

## SYSTEMATIC REVIEW

# Influences of healthcare workers' behaviours towards infection prevention and control practices in the clinical setting: A systematic review

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**Funding information**

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**Abstract**

**Aim:** To systematically evaluate empirical studies investigating the influences of healthcare workers' behaviours towards infection prevention and control practices in the Coronavirus clinical space, and to appraise and synthesise these findings.

**Design:** A systematic review of the literature.

**Methods:** The review used a five-step framework described by Khan et al. (Journal of the Royal Society of Medicine, 2003, 96 and 118) of Framing questions for a review; Identifying relevant work; Assessing the quality of studies; Summarising the evidence; and Interpreting the findings. Searches were conducted in CINHALL, MEDLINE, PsychINFO, Scopus, and Google Scholar databases to retrieve relevant peer-reviewed literature published in English between 2019 and 2023. Covidence and Joanna Briggs Quality appraisal tools were used for critical assessment. To improve transparent reporting, this review used a Synthesis Without Meta-analysis (SWiM) in systematic review guidelines, as informed by Campbell et al. (BMJ, 2020, 368).

**Results:** Twenty studies were included in this review, identifying nine themes describing factors influencing HCWs' behaviours towards IPC practices in the coronavirus environment. The overarching influences emerged as knowledge-oriented, person-oriented, and environment-oriented.

**Conclusion:** Healthcare workers' responsibilities at point-of-care involve providing direct care to patients with highly transmissible infections and working in clinical settings that may be ill-designed for IPC practices, increasing the risk of transmission. Given the lack of a definitive solution to eradicate new mutant viruses and that IPC practices are the mainstay of prevention and control of transmissible, measures to improve are imperative. The identified HCWs' domains on behaviours towards IPC are critical in strategies to mitigate risks and further set an opportunity for developing an IPC model congruent with the rapid response required for HCWs during emerging or re-emerging mutant virus outbreaks. This is significant, given that HCWs' preparedness with IPC practices at point-of-care is central to patient care, the workforce and community safety.

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## KEYWORDS

behaviour, compliance, healthcare worker, infection control, systematic review

## 1 | INTRODUCTION

The emergence and rapid transmission of new mutant viruses with pandemic potential beyond borders have occurred regularly throughout history (Centers for Disease Control and Prevention [CDC], 2011). This has caused untold human suffering and deaths – posing a grave danger to our very existence (Baker et al., 2022). More recently, the Coronavirus-19 (COVID-19) pandemic caused global healthcare crises and insurmountable stress to humanity (United Nations Department of Economic and Social Affairs Social Inclusions, 2021; WHO, 2022). The pandemic was worsened by a lack of permanent pharmaceutical solutions to eradicate it and a lack of healthcare workers' (HCWs) response readiness (WHO, 2021). Controlling and implementing preventive measures were the main options to mitigate transmission (WHO, 2020). However, the high transmissibility of COVID-19 presented challenges to healthcare workers (HCWs), who, as the first line of defence, needed to swiftly adapt to their situation with vaccines still in development (WHO, 2020). At the forefront, nurses, midwives and physicians, among other HCWs, risked their lives when implementing measures to prevent and control COVID-19 from spreading – underscoring the importance of ongoing infection prevention and control (IPC) practice improvement.

The prevention and control of COVID-19 required a multi-faceted approach with various strategies deployed on several fronts. For example, source isolation and quarantine measures were implemented to minimise the spread of COVID-19 virus to individuals and communities (CDC, 2021). These measures were enforced with a combination of standard and transmission-based precautions such as hand hygiene, personal protective equipment (facial masks – N95, gloves, disposable gowns, eye protection), and correct disposal of sharp instruments to break the chain of transmission (Clinical Excellence Commission [CEC], 2022)

While physical isolation measures and availability of PPEs, infection prevention and control policies, and procedure guidelines are crucial, HCWs needed adequate knowledge and training to ensure competency and compliance in order to minimise being infected with COVID-19 (WHO, 2021). HCWs' compliance with IPC practices is critical for patient safety, occupational health and safety and for safeguarding functional health systems (Silverberg et al., 2021). Despite using stringent IPC measures, many HCWs succumbed to the pandemic, with recorded deaths of up to 180,000 by the year 2021 (WHO, 2021), with others suffering long-term chronic COVID-19 symptoms. In addition to the high mortality, the COVID-19 pandemic spurred resignations in large numbers, exacerbating the already existing global shortages of HCWs (Poon et al., 2022). The high death rates of frontline HCWs from COVID-19 reflected the HCW's vulnerabilities at the point of care and also the ineffective occupational health and safety failures of healthcare systems in crisis (WHO, 2021). The World

### Implications for the healthcare profession

- By the nature of their work at point-of-care, which involves providing care for people with any transmissible infection, healthcare workers (HCWs) are always at the highest risk of being infected. This review brings together healthcare ideas on the influences of infection prevention and control (IPC) practices in the coronavirus (COVID-19) space from various disciplines highlighting the importance of collaboration when dealing with infectious disease outbreaks.
- The findings set the groundwork for further developing a care model aligned with the rapid response and safe practice needed for healthcare workers at point-of-care during mutant virus outbreaks.
- From the synthesis, the overarching factors influencing HCWs' behaviours towards IPC practices emerged as oriented in knowledge, the person and the environment. Given the need for all-time HCWs' preparedness for deployment at point-of-care, these present an opportunity for policymakers, public health authorities and university curriculum developers to review existing IPC practices to ensure more efficient response measures for mitigation of transmission.

### Implications for nursing practice and policy

- Nurses are at the forefront of identifying transmissible infections (commencing at triage), initiating isolation, implementing universal and transmission-based precautions, and monitoring multidisciplinary HCWs adherence to IPC practice in the clinical environment. Therefore, the emphasis of these synthesised findings on knowledge, the person, and the environment calls for consideration in reviewing current policies, training programs and clinical guidelines for the prevention and control of transmissible viral infections.

### Impact statement

- The review synthesised findings from multiple studies investigating factors influencing HCWs' behaviours towards IPC practices in the COVID-19 environment. This understanding is crucial for strengthening IPC practices in the post-COVID-19 pandemic or other new mutant virus outbreaks.

- Understanding factors influencing IPC practices is a baseline safety and quality requirement for HCWs' point-of-care readiness during new mutant virus outbreaks.
- The HCWs' knowledge of the influences of IPC practices directly impacts clinical practice experience, patients' recovery and overall community well-being.
- Rapid responses to counter new mutant virus outbreaks and effective epidemiological control strategies can be impeded by a lack of understanding of factors influencing HCWs' behaviours towards infection prevention and control practices.

#### Patient or public contribution

No Patient or Public Contribution because this is a systematic review of already existing literature.

Health Organization (2021) described the tragic loss arising from poor pandemic responses and also the lack of clear occupational health and safety measures as warranting imminent action. At the same time, concerns were raised about some HCWs' lack of compliance with IPC practices at point-of-care (WHO, 2021). There continues to be considerable concern for HCWs' preparedness in dealing with future pandemics, which often spread rapidly with little warning.

The high death rate among HCWs at the height of COVID-19, the critical shortages of frontline HCWs which resulted from large resignations, and the reports of concerns about the lack of HCWs' compliance with IPC generated interest from researchers in examining the factors that influence HCWs' behaviours towards IPC in the COVID-19 space. While researchers have explored factors influencing HCWs' behaviours towards IPC in the COVID-19 space, these studies stand as solo work as our effort to find any reviews discovered no systematic reviews explicitly focusing on the factors influencing HCWs' behaviours in the COVID-19 space. Given the lack of epidemic control or a definitive solution to eradicate new mutant viruses and that IPC practices are the mainstay for safety and quality, measures to improve these practices are imperative (CEC, 2022). This became the impetus for undertaking this review, as a broader understanding of the topic is integral to policy and guidelines development, and crucial for strengthening strategies to promote adherence for patient safety, HCWs and the community. The findings are relevant in the current COVID-19 endemic and for future outbreaks of emerging new mutant viruses to reduce the risk of transmission.

## 1.1 | Aim

This review aimed to search for and systematically evaluate empirical studies investigating the influences of healthcare workers' behaviours towards infection prevention and control practices in

the COVID-19 clinical space; and to appraise and synthesise these findings.

