). Nonmaleficence, the main principle of nursing ethics, seeks to ensure patient and community safety in the course of healthcare delivery with no intentional harm (Yildiz 2019, 1129; McDermott-Levy et al. 2018, 478). It follows that while the nurse may not deliberately cause harm to patients and the environment, extra efforts should be levied on creating and maintaining disease-free environments in the course of discharging one's duty as a healthcare worker. Nurses have a duty to maintain the health service environment for patients' well-being and to promote recovery from illnesses (Mccauley & Hayes 2021, 720). The benefit of a healthy environment extends to the nurses and other HCWs because they are also faced with the risk of exposure to infectious materials and may therefrom contract infections as they deliver care (Perry, Potter & Ostendorf 2014, 166). In reference to Florence Nightingale's Environmental Theory, Gilber (2020, 628-629) opined that the hygienic of the nursing environment has a direct bearing on comprehensive patient care and impacts morbidity and mortality of people within the environment.

3.1 The need to reappraise the healthcare environment

The healthcare environmental surfaces include built touchable items, fixtures, moveable articles or furniture and patient care devices such as those classified as invasive or critical and non-critical medical devices. These touchable and moveable items in the healthcare environment make up the common touch surfaces or the so-called high-touch sources. The nomenclature derives from how often people in the healthcare settings namely HCWs and patients touch these surfaces. (Porrit, Marin & Pamaiahgari 2022.) The role of the healthcare environment in facilitating infection transmission cannot be over-emphasized. Humans frequently shed pathogens which repeatedly contaminate the environment. Mutating strains of pathogens can survive on floors, equipment of care and therefrom pose infection risks. (Dancer 2014, 666.) One of the modalities by which HAIs result is the human or patient's own microbiome. For example, the commensal existence of staphylococcus aureus on intact, colonized human skin may become a systemic infection when the skin is broken and infection occurs (Gobinath et al. 2022, 1). A hospitalized patient's microbiome may be altered due to infectious agents in the hospital which may be transferred to the patient through HCW's hands or contact with the hospital environment (Peters et al. 2022, 2). Being admitted to a hospital room that accommodated a patient colonized or infected with an MDR organism presents an increased risk for the subsequent patient to acquire the same pathogen, irrespective of hand hygiene protocols (Mitchell, Dancer, Anderson & Dehn 2015, 212). According to Otter et al. (2011, 688), infected or colonized patients have a suitable enough concentration of transmissible contamination. Mitchell et al. (2015, 215) further observed that both Gram-positive bacteria and GNB can remain infective on dry inanimate surfaces for periods of up to 16 months under favourable conditions. Not only are dry surfaces implicated, but moist surfaces like the sink have also been observed to incubate and transmit GNB (Ling & How 2013, 146).

Many studies have established that contaminated surfaces are important for the transmission of HAIs, especially for MRSA, Acinetobacter baumannii, norovirus, C. difficile, VRE and some respiratory viruses. These pathogens are able to thrive on surfaces for extended periods. (Suleyman et al. 2018, 12; Otter et al. 2016, 247; Coulliette et al. 2013, 2153; Otter et al. 2011, 689.) The built environmental surfaces of healthcare including fittings and fixtures within the environment, and patient care devices have been scientifically proven to constitute avenues for the incubation and spread of HAIs, contaminating and cross-contaminating HCWs' hands, attires and devices, as well as patients and other players within healthcare settings. (Rawlinson, Ciric & Cloutman-Greene 2019, 370; Montoya et al. 2018, 701; Inkinen et al. 2016, 20). Poor environmental hygiene status has the potential to cause HAIs among HCWs and patients in healthcare settings. Hospital wards, work surfaces, door handles, medication trays, beds and patient care items have been found to have the highest isolates in terms of the pathogens swabbed from the environment. (Tagoe & Desbordes 2012, 23.)

Environmental hygiene depends on human inputs and technicalities employed in cleaning and disinfection. Improving the cleanliness of the healthcare environment may reduce incidences of HAIs in favour of positive patient outcomes. In reappraising the healthcare environment, efforts should be channelled towards maintaining surface integrity, proper management of water, air, waste, laundry, device reprocessing and sterilization procedures. (Peters et al. 2022, 2.) Environmental surface cleaning and disinfection minimize the risk of infection transmission and should be bundled with hand hygiene for effective prevention and control of HAIs (Porrit, Marin & Pamaiahgari 2022). Institutional and clinical management have the responsibility to reappraise the healthcare environment and determine policies that would be beneficial to minimizing HAIs. An adequate workforce and training on HAIs prevention and control methods would result in the knowledge and capacity of HCWs to apply evidence-based practice and guidelines in the institutions. (Sai Sivapuram 2021.)

3.2 Minimizing transmission of HAIs among hospitalized patients

The lofty goal of preventing all HAIs may not be realistic (Bearman, Doll, Cooper & Stevens 2019, 2). However, efforts channelled at reducing infections from healthcare facilities might yield significant improvements in transmission occurrences. Schreiber et al. (2018, 1277) opined that the preventable proportion of HAIs may decrease as care standards improve. Based on the conclusion of their study, a conservative figure of 35% of HAIs would be preventable with effective surveillance and control programs. Cleaning and decontamination of environmental surfaces in healthcare settings are essential for IPC (Dancer & Kramer 2019, e3). It may be possible that available science on IPC can potentially deliver up to 70% prevention of HAIs, if all HCWs abide by evidence-based guidelines regarding infection prevention. Additionally, the nonmaleficence principle in nursing ethics should underscore interventions to reduce HAIs and motivate HCWs towards achievement of reduced incidences of HAIs. Ultimately the focus is achieving full prevention of the preventable proportion of HAIs. (Bearman, Doll, Cooper & Stevens 2019, 6.)

Varied methodologies, programs and instrumentation have been developed and launched to control infections. Apart from efforts geared towards infection prevention, early detection and proper preparation may assist in containing the spread of infections and forestalling outbreaks. Innovative

technologies for 'non-touch' disinfection may be combined with improved housekeeping to reduce surface contamination (Dancer & King 2021, 17-18).

Behavioural change among HCWs is considered a major need in order to win the fight against HAIs. Wrong attitudes of HCWs toward evidence-based hygiene protocols are a huge barrier to IPC success. Poor attitudes may perhaps be corrected by appropriate training programs. (Jackson, Lowton & Griffiths 2014, 400 & 407.) Patient empowerment may be considered an additional boost to IPC. Patients knowing they have the right to ask or demand that HCWs disinfect equipment and perform hand hygiene before contact might improve IPC outcomes (Davis, Parand, Pinto & Buetow 2015, 159).

Appointment of infection prevention champions or infection control link nurses in every ward could help lessen the burden of the risks HAIs in hospital wards and other healthcare settings, including long-term care facilities. The champion is charged with the responsibility to liaise with the IPC team of the institution and create awareness of behaviours that favour the prevention of HAIs among the staff in the ward. The champion notes deviations from best practices in line with the policies of the institution and facilitates staff implementation of IPC behaviours. The champion should be adequately equipped through requisite trainings to train the ward staff and ensure compliance with proven guidelines for infection control. The champion directs the handling of patient care devices and ensures the cleanliness of the patient environment. (Dekker et al. 2019, 1-3; Peter et al. 2018, 217.)

3.3 Environmental cleaning and disinfection of patient areas

Cleaning and disinfection are crucial interventions to lessen hospital contamination risks. Effective cleaning, which contributes to reducing environmental infection of high-touch surfaces, should be consistently designed in IPC guidelines and training programs, especially during the pandemic. Most microbes such as norovirus, MRSA and C. difficile grow in dirty, humid and warm conditions. As they grow, they effortlessly infect built surfaces and surfaces of medical and non-medical equipment. Therefore, disinfection cleaning becomes a prerequisite to control microbial growth. In healthcare facilities, disinfection cleaning should be strictly and routinely performed to achieve a healthy environment. (Dancer 2011, 1473-1474.)

Detergent- and disinfectant-based cleaning is fundamental to a clean and infection-free environment. Inadequate cleaning procedures or delayed cleaning implementation may reintroduce contamination situations. (Dancer 2014, 375-385.) Developing evidence-based guidelines for routine cleaning is a way to minimize disease-causing agents in the environment and thus limit HAIs. Dancer and Kramer (2019, e2-e5) recommended four methodical steps to clean the hospital environment in order that no item or area is missed: look, plan, clean and dry. 'Look' suggests a conscious survey of the area be cleaned so as to appreciate spots that may require more intense attention. 'Plan' refers to pre-cleaning processes including hand hygiene and donning of personal protective equipment, repositioning of furniture and equipment to make for better access. 'Clean' is the systematic and physical process by which dirt and microorganisms may be removed from surfaces. Common touch surfaces are a priority during cleaning. Disinfection should be done after thorough

cleaning and in accordance with the manufacturer's instructions. 'Dry' completes the cleaning process. Cleaning fluids may be wiped dry with clean wipes or towels while disinfectants should be allowed to air-dry in order to achieve successful cleaning intervention.

Comprehensive elimination of pathogens is roughly impractical. However, frequent and efficient cleaning will remarkably reduce infection risks. As a result of unmet demands in terms of time, costs and personnel in healthcare facilities, unit managers may not be inclined to prioritize cleaning. On the other hand, these limiting resources pale in comparison to costs incurred in treating HAIs. It, therefore, becomes imperative to maximize scarce resources by giving worthy consideration to the standard of cleaning in clinical settings. (Dancer 2011, 1475.)

