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Review Article

Barriers and Facilitators to the Use of Personal Protective Equipment in Long-Term Care: A Scoping Review



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A B S T R A C T

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Objective: To review existing literature evaluating barriers and facilitators to the use of personal protective equipment (PPE) by health care workers in long-term care (LTC).

Design: Scoping review.

Setting and Participants: Health care workers in LTC settings.

Methods: Several online databases were searched and a gray literature search was conducted. Study inclusion criteria were (1) conducted in nursing homes or LTC settings, (2) focused on LTC health care workers as the study population, and (3) identified barriers and/or facilitators to PPE use. The Theoretical Domains Framework (TDF), which assesses barriers to implementation across 14 behavioral change domains, was used to extract and organize data about barriers and facilitators to appropriate use of PPE from the included studies.

Results: A total of 5216 references were screened for eligibility and 10 studies were included in this review. Eight of the 10 studies were conducted during the COVID-19 pandemic. Several barriers and facilitators to PPE use were identified. The most common TDF domain identified was environmental context and resources, which was observed in 9 of the 10 studies. Common barriers to PPE use included supply issues (n = 7 studies), the cost of acquisition (n = 3 studies), unclear guidelines on appropriate use of PPE (n = 2 studies), difficulty providing care (n = 2 studies), and anxiety about frightening patients (n = 2 studies). Having PPE readily available facilitated the use of PPE (n = 2 studies).

Conclusions and Implications: Further research is necessary to identify barriers and facilitators more extensively across behavior change domains to develop effective strategies to improve PPE use and prevent infection transmission within LTC.

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Controlling exposure to potentially infectious agents is fundamental to protecting health care workers and patients/residents. Personal protective equipment (PPE) protects health care workers and patients/residents from infectious agents of epidemiologic concern via contact exposure to blood/body fluids, respiratory droplets and fine aerosols.¹ There are 2 different modes of pathogen transmission: direct transmission through direct contact or droplet spread, and indirect transmission, which includes airborne transmission, vehicle-

borne transmission, and vector-borne transmission.² In response to the unique transmission modes of different infectious agents, there are different components of PPE (masks, gloves, gowns, and shields) that can be used in combination with the others to protect health care workers.³

PPE is an important strategy for protecting health care workers and patients/residents from infectious agents during clinical interactions.^{4–6} Health care workers' adherence to appropriate PPE use and other infection prevention and control measures is important to prevent the spread of nosocomial infections. Several guidelines exist to ensure that health care workers take steps to mitigate infection transmission.^{7–10} If PPE is not properly used, health care workers can be exposed to infectious pathogens that can potentially infect themselves and their patients/residents.

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Infection transmission needs to be limited in vulnerable populations, such as long-term care (LTC) residents. LTC facilities are designed to care for individuals living with frailty and complex medical needs who require 24-hour on-site care.¹¹ Nursing services are available on-site in LTC for 24 hours, 7 days per week. However, most personal care services, including assistance with activities of daily living, are provided by health care aides and licensed practical nurses. Because of factors such as physiologic changes associated with aging, multiple comorbidities, functional and cognitive impairment, and increased opportunities for transmission of pathogens in institutional settings, additional focus needs to be placed on preventing infection in LTC settings.^{12,13}

Infections impose a large burden on LTC facilities. In the United States, endemic infections occur with frequencies estimated between 1.64 and 3.84 million per year and costs associated with these infections exceed \$1 billion.¹⁴ Despite the burden of infection in LTC facilities, research has shown that health care workers in LTC facilities are poorly informed about infection prevention and control procedures and adherence to these procedures tends to be low.^{15–17} Several infection prevention and control issues have arisen in LTC facilities leading to outbreaks, including improper use of PPE.¹⁸ Issues with PPE included potential cross-contamination between residents when health care workers did not change gloves between caring for different residents or by storing PPE in the room of the index case.^{19,20}

In acute care settings, the perceptions of health care workers about PPE have been previously evaluated.^{21–26} Factors such as poor PPE fit, lengthy and ambiguous infection prevention and control guidelines, frequently changing guidelines, mistrust of guidelines, level of clinical experience, lack of PPE access, low perception of risk of contamination, and low-quality PPE contributed to health care workers not using PPE correctly. From the same studies, when PPE use became a social norm, visual cues to use PPE were available, and when health care workers perceived greater danger, health care workers believed they were more likely to use PPE. In LTC settings, it is unclear whether similar barriers and facilitators to PPE use exist.