## 1.2 | Problem identification

This review addressed the question: What influences healthcare workers' behaviours towards infection prevention and control practices in the acute care environment during COVID-19?

## 2 | METHOD

This review was modelled on a framework by Khan et al. (2003) to systematically analyse and synthesise findings from empirical studies on the influences of HCWs' behaviours towards IPC practices in the COVID-19 space. The review followed structured and pre-defined steps based on clearly formulating a review question, identifying relevant studies, appraising their quality, and summarising the evidence using an explicit methodology. Specifically, the five steps used in conducting this systematic review were: 1: Framing questions for a review; 2: Identifying relevant work; 3: Assessing the quality of studies; 4: Summarising the evidence; and 5: Interpreting the findings (Khan et al., 2003).

The tools used for the review included Covidence (Veritas Health Innovation, 2019) and Joanna Briggs' Institute (2017) quality assessment tools as guides. This review was registered in the International Prospective Register of Systematic Reviews [(PROSPERO) ID: *de-identified*], ensuring transparency, minimising duplication, and the risk of bias. In addition, a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram was used to show the flow of information through the different phases of a systematic review and to present the records identified, excluded and included, and the reasons for any exclusions (Page et al., 2021). To improve transparent reporting, the review used the Synthesis Without Meta-analysis (SWiM) in systematic review guidelines, informed by Campbell et al. (2020).

## 2.1 | Eligibility criteria

Studies for inclusion have healthcare workers as participants (population), an acute care setting, infection prevention and control of COVID-19, primary studies with original data, published peer-reviewed journals written in the English language, mixed methods, quantitative or qualitative studies, studies conducted and are published in the period 2019 to 2023 with full text available. The studies focused on a population of HCWs  $\geq 18$  years of age. The exclusion criteria were: (a) studies of students in pre-registration healthcare programs, (b) studies that did not focus on COVID-19, and (c) studies that did not focus on healthcare workers in acute care settings. Grey literature was excluded for validity reasons. Studies conducted before 2019 were excluded as COVID-19 was first reported in 2019.

## 2.2 | Search strategy

A preliminary search from CINHAL, MEDLINE, PsychINFO, Scopus and Google Scholar and JBI and Cochrane reviews could not find any existing reviews or similar reviews. The formal search was conducted by (Reviewers=4) MM, MK, GM and PG from CINHAL, MEDLINE, PsychINFO, Scopus and Google Scholar databases as these are known for including publications on health workforce and health practices. The fourth reviewer (PG) facilitated reconciliations whenever disagreements emerged. A list of keywords was developed (Appendix A) with the exact keywords used in all databases with different Boolean operators to search for the most relevant articles. The list of keywords included Coronavirus, Covid\*, Covid-19, SARS-CoV, Health care worker, Health care professional, Healthcare professional, Healthcare worker, Healthcare worker, Health care worker, Nurs\*, Nursing, Behaviour, Compliance, Non-compliance, Knowledge, Perception, Practice, Non-adherence, adherenc\*, Attitude, Compliant, Complian\*, Infection prevention and control, Infection prevention, Infection control\*, Covid-19 Prevention, Coronavirus prevention, Prevent\*, Precaution, Infection\*, Factors, Factor\*, Driver\* and Enabler. The search was completed on 24th of November 2023.

## 2.3 | Search outcomes

The identified studies were initially imported to EndNote X9 (Clarivate Analytics) from their respective databases and subsequently exported to Covidence systematic review software (Veritas

Health Innovation, 2019), an online tool used when appraising the articles. The screening process of the studies followed pre-determined eligibility criteria for the review. In summary, the initial search identified 5217 records (4437 were removed); after further screening (abstract, full text, duplicates, eligibility) 20 studies fulfilled the inclusion criteria. The search process was summarised on a PRISMA flow chart (Figure 1).

## 2.4 | Quality appraisal of sample studies

In using the Joanna Briggs Institute (2017) critical appraisal tools (Appendices B and C) for assessing methodological relevance, trustworthiness and the quality of results, it was determined that the 20 studies met the requirements of this review. Specifically, the analytical cross-sectional and qualitative studies checklists were used to appraise the quantitative studies ( $n=19$ ), and the qualitative studies ( $n=1$ ), respectively (Tables 1 and 2). The quality appraisal process discovered a considerable heterogeneity in sample sizes, healthcare workers, work environment, survey questions and outcome measures. In total, 20 studies were included in this systematic review at the completion of screening. The total scores for each included study were assessed, and the specific criteria were analysed to determine their quality. Although the included studies scored low in criteria 5 and 6 (Appendix B) for cross-sectional studies; the qualitative study did not address criteria 6 and 7 (Appendix C). There was a reviewer agreement that the minimum score of 75% from the included studies indicated good quality and that these studies also addressed the question for this systematic review.

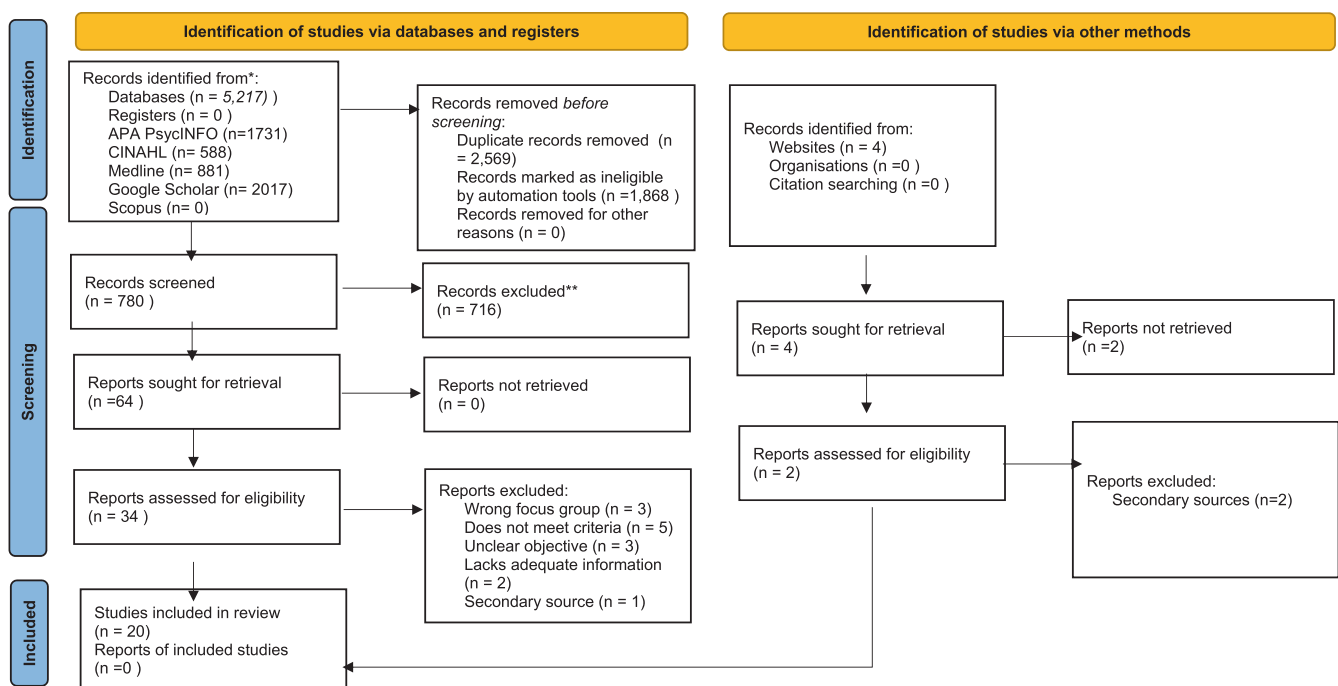


FIGURE 1 Prisma flow diagram for systematic review. Displaying Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram for a systematic review with the outcomes of article searches from databases and registers and other sources.

TABLE 1 JBI quality appraisal for quantitative studies included in the review.