3.4 Improving nurses' knowledge, attitudes and practice for effective infection control

Healthcare is multidisciplinary teamwork. However, nurses have the most number and duration of contacts with patients. This naturally disposes them to champion the IPC cause as they are central to patient management, from basic care to observation and monitoring, as well as the implementation of prescribed interventions. (Blot et al. 2022, 2.) Nurses as patient advocates may also become IPC champions to ensure other team members act responsibly and follow evidence-based HAIs prevention guidelines. Recommendations for the prevention of HAIs from common touch surfaces include personnel education, environmental cleaning and disinfection, use of dedicated equipment, contact precaution, hand hygiene, cohorting and decolonization therapy. (Abad, Barker & Safdar 2020, 2; Upshaw-Owens & Bailey 2012, 80.) Education connotes training and re-training to inform and remind HCWs to conform to practices aimed at preventing or minimizing HAIs emanating from all sources, including common touch surfaces. HCWs can avail themselves of checklists to enable them to assess the effectiveness of cleaning interventions (Cobrado et al. 2017, 2056). Environmental cleaning and disinfection refer to the implementation of an applicable evidence-based approach in consideration of positive ecological impact and proven capacity to control the spread of infections. The use of dedicated equipment for the specific patient room(s) would undoubtedly minimize cross-contamination. Decolonization therapy is a useful intervention targeted at reducing illnesses and deaths resulting from MRSA infections. Decolonization therapy involves use designated antimicrobial solutions for nasal ointment, body or denture wash. This procedure should not be undertaken frequently as it may expose the patient to further infection risk. (Tacconelli et al. 2019, 808.) Cohorting is a practice by which patients that are colonized or infected by the same pathogens are grouped together and cared for separately from the rest patients in a healthcare setting. Cohorting is beneficial in limiting further pathogenic transmissions to the uninfected populations because it presupposes the availability of dedicated personnel for the cohort groups. This strategy is, however, challenged by the dearth of staff in healthcare settings. (Abad, Barker & Safdar 2020, 2.)

The possibility of medical equipment becoming a reservoir for infectious agents during the treatment period has been established. In a study to determine environmental surface contamination in public health settings, it was found that physicians' personal belongings, books and patient care tools were contaminated with the SARS-CoV-2 RNA virus (Vicente et al. 2021, 5). To lessen infection risks, it is important to comply with decontamination procedures from healthcare management to the rest team members. Nursing management should instruct and supervise cleaning and disinfection in line

with evidence-based guidelines. Even though environmental service workers mainly undertake cleaning and decontaminating tasks in healthcare settings, a team of nurses and other HCWs should have an oversight function in ensuring compliance with set standards. (Wigglesworth 2019, 1).

Having established the infectivity of pathogens on medical devices, HCWs should always, as a rule, clean and disinfect care devices prior to and post use, and in accordance with the manufacturer's instructions. More intense cleaning and disinfection should be done in event of equipment contact with body fluids. Contact surfaces of built structures and fixtures should be frequently decontaminated in accordance with facility protocol. (Cobrado et al. 2017, 2056-2057.)

Nurses also play the role of patients' advocates, communicators and educators. This role entails teaching and informing patients about routes of infection transmission and ways to break the infection chain in order to prevent infections. Nurses need to develop good interpersonal and communication skills to be able to brilliantly execute these roles. Nurses are required to prepare up-to-date and evidence-based knowledge and competencies about IPC. The relevance of top management awareness and support for successful IPC strategies cannot be underestimated. (Burnett 2018, 71.)

According to Jansson, Kääriäinen & Kyngäs (2013, 207) nurses' knowledge, adherence to and attitudes toward evidence-based guidelines for preventing ventilator-associated pneumonia are low. Educational interventions such as repeated lectures, self-study modules, group discussions, visual presentations, examinations, direct feedback and reinforcements may significantly improve nurses' knowledge levels and quality of care resulting in the prevention and control of HAIs. The impact would be positive clinical outcomes, lessened hospitalizations and associated treatment costs. (Jansson, Kääriäinen & Kyngäs 2013, 212.) To further elaborate on the need to assess nurses' knowledge and practice of HAIs prevention and control, a study comprised of employed nurses and nursing students found among the subjects an adequate level of knowledge about the prevention and control of HAIs without a corresponding level of practice (Nasiri et al. 2019, 832). Nurses require education and training to become able to adopt and apply standard and transmission-based precautions. Standard precautions refer to basic infection prevention practices that should be adhered to in healthcare settings irrespective of the patient's infection status. (Burnett 2018, 70-71; Storr et al. 2017, 5-10; Loveday et al. 2014, s3-s4.) Components of standard precaution are hand hygiene, personal protective equipment, respiratory hygiene, sharps safety, safe injection practices, sterile instruments and devices, clean and disinfected environmental surfaces. Transmission-based precautions supplement standard precautions in disease situations that may be transmissible through contact, droplet or airborne routes. (CDC 2018.)

It might be of benefit to periodically assess the knowledge of nursing students regarding the prevention and control of HAIs with a view to ingraining an aptitude for compliance with infection control protocols, even ahead of full employment in the healthcare sector. This is of particular importance because nursing students could be at risk of contracting and spreading HAIs as they partake in patient care and participate in invasive procedures during internships. (Brosio et al. 2017, 1.) It has been observed that gaps exist between knowledge and practices of infection prevention and control among nurses. Significant knowledge and practice deficits were found among nurses in a paediatric unit regarding central venous catheter care. (Ullman, Long & Rickard 2014, 202.) To

bridge these gaps, educational interventions coupled with the organisation of a leadership team for infection control could be considered to foster a culture of safety that would improve nurses' knowledge and practices towards controlling HAIs. (Ullman, Long & Rickard 2014, 206.) Education modules should be bundled with checklists to guide the operations of HCWs with a view to controlling HAIs (World Health Organization 2016).

A study by Yazie, Sharew and Abebe (2019, 5) reported low scores for HCWs' knowledge, attitudes and practice for infection control. In the study, only 55% of the participants observed hand hygiene protocol after patient contact or handling medical substances. Subsequently, a very low number of those used proper personal protective equipment during potential exposures. The findings from Yohannes (2019, 11) also showed similar results as only 15% of the sampled HCWs complied with IPC guidelines. These outcomes suggest that healthcare institutions need to provide appropriate and adequate number of personal protective equipment as well as training to ensure compliance. These outcomes portray knowledge deficits and therefore, training programs on IPC should be organized to create awareness and enhance staff compliance with best practice guidelines for improved safety of patients, staff and visitors to the healthcare units. Particularly, areas of IPC that deal mainly with preventing and controlling HAIs should form the modules of the training. The modules should include hand hygiene, personal protective equipment and safe handling of patient care devices and waste. It is highly recommended that these trainings are organized periodically followed by observation of the HCWs' performances. It is important that HCWs are committed to the guidelines of IPC for patient safety. HCWs' awareness and implementation of IPC evidence-based guidelines can be enhanced by regular and comprehensive learning programs. (Yazie, Sharew & Abebe 2019, 5.)

The essence of IPC training programs is to improve the safety of patients, staff and visitors to healthcare institutions. HAIs can be minimized when HCWs and patients perform their roles successfully. On the patients' part, awareness can be created through pamphlets and posters that outline their rights and responsibilities towards IPC in healthcare settings. For HCWs, programs or courses that emphasize IPC guidelines should be launched early in the nursing schools to prepare nursing students to apply evidence-based practices in clinical settings from internships to proper work life after graduation. Onsite or online lectures and simulation-based sessions or videos with assessments and reflections are recommended to provide the students with knowledge and enhance their awareness and attitudes relating to IPC. The learning programs should be introduced early in the nursing studies with the teachers, supervisors and experienced HCWs playing the role of mentors, whom the undergraduates would look up to become empowered nurses that will fight against HAIs from the present to their future careers. Developing HCWs' awareness of the requirements for the prevention and control of HAIs would positively impact their attitudes toward their practices thereby limiting the risks of acquiring HAIs and improving patient safety. (Ibrahim & Elshafie 2016, 509.)

In the fight against HAIs, priority should be given to developing a total educational package for quality improvements in infection prevention, particularly from patient care devices and touch surfaces. Awareness should be created about adherence in comparison to HAIs incidence rates, risk factors, outcomes and pathogenesis. The modality for surveillance and prevention should be defined with care bundles and checklists mapped out. The implementation process should include point-of-

care education, practice monitoring and stewardship, closely followed by performance measurements to determine how well the educational guidelines have been followed by the healthcare practitioners, and the extent of goal achievement. (Blot et al. 2022, 9-10.)

Total educational package for HCWs workers should include aspects of personal grooming for effective prevention and control of HAIs. Hands are effectively decontaminated when the wrist and hands are free of jewelry. Also fingernails should be short and without polishes and external or artificial nail fixing. Sustained cuts or abrasions on hands should be covered with waterproof dressings. Except otherwise warranted, the HCWs' clothing or work uniform should be short-sleeved. (Loveday et al. 2014, S3.)

4 EFFECTIVENESS OF INSTRUCTIONAL VIDEO IN NURSING EDUCATION

Healthcare students obtain theoretical lectures in contact classes, which may be remarkably different from real cases in hospitals or other clinical settings (Ajani & Moez 2011, 3927). Therefore, practical learning is one of the main considerations that support nursing students to acquire clinical skills and techniques before entering real-life situations. Simulations of clinical skills help to bridge the gap between theoretical knowledge and clinical realities. (Mahmoud 2014, 5083.) A study by Hustad et al. (2019, 1) showed that training by simulations produces effective results. Simulations help students to learn and improve clinical skills, acquire practical experiences, and boost self-confidence in nursing education. Nursing students also begin to recognize the importance of multidisciplinary teamwork through joint simulation scenarios. Kelly et al. (2020, 11) also emphasized the effectiveness of applying simulation-based education in filling the gap between theoretical knowledge and actual skills in healthcare training. Therefore, simulation is considered an effective method of teaching and learning in nursing programs (Ross et al. 2022, 41-42; Haddeland, Slettebø & Fossum 2021, 5-7; Hustad et al. 2019, 3-7).

Currently, it can be argued that students are more technologically skillful due to blended learning which combines technological pedagogical efforts with basic learning methods. Blended learning incorporates audio-visual methods, internet-based materials, and traditional classroom teaching methods. As an audio-visual method, video is an effective and widely accepted approach to refresh and strengthen nursing students' knowledge in many ways, either in contact or remote training. With audio-visual elements, educational videos successfully promote the students' comprehension. (Salina et al. 2012, 68, 72-73.) Additionally, audio-visuals empower the students to learn at own pace. This creates convenience as the resource is readily available. The flexibility that audio-visual resources provide to nursing students lowers attrition and enhances interest in learning. (Krautscheid et al. 2022, 463.) One of the efficient and cost-effective simulation methods for teaching and assessment of nursing students is the objective structured video examination (OSVE).