Accordingly, the objective of this scoping review was to understand what barriers and facilitators exist to the use of PPE by health care workers in LTC settings. The factors that affect why health care workers in LTC settings use or do not use PPE needs to be properly understood before interventions can be designed to encourage the proper use of PPE within this context.

Methods

Protocol and Registration

A scoping review of the published literature of PPE use in LTC settings was conducted to address the following question: what barriers and facilitators exist to the uptake and appropriate use of PPE by health care workers in LTC facilities? The research question was guided by the PCC (population, concept, and context) framework.²⁷ The population of interest was registered nurses, licensed practical nurses, and health care aides. The concept of interest was determining the barriers and facilitators to uptake and appropriate use of PPE within the context of LTC facilities. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist was followed.²⁸ The protocol for this scoping review was preregistered on Open Science Framework (Registration DOI: 10.17605/OSF.IO/SEZDP, Center for Open Science).²⁹

Information Sources

Online databases were searched from database origin to November 4, 2021, including Medline (Ovid), Embase, CINAHL, medRxiv, the Cochrane Central Register of Controlled Trials, and the Cochrane

Database of Systematic Reviews (Supplementary Table 1). A gray literature search was conducted between January 7, 2022, and January 25, 2022, using the Canadian Agency for Drugs and Technologies in Health (CADTH) Grey Matters tool³⁰ and the University of Toronto's guide to searching gray literature.³¹ The search strategies used a combination of controlled vocabulary (eg, "Health Personnel," "Personal Protective Equipment," and "Long-term Care") and keywords (eg, "nurse," "mask," "nursing home") (Supplementary Table 1). Vocabulary and syntax were adjusted across the databases. No language or date limits were applied. The reference lists of all included articles were searched for additional studies. All study designs were considered for inclusion. Only literature that used human participants was included. One reviewer conducted the searches for the scoping review. Covidence (Veritas Health Innovation) was used to manage identified articles and reports throughout the scoping review.

Eligibility Criteria and Selection of Sources of Evidence

Abstracts identified through database searching were screened in duplicate independently by 2 reviewers, and all abstracts included at this stage by either reviewer proceeded to full-text review. Included were abstracts that were set in nursing homes or LTC settings or focused on LTC health care workers as the study population and discussed PPE use or infection prevention and control strategies. The uptake and appropriate use of PPE may be included as part of a broader infection prevention and control strategy, and so it was decided to broaden the inclusion at the abstract review stage. No language restrictions were applied to the abstracts. Results were downloaded from the databases and uploaded into Covidence, which removed the duplicates.

Full-text screening was performed independently by 2 reviewers. Discrepancies in screening were resolved through discussion until consensus was reached. Studies were excluded if they only included physicians in their study population or if relevant data about barriers or facilitators to PPE use in LTC could not be extracted. The full-text review was not restricted by language. If relevant abstracts written in English were identified but the full-text article was not written in English, Google Translate was used. Google Translate has been suggested to be a viable, accurate tool for translating non-English-language research for the purpose of conducting reviews.³²

Data Charting Process

All data extraction was conducted by 1 reviewer and reviewed by a second reviewer. A standardized data extraction tool was used to systematically extract data on study characteristics, study participants, intervention, implementation approaches and evaluation, and barriers and facilitators.

Synthesis of Results

The Theoretical Domains Framework (TDF) was used to code the barriers and facilitators.^{33–35} Barriers and facilitators could be coded to more than 1 TDF domain if relevant. Coding was discussed and agreed on by the entire study team. Frequencies of coded TDF domains and themes were reported. Text evidence from the included articles to support thematic analysis was included in the text. Extracted data are summarized in tables.

Results

Search and Selection of Literature

From the published and pre-print databases, 3459 citations were retrieved, 36 full-text articles were reviewed, and 7 were

included^{36–42} (Figure 1). From the citation searching of reference lists and the gray literature search, 2123 records were retrieved, 16 full-text articles were reviewed, and 3 were included.^{43–45} The primary reasons for exclusion at full-text screening were that the records did not include information on barriers or facilitators to the appropriate use and selection of PPE, the records were not collected in a LTC setting, and the records did not collect data on health care workers.