Quantitative studies		Criteria and corresponding scores										Appraisal rating	Include/Exclude
Author and Year	Study type	Study #	1	2	3	4	5	6	7	8			
Al-Dossary et al., 2020	Cross-sectional descriptive	41	1	1	1	1	0	0	1	1	6	Include	
Alrubaiee et al., 2020	Cross-sectional descriptive	10	1	1	1	1	0	0	1	1	6	Include	
Anuar et al., 2022	Cross-sectional descriptive	58	1	1	1	1	0	0	1	1	6	Include	
Chanie et al., 2021	Cross-sectional descriptive	59	1	1	1	1	0	0	1	1	6	Include	
Abdel Wahed et al., 2020	Cross-sectional descriptive	45	1	1	1	1	0	0	1	1	6	Include	
Abed Alah et al., 2021	Cross-sectional descriptive	39	1	1	1	1	0	0	1	1	6	Include	
Abolfotouh et al., 2020	Cross-sectional descriptive	7	1	1	1	1	0	0	1	1	6	Include	
Deressa et al., 2021	Cross-sectional descriptive	60	1	1	1	1	0	0	1	1	6	Include	
Ezike et al., 2022	Cross-sectional descriptive	5	1	1	1	1	0	0	1	1	6	Include	
Hasuikie et al., 2021	Cross-sectional descriptive	15	1	1	1	1	0	0	1	1	6	Include	
Kassie et al., 2020	Cross-sectional descriptive	53	1	1	1	1	0	0	1	1	6	Include	
Kim & Kim, 2022	Cross-sectional descriptive	22	1	1	1	1	0	0	1	1	6	Include	
Linlin et al., 2021	Cross-sectional descriptive	42	1	1	1	1	0	0	1	1	6	Include	
Latif et al., 2022	Cross-sectional descriptive	26	1	1	1	1	0	0	1	1	6	Include	
Odikpo et al., 2021	Cross-sectional descriptive	6	1	1	1	1	0	0	1	1	6	Include	
Salwa et al., 2022	Cross-sectional descriptive	63	1	1	1	1	0	0	1	1	6	Include	
Yang et al., 2021	Cross-sectional descriptive	19	1	1	1	1	0	0	1	1	6	Include	
Zandian et al., 2021	Cross-sectional descriptive	8	1	1	1	1	0	0	1	1	6	Include	
Ersin et al., 2021	Cross-sectional descriptive	32	1	1	1	1	0	0	1	1	6	Include	

Note: Showing the outcomes from Joanna Briggs's (JBI) critical appraisal tool for analytical cross-sectional studies.

TABLE 2 Quality appraisal of qualitative studies.

Qualitative studies			Criteria and corresponding scores										Appraisal rating	Decision
Author and year	Study type	Study #	1	2	3	4	5	6	7	8	9	10	10	Include/exclude
Hobbs et al., 2021	Qualitative	14	1	1	1	1	1	0	0	1	1	1	8	Include

Note: Showing the outcomes of Joanna Briggs's (JBI) critical appraisal tool for qualitative studies.

## 2.5 | Data extraction

As there is no generic data extraction form available for systematic reviews, a reviewer-developed form was piloted to ensure it captured all the main characteristics and the outcomes of the included studies consistent with the aim of this review. The two phases of data extraction included: (a) the main characteristics of the studies, which included the reference, the aim of the study, country, context, sample size, and study design; and (b) the data extraction included: results data identifying key themes consistent with the review question (Table 2).

## 2.6 | Data analysis procedure

The analysis of data was modelled on a framework by Popay et al. (2006) for narrative synthesis (synthesis without meta-analysis). The procedure was initially undertaken by each reviewer independently by, identifying recurring ideas or themes from the included studies. To exemplify: 'Knowledge of IPC; Knowledge of preventative behaviours; and Knowledge of modes of transmission; Social media' from which an overarching idea of Knowledge-orientated factors was assigned as a major outcome.

## 3 | RESULTS

### 3.1 | An overview of the included studies

The systematic search and quality assessment included the 20 studies shown in Tables 1 and 2 that met the criteria. These studies revealed that healthcare workers (HCWs) from a range of disciplines ( $n=10$ ) and from 14 countries worked at the front-line in the COVID-19 clinical space, including registered nurses, midwives, physicians, laboratory technicians, pharmacists, psychiatric specialists, anaesthesiologists, technologists, allied health and dentists from public or private acute care environments. However, more than 80% of the participants from the included studies were nurses, which is consistent with nursing and midwifery HCWs dominance and accounts for nearly 50% of the global health workforce (World Health Organization, 2022). Nurses also had leading roles at the healthcare frontline during new mutant virus pandemics. The sample sizes of HCWs from the

20 studies varied between 161 to 1757 with a total of 12,325 participants.

### 3.2 | The procedure for pooling the studies for a synthesis

The nature of this review aimed to systematically search, appraise and synthesise studies which reported influences of HCWs' behaviours in the COVID-19 space, and this was consistent with the included studies mainly undertaken through cross-sectional designs which used surveys. The 20 included studies were firstly grouped into broader sets according to their methodological framework, as quantitative ( $n=19$ ) and qualitative ( $n=1$ ). At this stage, it was clear that a narrative synthesis of qualitative studies would not be possible with a single study. Therefore, the findings from the individual qualitative study were integrated into the main synthesis. This process adhered to the relevant EQUATOR guidelines – narrative synthesis without a meta-analysis (SWiM) tool for reporting findings because of insufficient data for calculating standardised effect sizes and substantial heterogeneity among studies. More specifically, the outcomes were reported using different scales, and there was a lack of cause-and-effect relationships or interventions. There were also notable differences surrounding the PICO with HCWs (population) from 10 disciplines and the differences in sample sizes. These issues would render a meta-analysis of quantitative studies limited use and therefore a SWiM was the more appropriate reporting tool.

In grouping the included studies, the synthesis also identified some studies had more merit than others. For instance, studies with large sample sizes by Alrubaiee et al. (2020), Abed Alah et al. (2021), and Deressa et al. (2021) had over 1000 participants, and also had populations involving multiple HCWs disciplines as consistent with the aim of this systematic review (Table 3). No metrics were consistently used across the included cross-sectional studies. However, in determining statistical significance in the included studies, the  $p$ -values were used in the synthesis. As grouping the studies according to the HCWs disciplines ( $n=10$ ) showed an uneven representation, with the nursing studies dominating ( $n=8$ ); the included studies were sub-grouped according to thematic similarities, based on outcomes or ideas as shown in Table 3. This final synthesis incorporated the following overarching themes

TABLE 3 Data extraction information for systematic review studies.

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
45	Abdel Wahed et al., 2020	To assess the knowledge, perception, and attitude of the Egyptian HCWs towards the COVID-19 disease.	Egypt	407 HCWS	A descriptive cross-sectional study -Self-administered questionnaire	<ul style="list-style-type: none"> <li>• Sources of information about COVID-19</li> <li>• Physicians, MOHP website, and social media.</li> <li>• Knowledge mean - male and female no statistically significant difference.</li> <li>• Mean knowledge score higher in younger age groups</li> <li>• Knowledge score positively associated with attitude</li> </ul>	<p>PPE not always available, workplace circumstances such as crowdedness and ill-ventilation, and the population who do not commit to the preventive measures</p>
39	Abed Alah et al., 2021	To assess healthcare workers' compliance with IPC measures in different health care sectors in Qatar during COVID-19 pandemic	Qatar	1757 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>• Significant increase in the median self-rated compliance scores</li> <li>• Fully compliant with PPE</li> <li>• Fully compliant with hand hygiene</li> </ul>	<p>The most reported barriers were work overload and shortages of PPE and handwashing agents</p>
7	Abolfotouh et al., 2020	To assess perception and attitude of HCWs in Saudi Arabia with regard to COVID -19, and to identify potential associated predictors	Saudi Arabia	844 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>• Felt threatened if a colleague contracted COVID-19</li> <li>• Felt obliged to care for patients infected with COVID-19</li> <li>• Feel unsafe at work using the standard precautions</li> <li>• Predictors of high concern scores were; HCWs of younger age living with others</li> </ul>	<p>This study highlights the deep concern among HCWs about Covid-19 and identifies the predictors of those with the highest concern levels</p>

(Continues)

TABLE 3 (Continued)