OSVE is an assessment tool that uses computerized educational videos to determine healthcare students' knowledge and understanding of any health-related phenomenon or case study. OSVE uses predetermined questions which are designed close to real-life scenarios to test students' assimilation of the cases featured in the video after the students have watched the video. OSVE challenges the student's ability to critique the illustrated health situations and to respond objectively. This characteristic feature of OSVE as an assessment tool makes it an efficient and reliable tool for teaching and testing students' knowledge, observation skills and clinical competence. (Baribeau et al. 2012, e242.) This characteristic attribute of OSVE also lends validity and reliability by the use of internal consistency through homogenous, predetermined questions and model answers to the subject of the video examination. OSVE judges the student's cognition, analysis and memory abilities based on the scenarios played out in the video. Assessment of students' performances via OSVE is considered a functional method of examination although some students may regard it as stressful and time-consuming. In testing the reliability, all the students are graded in accordance with the model answers, through which their strengths and weaknesses in relation to the subject of the video are observed. (Selim & Dawood 2015, 87-93; Baribeau et al. 2012, e249.)

OSVE has been remarkably appraised by students because it involves a broad knowledge range and practical clinical skills. A combination of sounds and images attracts high attention from students. In addition, the features of playing, pausing, and repeating satisfy the individual needs of healthcare students. (Selim & Dawood 2015, 87-88; Salina et al. 2012, 72-73.) A study by Ikegami at al. (2017, 75) concluded that in comparison to paper-based learning, video-based learning affects students' memories more positively, helping them recall clinical skills while practicing. Video-based learning also heightens the students' imagination of the particular clinical situation and helps to improve their clinical reasoning ability (Ikegami at al. 2017, 74). Video-based learning generally improves the students' skills at gathering information from the featured case. This in turn helps the students to learn to pay close attention to details. Video-based learning improves students' abilities at considering the patient from a holistic perspective. (Nunohara et al. 2020, 8-9.)

In addition, Coyne et al. (2018, 100) found that incorporating videos into lessons highly generated positive feedback from students. In the United Kingdom, OSVE was adopted as an examination tool in partial fulfillment of requirements for a Bachelor of Medicine during neurology examination. The students watched the videos first and answered the questions based on the video at the end of each clip. This method proved to be an accurate tool to examine students' communication abilities with patients, and their awareness and understanding of the presented case. (Watson et al. 2016, 2-4.) Basic requirements for OSVE include good sound, high-definition quality images, clear instructions, and good structure. Nevertheless, some negative feedback from the students regarding OSVE included examination stress and lack of adequate time to execute the examination (Selim & Dawood 2015, 93).

Simulated audio-visual resources in a blended learning environment provide students with considerable opportunities to observe and reflect on their knowledge (Coyne et al. 2018, 99). The OSVE video produced in this development work is akin to simulation video with the added advantage of questions included to test the students' knowledge and understanding of the instructional video. The participants in Coyne's research gave positive feedback that the availability of videos at all hours also allowed them review access at any time, according to each student's convenience. The possibility of playing the videos repeatedly facilitates the connection between students and the teaching materials. Therefore, convenience is a great feature of electronic materials in nursing education. Online audio-visual resource promotes quality learning and sets the stage for knowledge sharing which enhances learning activities and international research (Kelly et al. 2020, 16). Moreover, the effectiveness of using pauses and reflective questions within the video is acknowledged by students as influencing their engagement in the video. (Coyne et al. 2018, 99.) Irrespective of the viewer's learning abilities and situation, instructional videos provide independence, flexibility and control to the viewer (Mahon & Crotty 2020, 7). Audio-visual resources in blended learning situations activate the nursing students' clinical judgment that makes for safe and quality decisions in real patient care scenarios (Kelly et al. 2020, 11).

Features of a good learning video includes the length or duration which should not exceed 5 minutes. Appropriate length of a learning video helps the students to remain focused and not drift away in their efforts to concentrate on the import of the video. This also empowers the students to

process the information accurately. (Nunohara et al. 2020, 8.) Video-based learning enhances the students' attention span and promotes efficiency while reducing cognitive overload. Instructional videos are considered very useful for acquiring nursing skills, as they facilitate the optical depiction of clinical care scenarios, enabling students to establish and advance clinical competencies and critical thinking ability. Accessibility of instructional videos via hand-held devices like mobile phones and tablets makes for quick reach, provides instant information to the students, especially in the light of contemporary advancements in information and communication technology. The quality of an instructional video in the nursing field is a very important consideration. Quality refers to the accuracy of information and procedures in line with evidence-based guidelines and practices in the nursing profession. The video quality is further enhanced by being realistic and having subtitles that tie the actions and narratives together, allowing the students to concentrate solely on important information. (Forbes et al. 2016, 53-55.)

5 IMPLEMENTATION OF THE DEVELOPMENT WORK

5.1 Purpose and aim

The purpose of this development work is to produce an educational video centered on preventing and controlling the risks of acquiring HAIs from common touch surfaces. The aim of the development work is to contribute to the development of Asian HEIs current nursing curriculum in HAIs prevention and control through the PrevInf project.

5.2 Implementation

This development work started from ideation to design, and to implementation, and climaxed at evaluation. Implementation of this development work was in Savonia University of Applied Sciences (Savonia UAS) in three phases. The first phase was the search for relevant literature on the subject of preventing and controlling HAIs from touch surfaces in healthcare settings. This formed the basis for the theoretical part, the scriptwriting for the production of the instructional video and the composition of the posters embedded within the video. The second phase consisted of consultations for casting, camera and permissions for use of the Simulation Centre as well as the video shooting and editing. The third phase included pilot-testing the instructional OSVE video, processing of feedback and evaluating the extent to which the instructional video satisfied the purpose of this development work.

There was a need to produce an instructional video on the prevention and control of HAIs for the development of Asian HEIs current nursing curriculum because Asian healthcare systems have been experiencing an increasing prevalence of HAIs. (Silén-Lipponen, Koponen, Myllymäki & Korhonen 2021.) Given that the development work thesis is geared towards workplace development to enhance communication and improve processes (Liikanen et al. 2013, 21), the authors based this development work on existing evidence, thereby ensuring its relevance to working life. Essentially, through this development work thesis, a reusable learning object has been produced which is evidence- and current practice-based, accessible with an internet connection and educating to the viewer (Mahon & Crotty 2020, 6).

5.3 Scope, planning and data collection

This development work thesis was delimited to focus on preventing and controlling HAIs that emanate from common touch surfaces which comprises built environment and patient care devices in healthcare settings. The plan for this development work thesis was to gather knowledge from the existing body of literary academic works that relate to the subject of HAIs from touch surfaces or fomites. The selected works included systematic reviews and evidence-based guidelines from relevant databases. The information gathered therefrom was used in the theoretical aspect and video production. The databases from which information was sourced include JBI, Cinahl, PubMed, EBSCOhost, Google Scholar and books. Google Scholar was particularly helpful in some instances where access to some studies was restricted or otherwise inaccessible. The searches were delimited to the English language and the time range between 2011 to 2022. Abstracts, introductions, methods, discussions and conclusions of the selected studies were read to determine their relevance and

acceptability to the development work. Studies that failed to meet the earlier stated parameters were excluded.

The keywords used in the database searches included "common touch surfaces", "fomite", "infection prevention and control", "healthcare-associated infections", "patient care devices", "contamination", "transmission", "role of nurses", "video learning", "objective structured video examination", "OSVE". Permutations were done with other known synonyms for HAIs such as nosocomial, hospital-acquired, using Boolean operators. Further searches were executed with keywords and phrases such as "medical devices", "NCMDs", "HCWs" and "high-touch surfaces". Findings were strictly selected based on relevance, and subsequently interpreted. The skills and know-how required of the authors of this development work were gained through previous studies and the course work on Research, Development and Innovation in Social and Health Care (Savonia University of Applied Sciences 2022a) and other study modules on infection prevention and control (Savonia University of Applied Sciences 2022b). Mendeley reference management was used to add references to the work and subsequently the citations were modified in accordance with the Savonia UAS thesis template (Gerrish 2015, 103).

5.4 Instructional video production process flow

The processes of production of the instructional video were grouped into three distinct phases namely: pre-production, production and post-production (Mahon & Crotty 2020, 7). The pre-production phase of the work entailed the planning, scriptwriting, location arrangements, equipment, casting, and shot listing (Wells & Rockwood 2019, 312). In the planning phase, the requirements for making a good learning video were researched and the salient points were noted (Mahon & Crotty 2020, 8). The video script was written in line with the thesis topic and purpose of the development work, allotting timing for every action. The script was presented to the thesis supervisors for their inputs. Amendments to the script were made as necessary and supervisors' approval was obtained to proceed to video shooting. Prior to the shooting, the nurse educators at the Simulation Centre of Savonia UAS were contacted and discussions regarding the use of the venue were had. The shooting locations and relevant nursing tools and equipment for the video were obtained through liaison with the nurse educators. For the casting, only two actors were required, namely the patient and the nurse. Directing and actual filming of the video was also decided at this stage.

During the production phase, the video shooting and still shots were undertaken. The actual videoshoot also entailed making sure that other users of the location were aware of the shooting to avoid data protection breaches. It also required that the director created a friendly atmosphere in order to ease off tension from the actors while eliciting the best possible performance through repeated actions and reviews. (Mahon & Crotty 2020, 8-9.) The video was shot at the Simulation Centre of Savonia UAS, Kuopio. The two authors of this thesis took up roles as follows: the first author directed and videotaped while the second author acted as the nurse. Another nursing student played the patient's role. The various scenes were shot multiple times from different angles to get the best shots for the instructional video. During the shooting, the videoed scenes were viewed and reviewed by the parties – the role players and the videographer cum director. Modifications to the set, actions, timing, and camera settings were made as deemed necessary to bring about high quality

video production. The thesis supervisors ascertained congruence of the video with the purpose of the development work by watching the video prior to the post-production processes.