Summary of Included Literature

Summary characteristics, such as the studies' main objectives, place of origin, participant characteristics, type of PPE investigated, and data collection methods of included records are presented in Table 1. The included studies were conducted between February 2017 and December 2021, with 8 of the 10 conducted during the COVID-19 pandemic. Studies originated from the United States (n = 5),^{36,40,41,44,45} United Kingdom (n = 3),^{37,39,43} Ireland (n = 1),³⁸ and Australia (n = 1).⁴² Six studies recruited health care workers from LTC settings^{36–38,40,42,43} and 4 recruited health care workers from both LTC settings and acute care settings^{39,41,44,45} but reported their findings for LTC separately. Four studies used surveys to collect data about barriers and facilitators to PPE use,^{40,43–45} 4 used interviews and/or focus

groups,^{36,39,42,44} 1 used a scoping review,³⁸ and 1 used both a survey and interviews.³⁷

Environmental Context and Resources

Of the 10 eligible studies included in this review, the most common TDF domain identified was environmental context and resources, which was observed in 9 of the included studies^{36–39,41–45} (Table 2). The definitions of each domain can be found in Table 2. Of the 9 papers found to reference this domain, 7 stated that the availability of PPE was a barrier to the appropriate use and selection of PPE.^{38,39,41–45} Five of these papers stated that PPE overall was not readily available,^{37–39,41,42} 3 stated that masks or N95 masks were unavailable,^{41,42,44} 2 stated face shields were unavailable,^{44,45} and 1 stated that gowns were not available.⁴² Without PPE being available, health care workers were unable to properly protect themselves and risk transmitting infection among themselves as well as with LTC residents.

“Nearly all the research participants in this study reported a severe shortage of PPE in their workplaces. This exposed the [health care workers] in many health and social care settings to possible infection of COVID-19. The shortage of PPE undoubtedly brought fear and anxiety among [health care workers].” (Nyashanu et al.³⁹)