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
41	Al-Dossary et al., 2020	To assess the awareness, attitudes, prevention, and perceptions about the COVID-19 outbreak	Saudi Arabia	500 nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Most nurses had excellent Knowledge of COVID-19</li> <li>Nurses had higher self-reported awareness, positive attitudes, optimal prevention, and positive perception</li> <li>Marital status showed a statistically significant difference between participants' responses for the prevention and perception domains</li> </ul>	Overall female nurses, married nurses, and BN degree nurses had greater awareness, better attitude, and prevention clinical experience towards COVID-19
10	Alrubaiee et al., 2020	To explore the knowledge, attitude, anxiety, and preventive behaviours among Yemeni HCPs towards COVID-19	Yemen	1231 HCPs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Obtained their information via social networks and news media</li> <li>Never attended lectures/discussions about COVID-19</li> </ul>	The majority of respondents had adequate knowledge, optimistic attitude, moderate level of anxiety, and a high-performance in preventive behaviours
58	Anuar et al., 2022	To assess COVID-19 knowledge, attitude and practice (KAP) among healthcare workers (HCWs)	Malaysia	373 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>HCWs showed good knowledge of COVID-19</li> <li>Nurses showed good attitude towards COVID-19</li> <li>Increased workload was challenging</li> <li>HCWs' workplace and profession were associated with good COVID-19 knowledge</li> </ul>	Challenges underlined by HCWs while working during the MCO were increased workload, and meet with family members



TABLE 3 (Continued)

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
59	Chanie et al., 2021	To assess the level of preparedness for COVID-19 and its associated factors among HCPs	Ethiopia	207 HCPs	A hospital-based descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Level of preparedness of HCWs for COVID-19</li> <li>Prepared to tell their family and friends if infected with COVID-19.</li> <li>Low level of preparedness</li> <li>Males less prepared</li> <li>Less knowledge for HCWs with less experience</li> </ul>	The most reported barriers were work overload and shortages of PPE and handwashing agents
60	Deressa et al., 2021	To assess preventive practices, perceived risk and worry about COVID-19 crisis among HCPs	Ethiopia	1134 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Perceived risk of becoming infected</li> <li>Potential risk of passing infection to family members</li> <li>Worried too many COVID-19 patients</li> <li>Fear of infecting loved ones</li> <li>Fear of losing someone due to COVID-19</li> </ul>	Increased perceived risk and worry about COVID-19 might enable healthcare workers to adopt appropriate IPC more effectively against the disease
32	Ersin et al., 2021	To determine the impact of nurses' fear of the coronavirus on health promoting and protective health behaviours	Turkey	301 Nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Correlation existed between the fear coronavirus and promoting and protective health behaviours</li> <li>IPC precautions reduced the fear of the coronavirus</li> </ul>	It can be recommended to conduct interventions to reduce the fear of the coronavirus
5	Ezike et al., 2022	To assess the risk perception, risk involvement/exposure and compliance to preventive measures to COVID-19 among nurses in a tertiary hospital in Asaba Nigeria	Nigeria	378 Nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>For the participatory observation, decontamination of high touch surfaces was poor in most of the units</li> <li>Personal protective equipment were lacking in some medical wards</li> </ul>	IPC measures for Covid 19 were neglected by the nurses, and this calls for reminder in the form of posters at strategic spots in

(Continues)

TABLE 3 (Continued)

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
15	Hasuike et al., 2021	To analyse feelings during the state of emergency in Japan, changes in behaviour and awareness after the rise of COVID-19, and the associated factors influencing these comparing nurses with nursing students	Japan	439 Nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Significantly increased scores anxiety/fear and voluntary restraint and significantly decreased score of motivation</li> <li>Preventive behaviour, lifestyle, anxiety</li> <li>Anxiety/fear and/or voluntary restraint and/or decreased motivation</li> <li>The type of hospital, experience of care of infected patients and sex affected some of the changes.</li> </ul>	This study demonstrates the importance of having a coping strategy for anxiety and damaged professionalism in nurses, and education on life and death in nursing students
53	Kassie et al., 2020	To assess the knowledge and attitude towards COVID-19, and associated factors among healthcare providers in Northwest Ethiopia in 2020	Ethiopia	408 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>The prevalence of knowledge and attitude towards COVID-19 was found to be high</li> <li>The Master's degree level of education was associated with knowledge of the participants</li> <li>Having good knowledge was positively associated with attitude of health care providers towards COVID-19</li> </ul>	Being Master's Degree holder and having good knowledge are associated with the knowledge and attitude of the respondents towards COVID-19
22	Kim & Kim, 2022	The aim of this study is to identify the factors influencing infection control practice related to COVID-19 in frontline emergency nurses.	Australia	161 nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Infection control practice related to COVID-19 was affected by the Infection prevention environment monitoring of Wearing Personal Protective Equipment</li> <li>Knowledge about COVID-19</li> <li>Perceived severity related to COVID-19 and perceived barrier related to COVID-19</li> </ul>	Creating safe infection prevention measures and revitalising PPE monitoring are necessary to improve infection control practices

TABLE 3 (Continued)

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
26	Latif et al., 2022	Our study explored the adherence to COVID-19 preventive measures and its associating factors among HCPs working in Saudi Arabia.	Saudi Arabia	978 HCPs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Participants were compliant with COVID-19 preventive behaviours</li> <li>Least compliant preventive behaviours were wearing masks and keeping social distancing</li> <li>Preventive behaviours were significantly higher in HCPs having more Knowledge of COVID-19</li> </ul>	Positive attitude, higher fear, nursing profession COVID-19 knowledge attitude and fear contributed significantly to IPC compliance
42	Linlin et al., 2021	This study aimed to investigate the attitudes and practices towards droplet and airborne universal precaution among nurses during the COVID-19 outbreak and to identify factors associated with IPC	Indonesia	550 Nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Attitude</li> <li>Perception of risk of contracting COVID-19</li> </ul>	To improve health services by enhancing and expanding tailored training programs for nurses on routine IPC and policies to better control
6	Odikpo et al., 2021	The study objectives include to determine the perception of nurses towards COVID-19 and to determine factors that influence IPC to COVID-19 among nurses in tertiary hospitals in Anambra State	Nigeria	344 nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>No formal training on COVID-19 protocol</li> <li>Good perception of the disease</li> <li>Can recognise symptoms easily</li> <li>COVID-19 could be handled professionally</li> </ul>	It is essential to prevent negative factors influencing IPC and also support the nurses with the necessary tools and knowledge to mitigate their exposure to the disease
63	Salwa et al., 2022	To assess healthcare workers' (HCWs) compliance with IPC and identify the factors influencing this compliance using the Health Belief Model as the theoretical framework	Bangladesh	604 physicians and nurses	A descriptive cross-sectional study Self-administered questionnaire	<p>Compliance with the IPC guidance was significantly associated with:</p> <ul style="list-style-type: none"> <li>Increasing age</li> <li>Female sex</li> <li>Working as a nurse and having non-communicable diseases and history of exposure to patients with COVID-19. Perceived benefits</li> </ul>	As self-efficacy exerted the greatest contribution to compliance, it should be emphasised in any endeavour to improve HCWs' IPC adherence

(Continues)

TABLE 3 (Continued)

Study #	References	Aim of study	Country	Sample size	Study design/data collection	Examples of results/findings	Keynotes
19	Yang et al., 2021	This study aimed to explore the levels and determinants of HCWs' IPC behaviours based on the TDF, which has been shown to be effective in guiding behaviour change.	China	768 HCWs	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Environmental context and resources domains were significantly related to hand hygiene</li> <li>Knowledge domain was significantly related to PPEs</li> <li>Emotion domain was a predictor of overall droplet isolation behaviours</li> <li>HCWs in high-risk departments had better compliance</li> </ul>	Adequate PPEs and human resources, education and training, as well as supervision and role model setting are necessary to improve IPC behaviours
8	Zandian et al., 2021	This study examined nurses' work intention, stress and professionalism levels and determined the relationship between nursing work intention and factors in response to COVID-19	Iran	362 nurses	A descriptive cross-sectional study Self-administered questionnaire	<ul style="list-style-type: none"> <li>Gender</li> <li>Marital status</li> <li>Training groups</li> </ul>	An adequate staff requirement plan, appropriate nurse training, and proactive psychological support are crucial to prevent burnout for IPC practices
14	Hobbs et al., 2021	The aim of this study was to understand the challenges that nurses and midwives face when seeking to practice social distancing within the various clinical settings in a hospital work environment during COVID-19	Australia	579 nurses and midwives	Cross-sectional (Qualitative)	<ul style="list-style-type: none"> <li>Challenges relating to social distancing with patients</li> <li>Patient care</li> <li>Nature of caring</li> <li>Challenges related to social distancing with colleagues</li> <li>The built environment</li> <li>People</li> <li>Equipment</li> </ul>	Overwhelmingly, responses indicated that participants found it challenging to practice social distancing in their workplaces across various clinical settings within the hospital

Note: Showing a summary of data extraction information from the included studies for a systematic review.

about knowledge, the person and the environment and their related sub-themes.