Post-production was the phase when all the works were put together with every necessary effect to produce a high-quality instructional video (Mahon & Crotty 2020, 9). During the post-production of this video, the logos of Savonia UAS and those of the associated partners to the development work were added to the title page of the video wherein also the purpose of the development work and the authors' request for the adjoining video-based questions to be answered were stated. The scenes captured during production were edited and the mellow soundtrack was added. Captions and subtitles were also added to clarify the content and structure for easy assimilation (Mahon & Crotty 2020, 10). Acknowledgement of the parties to the development work was noted at the end of video.

The final output was watched by the thesis supervisors and found to be correctly sequenced and in sync with the stated purpose. The video was also watched and confirmed by two other nursing teachers in addition to the named supervisors who were also team members of the PrevInf project. Similarly, the 12-question video-based quiz was considered appropriate and insightful by the supervisors and teachers. The instructional video was approved to be pilot-tested by two international nursing student groups in Savonia UAS, Kuopio. The last phase was the evaluation of the performance of the nursing students in the anonymous video-based quiz. The nursing students' performance during the pilot test indicated the extent to which the instructional video satisfied the purpose of this development work. Analysis of the anonymous feedback survey from nursing students measured the nursing students' satisfaction with the development work product as an instructional and learning video.

5.5 The pilot test and feedback on the instructional video

The instructional video produced in this development work with the Webropol video-based quiz and feedback survey were piloted in early October 2022 to the designated Savonia UAS nursing student groups – final year and third year. An email containing three hyperlinks each for the OSVE instructional video, 12-question video-based quiz and the feedback survey was sent to the two groups informing them of this development work thesis and its purpose. The students were requested to kindly watch the video, attempt the knowledge test and complete the feedback survey. The deadline set for completion of the pilot test was in late October 2022. Prior to the deadline, two reminders were sent to boost participation.

The video script and video-based quiz were included in the Appendix to this report. The objectives of the pilot test were to develop the OSVE design and to reach the learning outcomes of preventing and controlling infection risks from common touch surfaces among nursing students. The duration of the video averaged 5 minutes. The students watched the video and answered the quiz related to the content via the links provided. In the video, microbes on common touch surfaces were animated to attract the viewer's attention to possible existence of pathogens on surfaces. The video captured the importance of hand disinfection after contact with common touch surfaces. It captured how the nurse should attentively observe hand hygiene, clean and disinfect the work desks, phones, computers and accessories. The video provided clear instructions on handling NCMDs and demonstrated the

nurses' role in mitigating HAIs by cleaning and disinfecting patient care devices before and after attending to a patient. The video also highlighted that fixtures such as door handles in the built environment could be reservoirs for pathogens, for which reason hands should be disinfected after contact. Proper disinfection of the medication dispensing trolley and tray was also demonstrated. These instructions when applied would help to eliminate HAIs. Also portrayed in the video is the smart handling of HCW's identification or access card key lanyard. It hung snugly around the HCW's neck and was nicely tucked into the breast pocket to avoid interference with duties and contact with the patient's environment which occurrence may precipitate inadvertent contamination. Further to this, a proper demonstration of key access disinfection was depicted as well as desk and workstation at the beginning and end of the shift.

The questions developed based on the OSVE instructional video were to engage the nursing students' interests while improving their acuity as they watch and learn how to prevent and control HAIs from common touch surfaces. The quiz was created online on Webropol and made anonymous so that the privacy of participants was maintained and their responses irretraceable to them. All the questions had multiple-choice answers. Responses obtained from the test proved the viewers' assimilation of the nurse's role in HAI prevention and control. Answers were received from 11 students, in which only 1 student got lower than half of the correct answers. The rest students passed the quiz, with most of them performing very brilliantly.

By the same token, the feedback survey informed the achievement of the purpose of this development work thesis. It contained 8 questions, 7 of which were mandatory and designed according to the Likert scale (Sullivan & Artino 2013, 541), and the last one, an open-ended option for extra comments. The 7 questions were tailored to obtain nursing students' generalized perspective of the effectiveness of the OSVE method in supporting their learning (see Table 2). An anonymous survey was made to collect feedback voluntarily from the students. The students were guided to select alternatives that best matched the statements of their opinion, after watching the video and doing the video-based quiz.

TABLE 2. Summary of mandatory OSVE feedback received from the Webropol survey

Statements	**Completely agree**	**Agree**	**Neutral**	**Disagree**	**Completely disagree**
1. The OSVE video supports your learning about preventing and controlling healthcare-associated infections from common touch surfaces.	6	5	0	0	0
2. The duration of the video was appropriate for the topic.	5	5	1	0	0
3. The actions matched subtitles making it easy to understand the purpose of the video.	5	5	1	0	0
4. The video was easy to understand and supported your learning.	4	5	2	0	0
5. The quiz at the end of the video supported your learning.	2	7	2	0	0

6. After watching the video, it was easy to spot the correct answers in the quiz.	2	3	5	1	0
Question	**Excellent**	**Very good**	**Good**	**Fair**	**Poor**
7. What is your overall assessment of the video?	5	4	2	0	0

The video generally received positive feedback from all the students that participated in the pilot test. Three of the participants freely provided additional comments. One commented as follows, "It would have been nice as an instruction at the beginning of the video, that the viewer should look for mistakes that might happen in the video. Also, time to read the posters and first and last page was very minimal." The second comment read, "The video pictures and disinfection techniques that were demonstrated in there were easy to understand and can be practised by all healthcare workers." The last comment was "It would be nice if we can see feedback right after submitting the questionnaire."

All the nursing students that participated in the survey acknowledged that the OSVE video supported their learning about preventing and controlling HAIs from common touch surfaces. Most of the feedback on the video and OSVE method was positive. Regarding the ease of spotting correct answers after watching the video, there was a few neutrality and 1 disagreement. These values were considered reflective of the students' performances in the analysis of the video-based quiz as stated above. The video was adjudged to be supportive of reaching the students' learning goals.

6 DISCUSSION

6.1 Evaluation of the development work process and output

Development work is an approach which seeks to reform and transform practices of education and training through a combination of scientific inquiry, practical development work and expansive learning. It relies on concepts, their definitions and an understanding of their applicability. Studies that use the development work method are geared towards producing new or enhancing existing concepts to improve the working life context. (Teräs 2017, 25; Salonen 2013, 12.) HAIs are challenging problems militating against patients' safety. The continuing existence of HAIs begs for a commitment from every player in the healthcare sector for their prevention and control. (Di Paolo et al. 2019, 663.) This development work thesis is on the subject of the role of nurses in preventing and controlling HAIs from common touch surfaces in healthcare settings, with the objective of producing an instructional video that will empower nursing students in the fight against HAIs. The authors followed Savonia UAS thesis process guidelines in writing the theoretical aspect of this development work thesis (Savonia University of Applied Sciences 2022a). From the outset, the authors wrote a topic plan and obtained approval and subsequently the thesis work plan. The authors proceeded to write the script for the instructional video following approval of the work plan. The authors commenced the thesis report writing in accordance with the institution's guidelines and supervisors' confirmation. (Linden 2021.)

The output of this development work thesis is an instructional video that effectively demonstrated the nurse's role in containing HAIs that emanate from common touch surfaces. Important aspects of safe patient care such as prevention and control of HAIs may be better understood and adhered to by the parties involved in the care of patients when learning resources are available as written and videos (Clerkin et al. 2022, 9). According to the feedback from respondents to the survey of this development work, the instructional video supported their learning. Videos are veritable methods of teaching and instructing which enable the viewers to become proficient in clinical skills (Clerkin et al. 2022, 7). The importance of hand disinfection coupled with surface cleaning and disinfection in the prevention and control of HAIs from common touch surfaces and devices would continue to be emphasized.

The video demonstrated that gloves should be worn to create a barrier to pathogen transmission while saving the HCWs' hands from erosion that may arise from the chemicals embedded in the disinfectant wipes used on environmental surfaces and NCMDs disinfection. Hands should be disinfected before and after gloving. (Larese Filon et al. 2021, 1287; Wolfensberger et al. 2018, 11.) It has been established that touch surfaces in healthcare settings contribute to the prevalence and spread of HAIs (Montoya et al. 2018, 701; Inkinen et al. 2016, 20; Tagoe & Desbordes 2012, 23). The video featured how common touch surfaces in healthcare settings which include fittings, fixtures and other surfaces in the built environment and patient care devices should be disinfected as this is consistent with evidence-based practices for reducing and preventing incidences of HAIs (Dancer & Kramer 2019, e2-e5; Kanamori et al. 2017, 1412).

One of the novel learning points of this development work would be the proper handling of the stethoscopes while on patient rounds. As is usual with practical working life, in the video also, the stethoscope was placed around the nurse's neck. One of the supervisors of this thesis pointed out that the placement should be in the HCW's scrub pockets. In the pilot test, only two nursing students opted for the correctness of placing stethoscopes in pockets rather than around the neck. However, at the time of writing this thesis, the authors could not find any evidence-based practice guideline that recommended placement of stethoscopes in the pocket rather than around the neck (Thapa & Sapkota 2017, 5; Balapriya et al. 2016, 96). Many studies have considered the volume of HAIs associated with the use of stethoscopes in healthcare practices (Kanamori, Rutala & Weber 2017, 1413; Thapa & Sapkota 2017, 4; Haun, Hooper-Lane & Safdar 2016, 1368). A consensus recommendation regarding stethoscope handling in the light of IPC is its disinfection between patient uses combined with the use of a disposable barrier membrane (Kalra et al. 2021, 714; Grif Alspach 2014, 13-14; Zaghi et al. 2013, 1193).