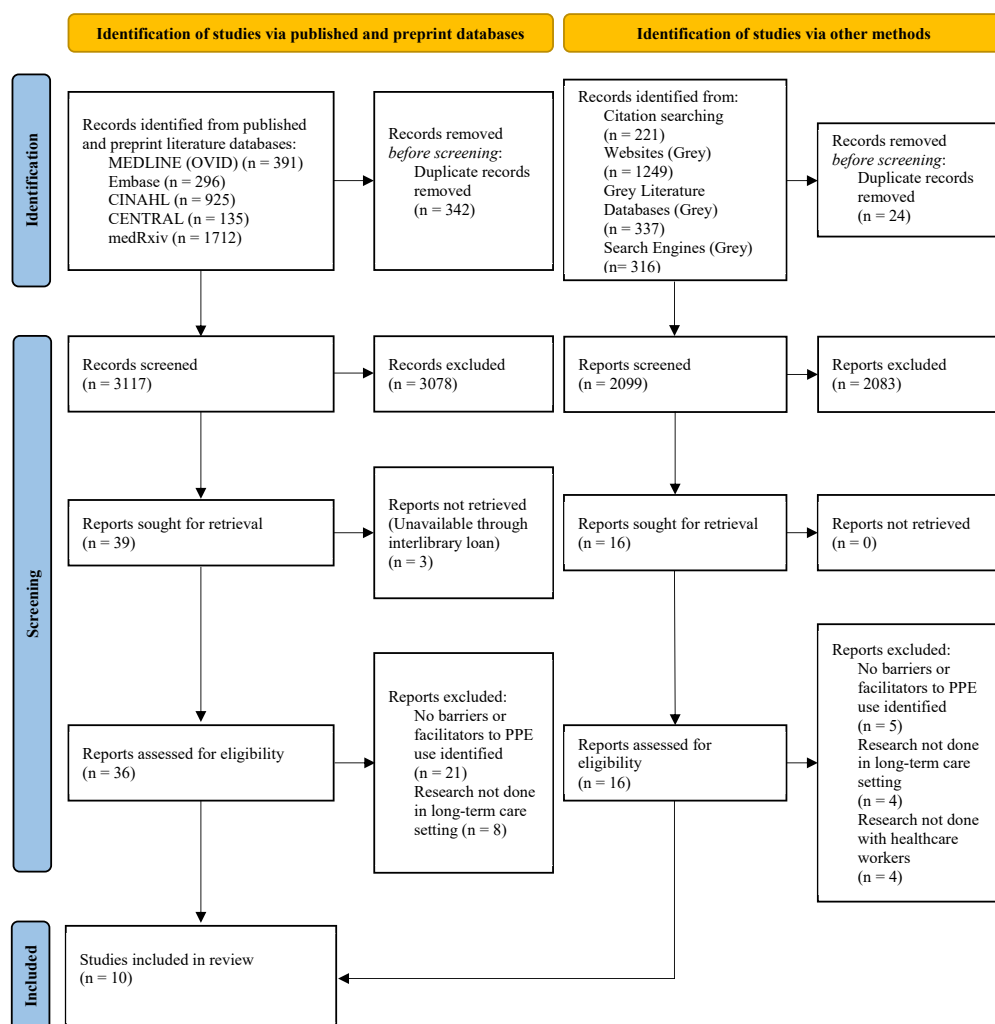


Fig. 1. The number of records identified, screened, and included in the scoping review as per the PRISMA flow diagram. Online databases and a gray literature search was conducted to determine the barriers and facilitators to PPE use by LTC health care workers. Adapted from Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. <https://doi.org/10.1136/bmj.n71>. For more information, visit: <http://www.prisma-statement.org/>.

Table 1
Study Characteristics of the 10 Included Studies Identifying Barriers and Facilitators to PPE Use by LTC Health Care Workers

Author(s)	Objective	PPE Investigated	Sample	Methods
Albrecht et al. (2017), USA ³⁶	Explore current use and perceptions of various approaches to glove and gown use in nursing homes	Gloves and gowns	Nursing home staff, administrators, and residents	Qualitative study: focus groups (staff), interviews (residents)
Bunn et al. (2021), UK ³⁷	Identify lived experience of care home staff implementing new infection control measures in care homes	General PPE, facial PPE (masks/goggles or face shield)	Care home staff	Mixed methodology: online surveys and qualitative interviews
Bushe et al. (2020), UK ⁴³	Understand more about the impact of COVID-19 on the care home nurse workforce in the United Kingdom	General PPE	Queen's Nursing Institute care home nurse network	Online surveys
Giri et al. (2021), Ireland ³⁸	Describe factors that contributed to the spread and mortality of COVID-19 in nursing homes	General PPE	Studies assessing factors affecting COVID-19 mortality in nursing homes	Scoping review
Nyashanu et al. (2020), UK ³⁹	Explore the challenges affecting frontline workers during the pandemic	General PPE	Frontline workers (including from care homes)	Explorative qualitative approach: semi-structured interviews
O'Neil et al. (2017), USA ⁴⁰	Assess knowledge, attitudes, and practices regarding infection prevention and control policies and influenza vaccination	Masks	LTC health care personnel	Surveys
Rebmann et al. (2021), USA ⁴⁵	Assess health care access to PPE, hand hygiene products, and disinfection supplies	Face shields	Infection preventionists (including from LTC)	Online surveys
Rebmann et al. (2021), USA ⁴⁴	Assess PPE availability and PPE crisis standards of care implemented	Masks, face shields	Infection preventionists (including from LTC)	Online surveys
Rebmann et al. (2021), USA ⁴¹	Evaluate infection preventionists experiences during the first 9 months of the COVID-19 pandemic and assess their preferences regarding COVID-19 related infection prevention education	General PPE, N95s	Infection preventionists (including from LTC)	Focus groups
The Lamp (2020), Australia ⁴²	Interview nurse in LTC about her experience in LTC during the COVID-19 pandemic	General PPE, N95s, gowns, masks	A nursing home registered nurse	One-on-one interview

During the pandemic, the price of PPE increased substantially. As a result, the financial cost of PPE was also cited as a barrier to its procurement and therefore its use.^{37,38,41} The costs associated with different components of PPE were not specified.

"Some LTC facilities could find PPE, but the price was incredibly high. Despite this, they reported still purchasing the expensive PPE. As one infection preventionist explained, 'I think I spent \$46,000 yesterday on PPE, but I had to. We finally found supplies and you can't wait.'" (Rebmann et al.⁴¹)

Table 2
Frequency of Barriers and Facilitators to PPE Use by LTC Health Care Workers From the 10 Included Studies