## 4 | KNOWLEDGE-ORIENTED FACTORS

Knowledge of IPC practice impacts HCWs' performances (Alah et al., 2022), and in many ways, knowledge is consistent with competency (Magadze et al., 2022). The reviewed studies identified the key elements of knowledge as being Knowledge of COVID-19 and Social media which correlated with the HCW's performance outcomes and scores.

### 4.1 | Knowledge of COVID-19

The competency and knowledge of HCWs about COVID-19 transmission modes and its associated risks are crucial for effective IPC practices (Alah et al., 2022). The main aspects of this knowledge from the reviewed studies ( $n=9$ ) incorporated: COVID-19 causes, modes of transmission, immunisation benefits, COVID-19 prevention and control measures, and associated risks (Abdel Wahed et al., 2020; Al-Dossary et al., 2020; Alrubaiee et al., 2020; Anuar et al., 2022; Kassie et al., 2020; Kim & Kim, 2022; Latif et al., 2022; Odikpo et al., 2021 and Yang et al., 2021). These identified the HCWs level of knowledge as central to their adherence to IPC practices. Latif et al. (2022) reported a positive correlation between HCWs' knowledge level and compliance with COVID-19 preventive behaviours ( $p=0.001$ ). In a related study, Abdel Wahed et al. (2020) reported a positive correlation between knowledge and attitude scores ( $p<0.001$ ). Notably, Knowledge of COVID-19 also correlated with their ages, in which younger age groups of 20- to 30-year-olds had significantly stronger knowledge levels. This evidence placed emphasis on HCWs' understanding of the appropriate IPC measures to ensure their readiness to address new mutant virus outbreaks which often occur without prior warning. In many instances, regular education and mandatory training in IPC procedures are necessary for HCWs' safety and quality of care. Updating their knowledge of IPC practices and transmission-based precautions is needed for recurring and new mutant virus outbreaks.

### 4.2 | Social media

Social media is a powerful educational and informative tool that is integral for raising awareness about various issues during mutant virus outbreaks. Social media has redefined the way healthcare workers receive information and communicate with others. The reviewed studies ( $n=3$ ) (Abdel Wahed et al., 2020; Abolfotouh et al., 2020; Alrubaiee et al., 2020) identified that social media influenced HCWs' behaviours towards COVID-19 prevention and control practices. Alrubaiee et al. (2020) reported that HCPs

( $n=1231$ ; 69.80%) generally had an adequate level of knowledge regarding COVID-19, with most respondents (57.1%) using social networks and news media as their source of information. Notably, most of these HCPs (60.0%) had never attended lectures or discussions specific to COVID-19 (Alrubaiee et al., 2020). In Abolfotouh et al. (2020), most HCWs ( $n=844$ ; 85%) developed significantly greater concern about the COVID-19 pandemic because of social media. The impact of social media also varied with age groups. As Abdel Wahed et al. (2020) reported, the influence of social media was significant in younger age groups (20–30 years of age), with them having the highest level of knowledge about COVID-19. This was credited to their capabilities to use online resources (social media and MOHP/WHO) to keep up to date with COVID-19 information, indicating the importance of social media in HCWs' communication and knowledge acquisition. This knowledge of COVID-19 was identified as crucial for HCWs' adherence with IPC practice. More often, HCWs had not acquired their knowledge from formal education or lectures but from other sources, which included government websites and social media. Given that social media influenced HCWs' behaviours for decision-making during the COVID-19 pandemic, it is important for infection control leaders, educators and university curriculum developers to consider how social media can be used as an open platform for learning and communication, and for expressing opinions and evaluating knowledge of IPC practices.

## 5 | PERSON-ORIENTED FACTORS

Within the theme of person-oriented factors personality was identified as being integral to the HCWs' behaviours towards IPC in the COVID-19 space. The influences of behaviours towards IPC were related to fear and concern for others, marital status, age groups and attitude towards COVID-19.

### 5.1 | Fear and concern for others

The high level of COVID-19 transmissibility and associated mortality of HCWs reported from even some of the most developed nations heightened the anxiety and fears of HCWs (World Health Organization, 2020). Increased fear and anxiety can influence human behaviours was discussed in a number of studies ( $n=8$ ) (Abdel Wahed et al., 2020; Abolfotouh et al., 2020; Anuar et al., 2022; Deressa et al., 2021; ErsiN et al., 2021; Ezike et al., 2022; Hasuikie et al., 2021; Kim & Kim, 2022; Latif et al., 2022; Yang et al., 2021) which identified the fear of HCWs about COVID-19 driving their increased compliance with IPC practices. Latif et al. (2022) reported that increased levels of fear positively correlated with improved COVID-19 preventive compliance behaviours ( $p<0.001$ ) among HCWs. Parallel outcomes were reported by Abolfotouh et al. (2020), who found that many HCWs (69.1%) developed fears of contracting COVID-19 while at

work, and also HCWs (69.9%) had improved IPC compliance if a colleague contracted COVID-19. In Deressa et al. (2021) HCWs (92%) were most worried about the health system being overwhelmed by COVID-19 patients as this increased their risk of being infected. While the majority of HCWs dreaded contracting COVID-19, others were concerned about cross-transmission prospects to other people. In Deressa et al. (2021) HCWs (90%) developed concern about the welfare of the vulnerable. Similarly, Abdel Wahed et al. (2020) found that HCWs (98.5%) often feared transmitting COVID-19 to their families. For Hasuike et al. (2021), an increased score of anxiety or fears of COVID-19 ( $p < 0.005$ ) was exacerbated by an increase in the frequency of preventive measures. In a mixed finding, Anuar et al. (2022) reported that more than half of the HCWs (59.0%) did not report any fear of contracting COVID-19 from their workplace. While having fear and anxiety is not a pleasant human experience, it is important to understand that these responses compelled some HCWs to improve their compliance with IPC practices. Many feared serious illness or death for themselves or significant others. This served as a catalyst in driving HCWs to adopt measures which mitigated the risk of infection and as a consequence improve clinical practice, safety and quality.

## 5.2 | Marital status

Marital or relationship status can influence human behaviours in many ways. The reviewed studies ( $n=7$ ) identified the status of being married or single as influencing HCWs' behaviours towards IPC practices in the COVID-19 space differently. Most of these studies ( $n=6$ ) (Abolfotouh et al., 2020; Al-Dossary et al., 2020; Anuar et al., 2022; Chanie et al., 2021; ErsİN et al., 2021) reported marital status as correlating with HCWs' compliance with IPC practices on COVID-19. However, of the seven studies, only Zandian et al. (2021) found no correlations between marital status and behaviours to IPC practices. Al-Dossary et al. (2020) found that married nurses scored statistically higher than single respondents in the prevention and perception domains ( $p=0.009$ ). Anuar et al. (2022) reported that HCWs' marital status was associated with an optimistic or positive attitude towards COVID-19 IPC measures ( $p < 0.001$ ). In Labrague et al. (2020), nurses' coronavirus fear levels were higher in married women, which influenced their behaviours towards IPC. Similarly, ErsİN et al. (2021) reported lower levels of fear of contracting the virus in single HCWs than married ones. Thus, the HCWs' fear of COVID-19 correlated with their compliance with IPC practices. This finding parallels outcomes from a study by Chanie et al. (2021), of those having a single status correlating with low levels of preparedness ( $p < 0.05$ ). The low level of preparedness among unmarried healthcare providers was 3.4 times higher than among married healthcare providers. Abolfotouh et al. (2020) also reported that the level of concern regarding COVID-19 positively correlated with marital status ( $p=0.043$ ). Contrary to the findings of most studies in this

review, Zandian et al. (2021) reported no significant relationships between marital status and professional nursing intention ( $p < 0.05$ ). The aspect of the HCWs being in a relationship or married was identified as another common driver for adherence to IPC practices. A probable result of being concerned about the welfare of their family members and significant others.