Regarding hand hygiene which is one of the critical principles of prevention and control HAIs, this development work draws the target audience's attention beyond the stipulated 5 moments when HCWs should comply with hand disinfection (World Health Organization 2022; CDC 2019). From this work, the viewer of the instructional video also learns the need to disinfect hands after contact with environmental surfaces and NCMDs. This practice would bring about leverage in reducing or eliminating HAIs from healthcare settings as the fomite route of pathogen transmission may be reduced by a combination of hand hygiene and surface disinfection (Porrit, Marin & Pamaiahgari 2022; Abad, Barker & Safdar 2020, 2; Lei et al. 2020, 9-10; Upshaw-Owens & Bailey 2012, 80). Additionally, periodic training of HCWs with reminders of IPC protocols by way of posters and videos may help to improve compliance (Issa, Dunne & Dunne 2022, 26; Cobrado et al. 2017, 2056). The product of this development work included illustrative posters of common touch surfaces in healthcare settings on which heightened cleaning and disinfection attention should be focused in a bid to minimize HAIs.

This development work illustrated that preventing and controlling HAIs remain continuing and all-inclusive exercises which involve HCWs and patients. HCWs are liable to ensure every patient's safety by curbing the spread of infections in the healthcare settings (Yazie, Sharew & Abebe 2019, 5; Ibrahim & Elshafie 2016, 509). Patients also should be informed and encouraged to observe behaviours that would help to minimize pathogen transmission. Patient guidance demonstrated in the instructional video was aerosol and droplet containment. Viral and bacterial pathogens can be directly transmitted between persons via aerosols when coughing, talking or sneezing (Jones & Brosseau 2015, 505).

For the OSVE assessment, 12 questions were predetermined with model answers based on the role of nurses in preventing and controlling HAIs from common touch surfaces in healthcare settings as presented in the video. These questions sought to determine the nursing students' knowledge and understanding of the subject as well as to test their abilities to keenly observe whether the right actions were taken to promote IPC. (Selim & Dawood 2015, 87-93.) The OSVE proved to support the students' learning of the possibility of contracting infections from touch surfaces and ways to

prevent the occurrence. This was determined by the scores of the individual students on the questions that examined their cognition and observation on the subject area. Most of the students identified the lapses to avoid for prevention of HAIs from common touch surfaces and thus, passed the tests.

This development work thesis achieved its purpose of producing an educational video that is centered on preventing and controlling risks of acquiring HAIs from common touch surfaces. The OSVE tool enabled assessment of the achievement of the aim of the thesis based on the nursing students' performance in the video-based quiz. All of the participants in the pilot test agreed that the video supported their learning about preventing and controlling healthcare-associated infections from common touch surfaces. Most of the students agreed that the duration of the video was appropriate and that the actions in the video matched the subtitles. On the ease of understanding the video and the quiz supporting the students' learning, 9 students agreed but 2 remained neutral. Regarding ease of spotting correct answers after watching the video, 5 students agreed correct answers could be spotted with ease, whereas 5 remained neutral while only 1 disagreed. The overall assessment of the video fielded 5 students scoring the video "excellent" and 4, "very good" while 1 student scored the video "good". From these analyses, it is conclusive that the video supported the students' learning about preventing and controlling healthcare-associated infections from common touch surfaces.

In summary, the instructional video produced from this development work thesis was of excellent quality and duration, captivating the viewer's attention, while enabling processing ability. The picture had good screen resolution with high definition. The structure is compact for focused viewing with subtitles that enhanced clarity (Kuntaliitto 2020). The language is clear and concise. Even with the introduction and acknowledgment at the beginning and end of the video respectively, the duration was within 5 minutes with calming soundtrack (Nunohara et al. 2020, 8). The supervisors, teachers and students who watched the video attested to its quality and impact in learning about the subject of the development work.

6.2 Ethicality and reliability

The authors of this development work thesis followed scientific practices to make the work ethical and reliable. This work was based on Savonia UAS thesis process guidelines in line with the ethical principles of research as provided by the Finnish Advisory Board on Research Integrity, TENK. The principles of ethical review demand that participants are protected from potential risks, availed with sufficiently clear information regarding the research content and processing of their personal data, and that the significance of new information that would result from the research is weighed against any potential risks. (TENK 2019, 15-17.) The authors duly informed the participants of their rights in English language to make for mutual understanding and maintained their anonymity as well. Processing of personal data was not required in this work. The authors adhered to open science by availing the keywords and the databases used for the data collection, to preserve the data for future researchers. (TENK 2019, 30.)

Ethicality refers to engaging in research with the right standards of conduct, ensuring no harm comes to the participants. It entails respecting individual participant's privacy and ensuring

nondisclosure of confidential information. In the course of this development work, the consent of the participants was obtained on the basis of full disclosure of pertinent information while their privacy and confidentiality were respected. (Clark 2019, 394.) The participants were the authors of this development work and other nursing students of Savonia UAS who willingly indicated interest when requested to be a part of the video shoot. All the participants gave informed consent to play a role in the production of the instructional video. In the same vein, the nursing students who pilot-tested the development work and responded to the survey willingly did so. With respect to nursing ethics regarding research, the authors ensured a safe environment for all participants during the video shoot. The pilot test was executed remotely and participants' safety was ensured by launching the survey only within Savonia UAS' secure webropol survey and reporting system. (Tinnon, Masters & Butts 2017, 4.)

As much as possible, relevant peer-reviewed articles were accessed and utilized for this thesis report. Granted that the authors of those sources have expertise in the subject of the publications as it related to the topic of this thesis. Obtaining information mostly from peer-reviewed articles lent validity and reliability to this report. Plagiarism was checked by placing the work in a plagiarism detection system, to find out if any prior author's texts were cited without due acknowledgment (Arene 2019, 8; Isenburg et al. 2019, 2). In accordance with the institution's policy, the completed thesis report was authenticated by the Turnitin internet-based plagiarism surveillance system and authorship was confirmed to be of the writers (Arene 2019, 15). The instructional video produced in this development work thesis met the requirement for accessibility as it is subtitled with clarity and the video rolls with a mellow soundtrack, devoid of background noises (Kuntaliitto 2020). Finally, this thesis report would be published in the digital Theseus archive (The Finnish Theseus Archive. s.a.) to account for the openness requirement (TENK 2019, 30).

Development work involves two processes namely development work and research work. The latter uses the reliability analysis and methods of traditional research and science, while development work advances in accordance with its own defined processes and goals. (Kananen 2012, 162.) Development work research is not an independent study on its own rights. It is dependent on the specific development work to which it relates, and combines several research methodologies to develop a product or provide solutions to specific problems. This means that the reliability of the development work thesis is assessed based on the criteria of the methods used. (Kananen 2012, 166.) On the basis of the aforementioned characteristics of the development work thesis, the reliability of this development work was assessed on the theoretical basis of the literature search and the outcome of the instructional video which was a product developed to improve learning and adherence to preventing HAIs from touch surfaces. The authors ensured the reliability of the information sources and data collection processes so that the research can be reliable and of high quality (Kananen 2012, 162). To ensure high quality, the authors mainly used peer-reviewed works. The existing body of literature used for this work was critically appraised and found to corroborate the findings of each other and to be practical in healthcare settings (Gerrish 2015, 106). This means that if the literature search was reconducted using the same methodology, settings and conditions, similar results would be produced (Holloway & Galvin 2016, 304-305; Grossoehme 2014, 112). The authors of this development work thesis strictly followed these requirements. Keywords used in data collection from the

database searches were stated in section 5.3. Citations applied in the development work were current, spanning from the period 2011 to 2022. All referenced authors were duly acknowledged in the in-text citations and correctly written in the Reference section below.

Reliability of a development work derives from discovering a need and finding solution to that need for improvement of workplace practices (Pitkäranta 2014, 8). According to Kananen (2015), reliability of a development work research starts from the research process wherein a real problem is researched through appropriate data collection methods, synthesis of relevant literature and provision of reliable, evidence-based solution.

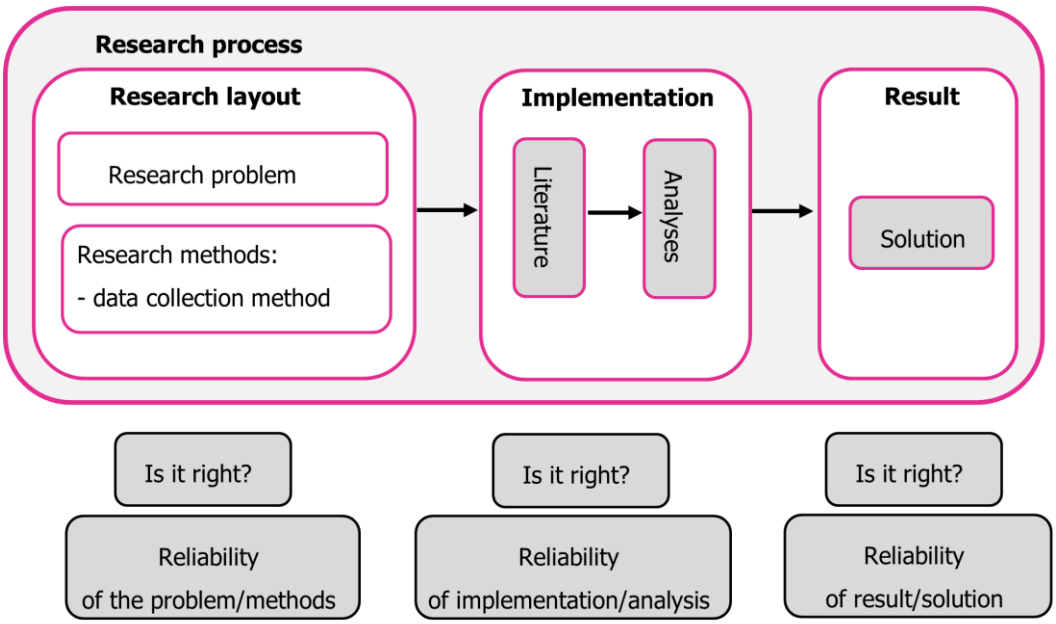

FIGURE 3. The reliability review (Adapted from Kananen 2015)

This development work thesis followed the stated reliability path as its initial processes included identification and assessment of a development need in the health sector, followed by provision of a solution. HAIs pose a global threat which this development work set out to provide a means of preventing and controlling through emphasis on common touch surfaces hygiene. To ensure that this development work is reliable, the authors analyzed many recent works, mostly systematic reviews and evidence-based guidelines, that dealt with preventing and controlling HAIs in healthcare settings, meticulously interpreting the research findings and conclusions. Additionally, the authors analyzed related resources from the web pages of WHO, CDC, ECDC and THL which are not for profit institutions charged with preserving health of the world and the areas where they operate. The policy thrusts from these institutions regarding HAIs were in sync with the product of this development work. The authors also researched the importance and effect of videos as learning material for nursing education. In line with previous research results, this development work also demonstrated that videos are veritable learning tools for nursing education (Clerkin et al. 2022, 7-9).

The reliability of this development work was also attributable to the quality of supervision. One of the reliability factors for this work was that all the processes were overseen by professional nurse educators with vast experiences in pedagogy and in the subject of IPC. The teachers certified the

relevance of the written literary report to the aim and purpose of the development work product. Likewise, they assured the appropriateness and convenience of the tasks the students were to undertake during the pilot test. The reliability of the questions and models answers were first-line proven by the supervisors of this development work thesis in consortium with two other teachers with vast experiences in nursing education. (Karabilgin et al. 2012, 295.) The extent of uniformity of the responses obtained from the participants across the predetermined video-based statements and questions in the pilot test further confirmed the reliability. This result conformed with the internal consistency method of reliability testing in that the participants' responses were in agreement and most of them passed the video-based quiz. The validity and reliability of this development work were confirmed through internal consistency of the responses obtained from the nursing students during the pilot test. (Clain et al. 2022, 1660; Selim & Dawood 2015, 93.)

6.3 Professional growth and development

The learning goal of both authors of this development work thesis was to deepen knowledge of the nurse's role in preventing and controlling HAIs from common touch surfaces. The authors were both concerned and challenged by the enormity of the risk of HAIs and the percentage of crystallization of these risks to clinically relevant adverse events. Creating and sustaining nurses' awareness are important factors in minimizing HAIs, and therefore cannot be over-emphasized. Choosing the thesis topic was a very natural process which was initiated from participating in the real healthcare environment during internships. The authors considered that hand hygiene and personal protective equipment were in practice, yet occurrences HAIs were still common (Greene et al. 2018, 624). The authors pondered over what the missing link could be and found from existing literature that common touch surfaces might be among the major contributors to incidences of HAIs. (Wong et al. 2018, 5.) Being requested by our supervisors who were engaged in an international project themed "Capacitating Asia's Nursing Students on Innovative and Sustainable Prevention and Control of Healthcare-associated Infections (PrevInf)" to participate in the PrevInf project for our thesis was a very welcome idea to both authors (Silén-Lipponen, Koponen, Myllymäki & Korhonen 2021).

As the thesis progressed, the authors went through a number of written works, articles, studies and evidence-based guidelines related to the topic. Based on those, the authors formed a comprehensive understanding of HAIs, the nursing environment and possible infection risks to the patients, HCWs and visitors to clinical settings. This comprehension fueled the authors' passion and determination to discover and disseminate information regarding the nurses' roles in preventing and controlling HAIs from touch surfaces. The authors of this thesis believed that they were successful in acquiring pertinent information and truncating the information for easy of understanding. The authors' professional skills increased considerably in the use of evidence-based and researched information for the thesis. In addition, as future nurses, the authors have acquired more comprehensive knowledge on how to prevent and control HAIs in our healthcare work environments (Gilber 2020, 628-629; Cobrado et al. 2017, 2056; Davis, Parand, Pinto & Buetow 2015, 159).

This development work thesis was put together by the authors working in concert. The authors searched some of the literatures for the theoretical aspect independently having outlined the focus of the development work (Kananen 2012, 162). Thereafter, meetings were held in person and

online via zoom or Microsoft teams for editing the whole work. When working independently, each of the authors retrieved information from databases, built up reference lists and reviewed already written sections while considering possible refinements. These actions significantly upgraded the authors' skills in in-text citation and bibliography. Individually, each of the authors' collaboration and writing skills deepened. Improvements were observed by the authors in their individual writing and verbal communication skills, teamwork, scheduling and feedback handling. Both authors successfully learnt from each other and developed new skills, especially regarding the development work thesis and filmmaking. Compiling the development work was a long process as a whole, which required planning and implementation, reporting and evaluation. A thorough plan was drawn up at the beginning of the thesis work which helped to guide the progress of the work process until its completion (Savonia University of Applied Sciences 2022a). The authors' information retrieval skills improved as searches of reliable databases progressed. By the same token, the authors developed skills at comparing research findings from selected sources. The authors' learning of professional words and their usage in the healthcare field increased as a direct result of the research process. Other areas of noticeable improvements included academic writing skills, word choices, spelling and grammar.

During the implementation phase, the authors familiarized themselves with the preparation of the video script, filming, directing and editing. It was quite challenging due to lack of experience, but also interesting and rewarding. The authors learnt to make a video shooting plan, scriptwriting, video shooting proper, directing and editing through the process of this development work (Kwon, Gaughan & Park 2012, 192). During the video shooting, the authors learnt to perform naturally in front of the camera as well as directing the role-play and scenes (Mahon & Crotty 2020, 8). This development work thesis demanded huge efforts from both of the authors. The challenges eventually turned into a victory for which the authors were glad for the final success and high-quality of the product of the development work. The encouragement of the supervisors in the course of this work was humbling and it was an honour to contribute to the development of Asian HEIs current nursing curriculum in HAIs prevention and control through the PrevInf project.

The video is concise in a practical way with the added advantage of the subtitles which would help nursing students develop their knowledge and skills to work aseptically in their future workplaces. In the authors' opinions, the video would in the foreseeable future, make a positive and sustainable impact on the healthcare industry from the perspective of HAIs prevention. As soon-to-be registered nurses, this thesis has ingrained in the authors and by extension, in the participants in the pilot test, a consciousness to work aseptically irrespective of the nursing tasks engaged in. It is hoped that by adherence to preventing infection spread from common touch surfaces, the sterling example for other colleagues would be set for emulation so that the fight against HAIs could be won.

6.4 Applicability and further research

In conclusion, the purpose of this development work thesis was achieved and the work leaned largely on evidence-based guidelines and practices. The authors believe that the OSVE instructional video would positively impact Asian nursing students, making them always conscious to carry out nursing roles aseptically and intentionally so that incidences of HAIs from common touch surfaces would be prevented and controlled. This belief is backed up a finding that videos in nursing

education are bona fide learning tools that also provide convenience to the viewer (Wells & Rockwood 2019, 319). The applicability of this research is far-reaching and cuts across every role performed in healthcare settings which involves patient care. Effectively, this development work thesis would be beneficial to everyone interested in curbing the menace that HAIs pose for humanity in terms of morbidity and mortality.

HAIs are such a global health issue that cannot be accentuated enough until there is total riddance. Therefore further research may focus on measures to boost healthcare workers' compliance with evidence-based guidelines to minimize or eradicate HAIs from common touch surfaces. Knowledge and attitudes of nurses towards cleaning and disinfection of NCMDs could be researched, also. Other studies may focus on either of the two aspects of common touch surfaces – built environmental surfaces or non-critical medical devices – considered in this development work to elaborate further on preventing or controlling healthcare-associated infections.

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APPENDIX 1: RIGHT TO CITE APIC'S "BREAK THE CHAIN OF INFECTION"

Nena N Michael

From: Liz Garman <egarman@apic.org>
Sent: Tuesday, November 30, 2021 8:03 PM
To: Nena N Michael; Trang a Nguyen
Subject: FW: Request for Right to Cite Published Information and Picture "break the chain of infection"

Dear Nena Michael,

Thanks for your request to use part of our infographic on the chain of infection:

The resource is free to download and share. We ask that it not be modified.

If you are modifying the information, please include this language in your attribution: "This information is modified from a resource from the Association for Professionals in Infection Control and Epidemiology (APIC) called "Break the Chain of Infection." Please also include the link to the original APIC resource, which is: https://infectionpreventionandyou.org/protect-your-patients/break-the-chain-of-infection/.

Thank you,
Liz

Elizabeth Garman, CAE
She/Her
Vice President, Communications, Marketing, and Practice Resources
APIC – Association for Professionals in Infection Control and Epidemiology
P: 202-454-2604 | M: 202-365-7421 | F: 202-789-1899

From: Nena.Michael@edu.savonia.fi <Nena.Michael@edu.savonia.fi>
Sent: Tuesday, November 30, 2021 3:04 AM
To: APIC Info <AInfo@apic.org>
Cc: Trang.Nguyen@edu.savonia.fi
Subject: Request for Right to Cite Published Information and Picture "break the chain of infection"

Hello,

I am a 3rd year nursing student of Savonia University of Applied Sciences, Finland, and I am writing a thesis on infection prevention and control (IPC) with my colleague, Trang Nguyen. I came across your pictorial description of chain of infection overview and I think it may be well suited to the thesis. Our thesis may form part of an e-book for teaching nursing students about IPC.

I therefore, seek your approval to adapt the picture to our thesis project. I hope to get favourable and timely response from you.

Kind regards,

Nena Michael
nena.michael@edu.savonia.fi

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APPENDIX 2: VIDEO SCRIPT

Title: Improving nursing students' skills regarding preventing & controlling HAIs from touch surfaces

Expected video length: approximately 4 min 40 sec – 5 min 35 sec
Space used for the shooting: Savonia UAS Simulation center
Filming date: 18.05.2022
Aim: To produce an educational video centered on preventing and controlling the risks of acquiring HAIs from common touch surfaces.