## 5.3 | Attitude towards COVID-19

Attitude has a significant influence on human behaviours. Studies ( $n=6$ ) (Alrubaiee et al., 2020; Latif et al., 2022; Linlin et al., 2021; Odikpo et al., 2021; Salwa et al., 2022) found a co-relationship between HCWs' attitude and their compliance with IPC practices with one study by Anuar et al. (2022) reporting a different outcome. Latif et al. (2022) reported that HCWs with a positive attitude had higher preventive or compliance behaviour ( $p=0.001$ ). In a study by Alrubaiee et al. (2020), 85.10% of HCPs respondents ( $n=1231$ ) had an optimistic attitude towards COVID-19, which positively correlated with their high performance of IPC practices. Linlin et al. (2021) found that HCWs' attitudes to IPC positively correlated with droplet and airborne isolation precautions practices during the COVID-19 pandemic ( $p=0.004$ ). Salwa et al. (2022) found a significant correlation between HCWs' higher scores of IPC practices compliance and perceived benefits ( $p=0.001-0.076$ ). Notably, Anuar et al. (2022) found that an increase in age by a year had lesser odds of a good attitude ( $p=0.001$ ). The outcomes from most of the studies demonstrate how positive attitudes were built on the HCWs' perceived benefits of IPC practices for themselves, their patients and their families.

## 5.4 | Age groups

Productivity deficiencies and age stereotypes are common towards older workers (Viviani et al., 2021). The reviewed studies ( $n=4$ ) (Abdel Wahed et al., 2020; Abed Alah et al., 2021; Ezike et al., 2022; Odikpo et al., 2021) identified correlations between the HCWs age groups with compliance with IPC practices in the COVID-19 space. Salwa et al. (2022) found that the age of HCWs increased with their compliance with IPC guidance ( $B=0.005$ , 95% CI 0.002 to 0.008). A study by Zandian et al. (2021) reported that nursing intention had a significant relationship with IPC compliance in older age groups ( $p < 0.001$ ). For Anuar et al. (2022), an increase in one year of age had lesser odds of a good attitude to IPC behaviours ( $p=0.001$ ). However, some mixed outcomes were reported by Abed Alah et al. (2021), who found that knowledge of IPC practices and compliance were significantly higher in younger age groups of 20- to 30-year-olds. This was because of their proficient technical skills in accessing online resources (social media and MOHP/WHO), which kept them updated with COVID-19 information.

## 6 | ENVIRONMENT-ORIENTED FACTORS

The included studies reported the physical clinical setting as influencing HCWs' behaviours towards IPC practices. The key elements of the environment which also varied institutionally were work environment, work overload, social distancing with patients, colleagues and sharing equipment.

### 6.1 | Work environment

A lived environment (spatiality) impacts how people interact with each other (van Manen, 1990). Similarly, a working environment influences HCWs' work performance and interaction with others. The reviewed studies ( $n=5$ ) by Abdel Wahed et al. (2020), Al-Dossary et al. (2020), Kim and Kim (2022), Hobbs et al. (2021) and Yang et al. (2021) reported a correlation between the status of the clinical environment and HCWs' compliance with IPC practices. For instance, Abdel Wahed et al. (2020) identified that many clinical environments included crowdedness (61.4%), poor ventilation (72%) and the population not adhering to infection prevention and control measures (75.4%). These influenced the work of HCWs' in these contexts by contributing to poor IPC practices and the resulting prevalence of COVID-19. Similarly, Kim and Kim (2022) found that the environment influenced HCWs' behaviours towards IPC practices related to COVID-19 ( $p=0.002$ ). Another reviewed study by Al-Dossary et al. (2020) found that nurses working in high-risk environments such as operating theatres demonstrated better awareness, prevention and attitudes to IPC practices than those from general wards ( $p$ -value of 0.005). This lies bare the variations in the learning trajectories for HCWs from the different environments, with those in less acuity at a disadvantage – hence the need for measures to close the gap. Consistent findings were reported by Yang et al. (2021), who described compliance with IPC practices among HCWs in the context of the environment domain as a determinant of HCWs' adherence to hand hygiene practices ( $p=0.026$ ). In addition, they reported that HCWs in high-risk clinical environments were more compliant with IPC than elsewhere.

### 6.2 | Work overload

The care of patients with novel COVID-19 requires special skills which are labour intense. This can often result in work overload with a direct influence on IPC practices, as reported in studies by Abed Alah et al. (2021), Al-Dossary et al. (2020), Hasuikie et al. (2021), Odikpo et al. (2021) and Zandian et al. (2021). Notably, Al-Dossary et al. (2020) found that, before the COVID-19 outbreak, 25% of the nurses ( $n=500$ ) were only working 12h per day, which increased to 46.2% after the outbreak. In essence, HCWs were working longer hours with increased responsibilities. In a study by Odikpo et al. (2021), 43.0% of the nurse respondents ( $n=344$ ) experienced an acute shortage of nurses during their shifts, resulting in increased

care responsibilities by 51.7%. Zandian et al. (2021) found that HCWs who were engaged in heavy workloads and also working extended hours experienced higher stress levels as a consequence ( $p<0.001$ ). Two studies by Hasuikie et al. (2021) and Abed Alah et al. (2021) found similar outcomes of nurses who worked long hours with heavy workloads as feeling demotivated, with a direct negative influence on IPC practices. In many instances, workload correlated with compliance with IPC practices as HCWs with unreasonably heavy workloads were often less likely to be compliant with IPC practices. This finding calls for a review of nurse staffing models and the need for reasonable adjustments to workload for patient safety by ensuring infection prevention and control is prioritised.

### 6.3 | Social distancing with patients

The practice of maintaining a safe or appropriate physical distance from other people during the COVID-19 outbreak influenced HCWs behaviours. Nurses and midwives needed to abide by social distancing at the point-of-care. However, participants in the study by Hobbs et al. (2021, p.31) stressed how basic clinical care was not practicable in the presence of social distancing with Participant 98 explaining '*Many interactions are physical, negating social distancing. The importance of touch is embedded in our practice of healing, making social distancing an anathema to our cultural practices*'. Hobbs et al. (p.31) also reported that '*Care, comfort and empathy are difficult to achieve without touching*' (Participant 34) and '*Showing empathy to patients and relations require physical touch*' (Participant 146). These findings demonstrate that nursing is a hands-on profession requiring these HCWs to be in close contact with their patients, even though social distancing was to be implemented.

### 6.4 | Social distancing with colleagues and sharing equipment

Compliance with IPC practices was described as worse during medical rounds, clinical handovers and emergency calls. Participant 69 stated: '*I work in an ED. We cannot do our job while social distancing. A trauma patient may have 25+ people in the room working on them*', while Participant 69 summarised this by saying: '*Not enough physical space to keep apart*' (Hobbs et al., 2021, p.31). As the accounts revealed, the congested clinical settings and emergency team calls response, made it almost impossible to comply with IPC practices. Equipment was often shared across the disciplines. The most common shared equipment were desktop phones, stethoscopes, sphygmomanometers, computers, and other emergency and administrative equipment (Hobbs et al., 2021). Participant 132 expressed how not sharing was impossible: '*Biggest issue is shared equipment and surfaces, e.g. computers, desk surfaces, physical patient notes, blood pressure devices*' (Hobbs et al., 2021, p.32). Similar concerns were raised by participants 148, 106 and 66, who all felt that the HCWs within the congested clinical spaces,

particularly the nursing station, were often non-compliant to IPC practices.

The lack of an obvious solution to eradicate COVID-19, resulted in the World Health Organisation stressing the importance of social and physical distancing to limit transmission (World Health Organization, 2020). The crowded clinical space made it impossible to comply with, supervise or monitor IPC practices. Social distancing with colleagues and sharing clinical equipment all combined to influence how HCWs responded to IPC practices.