Plot: Scientific evidence has proven the possibility of contracting infections through contact with touch surfaces. Doorknobs are one example of high-touch surfaces. Microscopic pathogens on the doorknob are animated and a nurse is seen arriving to work and naturally handling the doorknob to enter the nurses' station. Would the nurse be aware of the possibility of contracting the healthcare-associated infection from touching the knob? The nurse disinfects her hands, dons gloves, and disinfects her work desk, mouse, keyboard, ID card and shared phone. The nurse observes hand disinfection with respect to medication handling. The medication trolley is disinfected prior to use and afterward. The nurse must disinfect her work phone and shared care devices before and after each patient encounter. In the ward, a patient is lying in bed, coughing, sneezing, and touching her environment, inadvertently leaving trails that would contaminate the touch surfaces and possibly infect susceptible individuals. Cleaning and disinfection of patient areas entail wiping down high-touch surfaces – doorknobs, bed rails, tables, non-critical patient care devices in the patient location, call buttons and light switches – a poster reminds of this important procedure. The nurse observes the end of the shift disinfection protocols and disinfects workstations and associated gadgets as well as patient care devices.

Timing	**Situation and duration of the video**	**Filming in video**	**People in pictures and status**
(5-10 sec)	In the hospital ward... In front of the nurse's office door: A nurse comes to the office at the beginning of her morning shift. She opens the door by the handle, steps inside and closes the door.	Filming the nurse in front of the office door, her hand is on the doorknob (pathogens on the door handle are animated) and she walks in.	**Corridor of the simulation center** Nurse **Subtitle**: In a hospital ward, a registered nurse arrives to work to begin her shift.
(5 sec)	In the nurses' station ward… A poster reminds healthcare workers (HCWs) of fomite infection transmission prevention protocol…	Film the poster.	**In the simulation room/nurse's office** Nurse
(20 sec)	The nurse takes a copious quantity of hand disinfectant from a bottle hanging on the wall and disinfects her hands.	Filming the nurse as she disinfects her hands.	**Subtitle:** The nurse disinfects her hands after entering the office (mitigating any pathogens she might have contracted from contact with touch surfaces (doorknobs).
(10-20 sec)	The nurse dons gloves, takes disinfectant wipes and wipes the work desk, computer keyboard, mouse, her ID card and shared work phone to avoid contamination from touch surfaces. She doffs the gloves and disposes of them. She disinfects her hands. She puts the work phone in her scrub pocket.	Filming the nurse taking and wearing gloves from the box on the table. She takes disinfectant wipes and wipes the work desk, computer keyboard, mouse, her ID card and shared work phone, and discards the gloves. Filming nurse disinfects her hands. Filming nurse logging in to the computer and	**Subtitle:** The nurse wipes her work desk and gadgets; disinfects her hands after doffing gloves. **Subtitle:** Nurse disinfects hands.

(10 sec) (2 sec) (5-10 sec)	The nurse logs in to the computer using her keycard and checks for updates on her patients. Nurses read patients' information at the beginning of every shift to get acquainted with their patients' conditions. The nurse signs out of the computer, disinfects her hands and leaves for the medication room. The nurse takes a stethoscope from a drawer in the nurses' station, disinfects it and hangs over her neck. (Hand disinfection is omitted).	reading information about her assigned patients for the shift. Filming the nurse leaving her work desk and disinfecting her hands as she goes to the medication room. Filming nurse as she disinfects a stethoscope.	**Subtitle:** The nurse reads patients' information from the computer. **Subtitle:** The nurse disinfects the stethoscope.
(5-10 sec)	In the medication room… The nurse disinfects her hands and dons gloves. She double-checks the prescriptions against the dispensed medicines. The previous shift nurses dispensed medications into cups. She sprays the medication trolley with institutional alcohol disinfectant and wipes it off, then doffs her gloves and disinfects her hands. She collects the patients' medication tray and places it on the trolley and sets off to her patients' round.	The nurse unlocks the door and accesses the medication cabinet, taking the dispensed medication tray out of the cabinet and placing it on the countertop. Filming nurse in the medication room cross-checking dispensed medicines in the cups against printed prescriptions. She disinfects the medication trolley, places the medication tray on it and takes the medication to the patient's room. Filming nurse leaving medicine cabinet, pushing medication trolley along.	**Medicine cabinet** Nurse **Subtitle:** The nurse double-checks medication cups dispensed for patients and takes them to patients' rooms. **Subtitle:** Disinfecting medication trolley **Subtitle:** Nurse leaves with medication trolley for the patient round.
(5-10 sec) (5-10 sec) (30-40 sec)	In the patient's room… The nurse turns the door handle to get into the patient's room (pathogens on the door handle are animated). The nurse disinfects her hands before approaching the patient's bed. Hand disinfectant is hanging on the bed rail. The nurse has come to greet the patient and track her status.	Filming the nurse opening the door by turning a doorknob. Filming the nurse approaching the patient's bed and continuing to disinfect their hands. The patient and nurse are included in the video now. Filming patient sitting up in the bed, coughing and sneezing into her elbow and hands, touching surfaces around her – bed rails, light button and table. Filming discussion between nurse and patient. The nurse takes some	**Patient room** Nurse Patient **Subtitle:** Nurse starts her morning round. **Nurse:** "Good morning. I'm nurse Kaisu Savolainen. How do you feel? Did you sleep well last night? Does your wound still hurt?" **Patient:** "Morning. My name is Ulla Matthews. My wound does not feel too painful. My sleep was disturbed because I started coughing and sneezing last night". **Nurse:** "I am sorry to hear about your cough and sneeze. Do you also feel sore throat

		hand papers from the tissue box and places them on the patient's table. The patient already woke up before the nurse came. The patient's face shows an improving health condition. Nurse talks and demonstrates by body language that she will start to measure the patient's vital signs. The patient nods her head to agree. The nurse asks the patient if she would like to disinfect her hands and she pours some disinfectant into the patient's palm after she agreed.	and fever? The nurse places some hand papers on the patient's table. **Patient:** No, I do not feel sore throat or feverish. The night nurse checked my temperature and administered a Coronavirus test which result was negative. **Nurse:** May I check your oxygen level, breathing, temperature, blood pressure and heart rate?" The nurse pours disinfectant into the patient's hands. **Subtitle:** Nurse – - offers alcohol hand rub to patient. - confirms patient identification. -
(40-50 sec) (40 sec) (10 sec)	The nurse uses a pulse oximeter to check blood oxygen saturation (SpO2) and counts respiratory rate (RR), auscultates lungs and heart sounds with the stethoscope, and measures blood pressure (BP) and pulse or heart rate (HR) with the blood pressure monitor, and checks temperature (T°C) with a thermometer. The nurse tells the results to the patient and checks the patient's surgical wound. The nurse takes the work phone from her scrub pocket, records the patient's results to her work phone application and returns the phone to her pocket without disinfecting it first. The nurse looks at the clock and tells the patient to take part of the medications now. Informs her that breakfast will be served in 40 minutes, and she will take the rest of her medications while eating.	Filming nurse takes a pulse oximeter from the bedside table and puts it the on patient's right index finger. Filming nurse takes the blood pressure cuff and puts it the on patient's left arm, then she presses the button to turn on the monitor. Filming nurse takes the thermometer from the bedside table and puts it under the patient's right armpit. The nurse tells the patient to be calm, meanwhile, she counts the patient's respiratory rate. Filming nurse noting down all measurements into her work phone. Filming the nurse talking to the patient about the results. The nurse smiles and tells the patient that all results were good. The nurse starts to disinfect the stethoscope before hanging it back on her neck. Filming the nurse looking at the clock and discussing medication, breakfast, and the doctor's round with the patient. The nurse gives the patient early morning medications for her thyroid and pain care. The nurse takes a	**Nurse:** "I'll place a pulse oximeter on your right index finger. I'll put the thermometer under your right armpit. Then I'll put a blood pressure monitor on your left arm. Just relax and keep calm." **Subtitle:** Nurse – - begins to measure vital signs - informs the patient of the results - documents the results to the work phone. **Nurse:** "That's very good. Oxygen is 98%. Their blood pressure is 101/75. The temperature is 36.8. The breathing rate is 16. Your vital signs are good, and your lungs and heart sounds are neat. May I see your wound also?" **Patient:** "Yes, it's on my right knee" **Nurse:** "You said that it's not so painful anymore. It also looks clean, not bleeding, and not swollen. Very well. The doctor said you may go home today before lunch." **Patient:** "That's good news" **Nurse:** "Please take your Levothyroxine tablet 50 micrograms and Targiniq 5/2,5mg. Levothyroxine has to be taken as soon as you wake up and at least 30 minutes before meals and other medications. For your pain, the doctor ordered Targiniq 5/2.5 mg every 12 hours and it is just

		disposable cup and fetches water from the tap and hands the cup to the patient. Filming the patient taking her medications as ordered. She returns the empty cup to the nurse.	the right time now since you took the last dose."
(10 sec)	The nurse disinfects all shared care devices used to check the patient's vital signs	Filming nurse disinfecting patient care devices.	**Subtitle:** Proper cleaning and disinfecting help to lessen contamination and spread of infection.
(5 sec)	The nurse informs that doctor will come to check and let the patient know if she can be discharged. The nurse reminds the patient to ring the bell when necessary and leaves the room.	Filming the nurse telling the patient about the doctor's round and asking if the patient needs anything else. The nurse shows the patient the bell placed by the bedside and reminds her to ring it when needed.	**Nurse**: "Doctor's round starts at 9 o'clock and if everything goes well, you may be discharged home today. Please, ring the alarm if you need anything".
(10 sec)	The patient asks the nurse to elevate the bed height and lower the bed rail. The nurse uses a remote to adjust accordingly.	Filming the nurse taking the remote and showing patients how to control the bed. The patient adjusts her position to feel more comfortable.	**Patient:** "Yes, sure. First lower the bed rails, please. I want to put my feet down" **Subtitle:** Nurse gives patient guidance on alarm bell and remote-control use.
(20 sec)	The nurse reaches for the disinfectant hanging on the patient's bed and disinfects her hands, takes the medicine trolley, and moves towards the next patient space.	Filming nurse disinfected her hands by the patient's bedside and moved toward the next patient.	Next patient is seen lying in bed and the nurse moving with the medicine trolley towards him.
(5 sec)	**A poster reminds me of touch surface disinfection …** The first patient has been discharged and the bed space is vacated. A poster reminds us of cleaning and disinfection protocols for touch surfaces - doorknobs, bed rails, tables, and patient care devices.	Filming poster … instructions for disinfecting high touch surfaces in patient location to prevent contamination.	**In the patient's room … vacated bed space** **Subtitle:** Proper cleaning and disinfection help to lessen contamination and prevent infection spread.
(20 sec)	The nurse returns to the medication room with the trolley, disinfects their hands and dons gloves. She sprays the trolley with 80% alcohol disinfectant and wipes the trolley.	Filming the nurse disinfecting her hands, medication tray and trolley.	**In the medication room…** Nurse **Subtitle:** Disinfecting medication trolley
(10 sec)	The nurse is seen again returning to the nurses' station. She taps a disinfectant bottle hanging on the wall, disinfects her hands.	Filming nurse disinfecting her hands in front of the office.	**In the nurses' station** Nurse
(10 sec)	She sits at her desk and starts to document patient information to the computer system and signs	Filming the nurse's hands typing on the keyboard. In the office, she is seen working on the computer.	**Subtitle:** Nurse documents patients' information.