## 6.5 | Personal protective equipment (PPE)

Transmission-based personal protective equipment (PPE) is mandatory for frontline HCWs in the acute care setting (Clinical Excellence Commission, 2022). Without adequate PPE for managing patients infected with COVID-19, HCWs developed many fears. Abdel Wahed et al. (2020) reported the unavailability of PPE at the point-of-care as a fear-provoking experience for HCWs (83.6%), who felt vulnerable to being infected and causing cross-transmission. The review studies by Abdel Wahed et al. (2020), Abed Alah et al. (2021), Alrubaiee et al. (2020), Chanie et al. (2021), Ezike et al. (2022), Odikpo et al. (2021), Salwa et al. (2022) and Zandian et al. (2021) all reported PPE as influencing HCWs' behaviours towards IPC practices during COVID-19. Three studies by Abed Alah et al. (2021), Alrubaiee et al. (2020) and Ezike et al. (2022) found that the shortage of PPE contributed to a lack of IPC practice compliance for HCWs. Findings by Odikpo et al. (2021) identified that remembering to use PPE (45.9%) and the lack of time to apply this in an emergency (49.4%) were key factors which negatively influenced HCWs compliance with IPC practices. While adequate supplies of PPE correlated with HCWs' compliance with IPC practices (Abdel Wahed et al., 2020; Abed Alah et al., 2021; Alrubaiee et al., 2020), a study by Salwa et al. (2022) contradicted this in that supply had no direct influence, and instead, it was their perception of risk ( $p < 0.001$ ). Parallel to Salwa et al. (2022), an earlier outcome by Chanie et al. (2021) found that HCWs' behaviours were influenced by fear of death rather than the mere availability of PPE. As humans do not want to exist in solitude (Mutsonziwa & Green, 2011), the reluctance to maintain physical and social distancing requirements influenced HCWs' behaviours towards IPC practices. Consequently, in the clinical space, the availability and easy access to PPEs enabled healthcare interactions by HCWs donning and doffing PPE whenever required. However, due to their heavy workloads and having fewer resources, this often compromises compliance with IPC practices and safety in providing quality of care (Magadze et al., 2022).

## 7 | DISCUSSION OF THE RESULTS

As the first line of defence in new or re-emerging new mutant virus outbreaks, HCWs' preparedness to counter any new mutant virus

outbreaks is crucial. This review has identified various factors influencing their behaviours towards IPC practices in the COVID-19 space, from which overarching domains emerged as oriented in knowledge, person and the environment. Based on these factors, the HCWs' behaviours towards IPC practices were further examined as representing positive (compliance) or negative (non-compliance) behaviours.

*Knowledge-oriented influences* placed an emphasis on the HCWs' practical and theoretical understanding, and awareness of IPC practices for COVID-19 as drivers for compliance. Their knowledge varied based on healthcare disciplines, age groups, attitudes and scope of practice. Given that, nurses and doctors had high levels of knowledge, their awareness of IPC practices was consistent with their influential roles in the implementation of universal and transmission-based IPC measures; and policing of IPC practices through periodical surveys (Almohammed et al., 2021). This finding is parallel to the results from an Australian study by Nahidi et al. (2022), which identified knowledge of COVID-19 as crucial for HCWs at point-of-care to minimise transmission risks. Additionally, the reviewed studies reported positive correlations between young-age groups with higher levels of knowledge. This reflects their advanced technical skills in accessing COVID-19 information online and social networking (Abdel Wahed et al., 2020). This is particularly significant for the younger age groups, who are the future healthcare workforce in a digital world. Despite the knowledge of this younger group, it was the HCWs from the older age groups that had higher level of compliance with IPC practices (Abdel Wahed et al., 2020; Abed Alah et al., 2021; Ezike et al., 2022; Odikpo et al., 2021). It is likely that this compliance was related to a fear severe illness and death given the reports on COVID-19 morbidity and mortality increasing with ageing (World Health Organization, 2020).

Knowledge of COVID-19-related information was overtly influenced by social media platforms such as WhatsApp and WeChat groups. Although these were instrumental in the swift distribution of informative and educational material, which helped with timely updates, World Health Organization (2020) broadcasted a warning about the dangers of the infodemic. False information or misinterpretations potentially impacted clinical practice with adverse outcomes at times (Abolfotouh et al., 2020; Alrubaiee et al., 2020). Despite these incidents and warnings about using information from social media, WhatsApp and Facebook have emerged as game-changers in moving users from depending on the traditional ways of information dissemination and knowledge acquisition, due to its interconnectedness and speed of information exchange for HCWs and society. The studies by Alrubaiee et al. (2020), Abolfotouh et al. (2020) and Abdel Wahed et al. (2020) also reported that education campaigns conducted via social media increased awareness and reached large populations. The high level of social media usage to disseminate information on COVID-19 discussed in the reviewed studies demonstrated how the pandemic has both challenged and transformed some of the conventional ways of sharing clinical education information. This knowledge and awareness of COVID-19



transmission risks and the associated IPC practices may have motivated HCWs' compliance with IPC practices.

*Person-oriented* influences revealed how the individual HCW's attributes and relationships with others impacted behaviours towards IPC practices. For example, the HCWs' fear of COVID-19 had two main facets, involving: the fear of being infected with potential adverse outcomes and the concern of cross-transmission to other people at risk. This fear of COVID-19 was often exacerbated by media propaganda and the associated death rates (Ezike et al., 2022). Notably, females developed higher levels of fear of COVID-19, which also positively corrected with higher adherence to IPC practices than men (Abdel Wahed et al., 2020; Salwa et al., 2022). Although fear has adverse physical and life-threatening implications for the population (Abolfotouh et al., 2020; Nkire et al., 2022; Quadros et al., 2021; Stefanatou et al., 2022), it motivated the HCWs to take drastic measures to minimise transmission (Pakpour & Griffiths, 2020), therefore serving others. Similar to other new mutant virus outbreaks, such as during the SARS epidemic, HCWs reported adverse psychological experiences such as depression, fear and anxiety; however, expressed a willingness and commitment to serve (Ko et al., 2004). While the fear of COVID-19 emerged as a driver for HCWs' compliance with IPC practice, there is a need to strike a balance between compliance and at the same time mitigate the adverse effects of fear and anxiety from COVID-19.

Drawing from Ajzen (1985) theory of planned behaviour, which describes how subjective norms and intentions influence behaviour, this review revealed how personal attitudes impacted HCWs' behaviours towards IPC in the COVID-19 space. As social beings people exist in relationships with others (van Manen, 1990), which may explain why the personal relationships of HCWs involving marital status influenced their IPC practices. In this context, HCWs perceived compliance with IPC practices as crucial for the safety of others they cared about and considered at risk. For example, several studies (Abolfotouh et al., 2020; Al-Dossary et al., 2020; Anuar et al., 2022; Chanie et al., 2021; ErsiN et al., 2021) found a positive association between HCWs who were married or in a relationship with their IPC compliance compared to those who were single. Similar findings were highlighted from a previous study (Fang & Hung, 2014) which reported that married nurses working in healthcare institutions cared not only for patients' safety but were profoundly more cautious due to the safety and wellbeing of their own families. Moreover, the ongoing COVID-19 outbreaks that threatened human health (World Health Organization, 2021) created substantial fear and concern for HCWs and for vulnerable people.

*Environment-oriented influences* identified the physical clinical space and the associated institutional and administrative controls, such as policies and workload, as instrumental for HCWs' behaviours towards IPC practices. The working space can impact our daily work, just like our lived space (van Manen, 1990). The key descriptors of a COVID-19 physical environment emerged as ventilation, space

limitations, occupant numbers, physical distancing and workload. It is also known that the nature of clinical environments determines disease dynamics, directly impacting infection risks and cross-transmission (Pinter-Wollman et al., 2018). For this reason, social distancing between patients and HCWs was not always achievable as clinical work is embedded in teams where clinical and administrative equipment are routinely shared (Hobbs et al., 2021; Latif et al., 2022). The challenges presented within these healthcare contexts indicate the need for innovative measures to ensure that the effort to implement the recommended physical distancing and sharing of clinical equipment did not negate the very purpose of healthcare work of providing timely care and safety.

Institutional and organisational jurisdictions influence policy development and governance, and these have an impact on HCWs' work (Brubacher et al., 2022). In the COVID-19 space, institutions have had the primary role in the supply of transmission-based PPEs and in addressing critical unreasonable workload issues which arose from acute shortage of manpower. Research has widely reported that the availability of adequate resources, appropriate PPEs and reasonable workload are common motivators for HCWs' adherence to IPC practices at point-of-care (Al-Dossary et al., 2020; Hasuikie et al., 2021; Odikpo et al., 2021; Zandian et al., 2021). Lack of adequate PPEs resulted in some HCWs resorting to improvisation with non-standardised measures. This is an occupational, health and safety risk with consequences on HCWs, their patients and communities (Pinter-Wollman et al., 2018). In the reviewed studies, increased HCW workloads caused adverse physical and psychological effects, compromising HCW compliance with IPC practices.