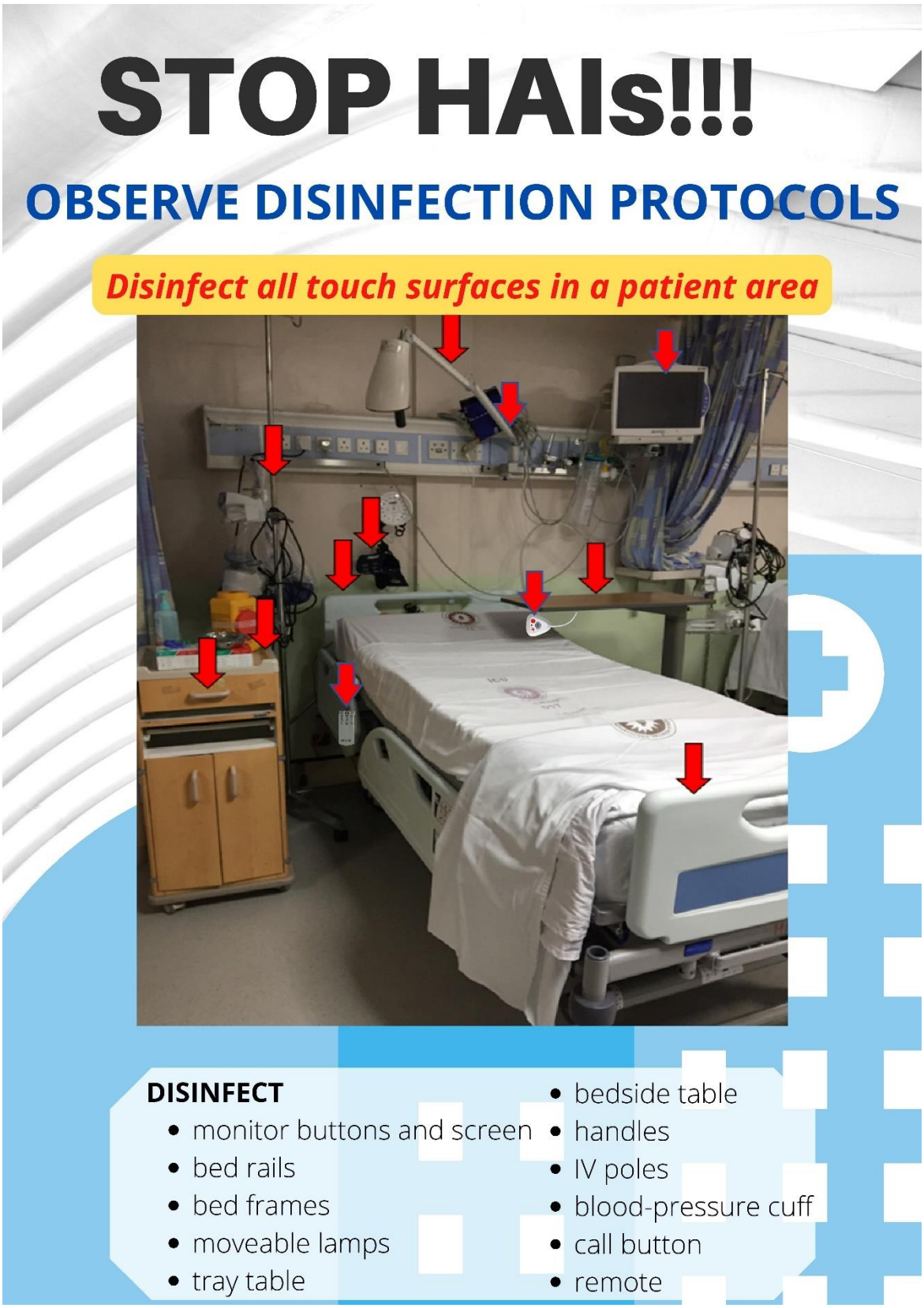
	out of the computer at the end of her shift.		
(10 sec)	The nurse dons gloves, takes disinfectant wipes, and wipes the work phone, desk, computer keyboard and mouse. She doffs gloves and disinfects her hands.	Filming the work desk, work phone, access card, computer keyboard and mouse being disinfected.	**Subtitle:** End of shift disinfection protocol for infection prevention from touch surfaces. All workstations and non-critical patient care devices are disinfected by all HCWs responsible for them during the shift. The nurse doffs gloves and disinfects her hands and leaves the room

APPENDIX 3: POSTERS IN VIDEO

Poster depicting nurses' station

Poster depicting corridor wall in a healthcare setting

Poster depicting patient's room



APPENDIX 4: VIDEO-BASED QUIZ

Quiz: Test your knowledge from the educational video on preventing and controlling risks of acquiring HAIs from common touch surfaces.

1. Why would the nurse wear gloves when disinfecting the touch surfaces such as computer accessories and patient care devices?
   A. To protect her hand from chemical corrosion.
   B. To appear psychedelic.
   C. To follow standardized precautions for infection prevention.
   D. No need to wear gloves at all.

Correct answers are A and C.

2. What high touch surfaces are evident in the poster in nurses' station?
   A. Work desk
   B. Chair
   C. Jacket hanger
   D. Computer keyboard and mouse
   E. Doorknob
   F. Stethoscope
   G. Work phone

Correct answers are A, D, F and G.

3. In the video, which of the following are the mistakes made by the nurse regarding the medication room?
   A. Unlocking the door and entering the medication room.
   B. Not disinfecting hands after touching the door.
   C. Accessing the medication tray prior to hand disinfection.
   D. Not disinfecting the countertop.
   E. Not disinfecting the medication trolley.

Correct answers are B, C and D.

4. What high touch surfaces are evident in the poster in patient's location?
   A. Call button
   B. Doorknob
   C. Blood pressure cuffs
   D. Bedside table
   E. Bed remote control
   F. Bedrail
   G. Tray table
   H. Patient monitor

Correct answers are A, C, D, E, F, G and H.

5. The nurse takes the stethoscope before going to the patient's location. What errors were observable regarding stethoscope use in the video?
   A. Not disinfecting after use.
   B. Disinfecting before use.
   C. Hanging over the neck.
   D. Stethoscope should be disinfected and placed in scrub pocket.

Correct answer is C.

6. Point out nurse's missed moments of hand disinfection in the video.
   A. Not disinfecting hands after disinfecting stethoscope.
   B. Not disinfecting hands after touching faucet in patient's room.
   C. Not disinfecting hands after using patient's bed remote control.
   D. Not disinfecting hands before returning work phone to scrub pocket.

Correct answers are ALL.

7. What high touch surfaces are evident in the poster in the corridor?
   A. Light switch
   B. Elevator button
   C. Staircases
   D. Stair rails
   E. Doorknob
   F. Blood pressure cuffs
   G. Faucet

Correct answers are B, D, E and G.

8. During patient care process, when should non-critical medical care devices be disinfected?
   A. No need to disinfect the devices because they are clean.
   B. When gloves are used no need to disinfect the devices.
   C. Before use on a patient.
   D. After use on a patient.
   E. After discharge home when patient has vacated the location.

Correct answers are C, D and E.

9. Patients are considered a factor in the spread of healthcare acquired infections (HAIs) in healthcare settings. Based on the video, how might the patient contribute to HAIs?
   A. By coughing into her elbows.
   B. By splash of aerosols through sneezing.
   C. Coughing into her hands and touching surfaces around her – table, call button, bed rail.
   D. By sitting up in bed.
   E. By asking the nurse to elevate her bed using remote control.
   F. By blowing her nose into tissue paper and disposing it.

Correct answers are B and C.

10. Seeing and hearing that patient has been coughing and sneezing, what extra precautionary steps could the nurse undertake towards curbing the spread of HAIs from human aerosols?
    A. Request patient to wash hands at the sink in the room, if possible.
    B. Do nothing because patient's wishes must be respected.
    C. Offer the patient hand disinfectant.
    D. Give patient guidance on safe coughing and sneezing etiquette.
    E. Lower all bed rails to avoid touching.
    F. Make tissue paper handy, if unavailable within patient's reach.

Correct answers are A, C, D and F.

11. The healthcare workers' (HCWs) work phones, other care devices and environmental surfaces are potential fomites for transmission of HAIs. It is therefore important to ensure:
    A. All HCWs participate in cleaning and disinfection training.
    B. There are posters reminding HCWs about care devices and environmental surfaces disinfections.
    C. HCWs including nurses clean and disinfect devices intermittently and between uses.
    D. Disinfection of the devices only after all patients in the same location are cared for.
    E. No device disinfecting in between patient uses as it is tantamount to increasing care costs.
    F. If there is no physical dirt, use the patient care device and return it afterwards.

Correct answers are A, B and C.

12. In what ways could patients help to prevent spread of HAIs in the healthcare settings?
    A. By coughing and sneezing without barriers.
    B. By complying with hand hygiene protocols.
    C. By maintaining coughing and sneezing etiquette of elbows and tissue paper use.
    D. By asking HCWs if they have disinfected hands and devices prior to care.
    E. By partially adhering to isolation instructions.

Correct answers are B, C and D.