The point-of-care environment, individual healthcare worker's personalities and knowledge of IPC practices all combined to influence HCWs' behaviours towards the control and prevention of COVID-19 with the ultimate impact on quality and safety. Considering, the high death rates among HCWs from COVID-19 (World Health Organization, 2021), addressing the factors influencing HCWs are multifaceted and requiring multidisciplinary involvement.

## 8 | LIMITATIONS

While this review has reported some important outcomes for IPC practices, some limitations were identified in sample sizes, healthcare workers, the scope of practices, survey questions and outcome measures of the included studies, which prevented the use of a meta-analysis. This could limit the generalisability of the results across all healthcare disciplines.

The reviewed studies were largely cross-sectional (19) which are often considered useful for establishing preliminary evidence when planning for a future advanced study (Wang & Cheng, 2020). These studies mostly used self-administered questionnaires information from online surveys. Arguably, the anonymous online surveys ensured an element of blinding to mitigate the risk of bias; however,

there is always a risk of poor responses. As self-administered online questionnaires were used in the non-interventional studies, the factors influencing HCWs' behaviours towards IPC practices were mainly based on subjective outcomes and non-measurable reports, which do not demonstrate the causal relationship between variables. The other limitation was that the reviewed studies mainly included nurses as participants. While this is a strength and a reflection of the role of nurses 'in the field' and at the forefront of IPC practices, this could limit the generalisability of the findings to all healthcare disciplines. A standalone nursing review would be recommended for more specific results relevant to the nursing discipline. Furthermore, the original aim was to conduct an integrative literature review; however, a meta-synthesis of qualitative studies could not be achieved using a single study; hence, this was incorporated into the main synthesis. Limiting the studies to the English language excluded three primary studies written in other languages. Notably, most reviewed studies were conducted in developing countries, so the generalisability of the results in a global context may be limited. The overall strength of this review process is its adherence to PRISMA guidelines and SWiM checklist, which guarantee the quality of the review process.

## 9 | CONCLUSION

Healthcare workers' responsibilities at point-of-care involve providing direct care to patients with highly transmissible infections and working in clinical settings that may be ill-designed for social or physical distancing. This increases their vulnerability to infection and increased risk of cross-transmission to other people. With IPC as the mainstay of reducing the transmissibility of infectious diseases measures strengthening these practices is crucial. In the COVID-19 space, this review identified the influences of HCWs' behaviours towards IPC practices as oriented in the person, knowledge and the environment. These factors should be considered when developing strategies to mitigate infection risks and further developing a model for the rapid response and safety required for HCWs during emerging new mutant virus outbreaks. This is significant, given that HCWs' preparedness with IPC practices at point-of-care is central to patient care, the workforce and community safety.

### SPONSORSHIP

Two (2) Bachelor of Nursing Students from the University of Western Sydney received Summer Scholarship awards to assist with the conduct of this systematic review.

### AUTHOR CONTRIBUTIONS

This study contributes towards understanding measures to assist bachelor of nursing students with infection prevention and control practices at point-of-care, which is the primary project. GM, PG, MK, MM: Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. GM, PG: Involved in drafting the manuscript or revising it critically for

important intellectual content. GM, PG, MK, MM: Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. GM, PG: Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

### ACKNOWLEDGEMENTS

I would like to acknowledge the hard work of all the reviewers throughout this systematic review. I also recognise the contribution of the Librarian for assisting in the systematic search of literature and Endnote guidance. Open access publishing facilitated by Western Sydney University, as part of the Wiley - Western Sydney University agreement via the Council of Australian University Librarians.

### FUNDING INFORMATION

Western Sydney University, Summer Scholarship Funding was received for MK and MM in 2022.

### CONFLICT OF INTEREST STATEMENT

The authors have no competing or conflicts of interest to declare.

### DATA AVAILABILITY STATEMENT

Data for this review was gathered from the included studies.

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**How to cite this article:** Mutsonziwa, G. A., Mojab, M., Katuwal, M., & Glew, P. (2024). Influences of healthcare workers' behaviours towards infection prevention and control practices in the clinical setting: A systematic review. *Nursing Open*, 11, e2132. <https://doi.org/10.1002/nop2.2132>

## APPENDIX A

Databases, search process and records.

Database	PsycINFO	CINAHL	Medline	Scopus	Google scholar
Keywords	Synonyms for search terms				
Healthcare workers	Coronavirus OR Covid* OR Covid-19 OR SARS-CoV	Coronavirus OR Covid* OR Covid-19 OR SARS-CoV	Coronavirus OR Covid* OR Covid-19 OR SARS-CoV	Coronavirus OR Covid* OR Covid-19 OR SARS-CoV	Coronavirus OR Covid* OR Covid-19 OR SARS-CoV
Behaviour	Health care worker OR Health care professional OR healthcare professional OR healthcare worker OR Healthcare worker OR Health care worker OR Nurs* OR Nursing	Health care worker OR Health care professional OR healthcare professional OR healthcare worker OR Healthcare worker OR Health care worker OR Nurs* OR Nursing	Health care worker OR Health care professional OR healthcare professional OR healthcare worker OR Healthcare worker OR Health care worker OR Nurs* OR Nursing	Health care worker OR Health care professional OR healthcare professional OR healthcare worker OR Healthcare worker OR Health care worker OR Nurs* OR Nursing	Health care worker OR Health care professional OR healthcare professional OR healthcare worker OR Healthcare worker OR Health care worker OR Nurs* OR Nursing
Infection prevention and control	Behaviour OR Compliance OR Non- compliance OR Knowledge OR Perception OR Practice OR Non- adherence OR Attitude OR compliant OR Compliant*	Behaviour OR Compliance OR Non- compliance OR Knowledge OR Perception OR Practice OR Non- adherence OR Attitude OR compliant OR Compliant*	Behaviour OR Compliance OR Non- compliance OR Knowledge OR Perception OR Practice OR Non- adherence OR Attitude OR compliant OR Compliant*	Behaviour OR Compliance OR Non- compliance OR Knowledge OR Perception OR Practice OR Non- adherence OR Attitude OR compliant OR Compliant*	Behaviour OR Compliance OR Non-compliance OR Knowledge OR Perception OR Practice OR Non- adherence OR Attitude OR compliant OR Compliant*
Factor	Factor* OR Driver* OR Enabler*	Factor* OR Driver* OR Enabler*	Factor* OR Driver* OR Enabler*	Factor* OR Driver* OR Enabler*	Factor* OR Driver* OR Enabler*
Initial search found	1731	588	881	0	2017
Limiters	Date range – 2019 to 2022 Peer reviewed English language	Date range – 2019 to 2022 Peer reviewed English language Major Headings	Date range – 2019 to 2022 Peer reviewed English language Health personnel	Date range – 2019 to 2022 Peer reviewed English language Journal article	Date range – 2019 to 2022 Peer reviewed English language Journal article Include citations
Records found	176	186	190	0	223
Records scanned	7	28	15	0	8

Note: Showing the databases, search works, and total records gathered from the search activities.

## APPENDIX B

Analytical cross-sectional studies.

Reviewer \_\_\_\_\_ Date \_\_\_\_\_  
Author \_\_\_\_\_ Year \_\_\_\_\_ Record Number \_\_\_\_\_

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the study subjects and the setting described in detail?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Yes	No	Unclear	Not applicable
4. Were objective, standard criteria used for measurement of the condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include  Exclude  Seek further info .

Comments (Including reason for exclusion).

## APPENDIX C

JBI critical appraisal checklist for qualitative research.

Reviewer \_\_\_\_\_ Date \_\_\_\_\_

\_\_\_\_\_

Author \_\_\_\_\_ Year \_\_\_\_\_

Record Number \_\_\_\_\_

	Yes	No	Unclear	Not applicable
1. Is there congruity between the stated philosophical perspective and the research methodology?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is there congruity between the research methodology and the research question or objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is there congruity between the research methodology and the methods used to collect data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there congruity between the research methodology and the representation and analysis of data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is there congruity between the research methodology and the interpretation of results?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is there a statement locating the researcher culturally or theoretically?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is the influence of the researcher on the research, and vice versa, addressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are participants, and their voices, adequately represented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include  Exclude  Seek further info .

Comments (Including reason for exclusion).