Domain	Definition	Themes
Knowledge	An awareness of the existence of something	Unclear guidelines (Barrier: 2 References, ^{36,39} 8 Times) Understanding of appropriate PPE selection (Facilitator: 1 Reference, ³⁶ 1 Time)
Beliefs about Capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Difficulty giving care (Barrier: 2 References, ^{37,40} 5 Times)
Optimism	The confidence that things will happen for the best or that desired goals will be attained	Belief that PPE is ineffective (Barrier: 1 Reference ³⁶ 1 Time)
Beliefs about Consequences	Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation	Fear of spreading pathogens (Facilitator: 1 Reference, ³⁶ 1 Time) Anxiety about scaring patients (Barrier: 2 Reference, ^{36,37} 4 Times)
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Perception that facility does not support PPE use (Barrier: 1 Reference, ³⁶ 1 Time)
Intentions	A conscious decision to perform a behavior or a resolve to act in a certain way	Protecting self (Facilitator: 1 Reference, ³⁶ 7 Times)
Memory Attention and Decision Process	The ability to retain information, focus selectively on aspects of the environment, and choose between 2 or more alternatives	Prioritization of resident care (Barrier: 1 Reference, ³⁷ 3 Times)
Environmental Context and Resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior	Staffing requirements (Barrier: 1 Reference, ⁴² 3 Times) Prioritization of acute care (Barrier: 1 Reference, ⁴¹ 1 Time) PPE not fit to purpose (Barrier: 1 Reference, ³⁹ 2 Times) Placement of PPE (Facilitator: 1 Reference, ³⁶ 1 Time) Cost of PPE (Barrier: 3 References, ^{37,38,41} 3 Times) Availability of PPE (Barrier: 7 References, ^{38,39,41–45} 17 Times, Facilitator: 2 References, ^{43,44} 2 Times)

Barriers and facilitators were categorized by TDF domain. Definitions of TDF domains were retrieved from Atkins et al.³⁵

Table 3
Barriers and Facilitators to PPE Use by LTC Health Care Workers in Each Study Categorized by the Domains in the TDF

Author(s)	TDF Domains Cited (Frequency)	Theme (Frequency)
Albrecht et al. (2017) ³⁶	Knowledge (3) Intentions (7) Environmental Context and Resources (1) Beliefs about Consequences (2) Optimism (1) Reinforcement (1)	Unclear guidelines (2) Understanding of appropriate PPE selection (1) Desire to protect self (7) Placement of PPE (1) Fear of spreading pathogens (1) Anxiety about scaring patients (1) Belief that PPE is ineffective (1) Perception that facility doesn't support PPE use (1)
Bunn et al. (2021) ³⁷	Memory, Attention, and Decision Processes (3) Environmental Context and Resources (1) Beliefs about Consequences (3) Beliefs about Capabilities (4)	Prioritization of patient care (3) Cost of PPE (1) Anxiety about scaring patients (3) Difficulty giving care (4)
Bushe et al. (2020) ⁴³	Environmental Context and Resources (4)	Availability of PPE (4)
Giri et al. (2021) ³⁸	Environmental Context and Resources (2)	Cost of PPE (1) Availability of PPE (1)
Nyashanu et al. (2020) ³⁹	Knowledge (6) Environmental Context and Resources (6)	Unclear guidelines (6) PPE not fit to purpose (2) Availability of PPE (4)
O'Neil et al. (2017) ⁴⁰	Beliefs about Capabilities (1)	Difficulty giving care (1)
Rebmann et al. (2021) ⁴⁵	Environmental Context and Resources (1)	Availability of PPE (1)
Rebmann et al. (2021) ⁴⁴	Environmental Context and Resources (2)	Availability of PPE (2)
Rebmann et al. (2021) ⁴¹	Environmental Context and Resources (5)	Availability of PPE (3) Prioritization of acute care (1) Cost of PPE (1)
The Lamp (2020) ⁴²	Environmental Context and Resources (7)	Staffing Requirements (3) Availability of PPE (4)

Other themes that were coded as barriers into the environmental context and resources domain included that additional staffing was required to manage the PPE and ensure that it was distributed properly,⁴² that PPE was being prioritized for acute care settings leading to LTC facilities lacking an appropriate number of PPE,⁴¹ and that the PPE that was supplied to LTC facilities was not fit for purpose and inappropriate for preventing COVID-19 transmission.³⁹ However, some themes were coded as facilitators into the “environmental context and resources” domain. Placing gowns and gloves outside resident rooms

Table 4
Number of Times Each Behavioral Domain of the TDF is Identified and Coded in the Included Studies (n = 10)

Domain	Number of References With Domain	Total Times Domain Coded
Knowledge	2 ^{36,39}	9
Skills	0	0
Social/Professional Role and Identity	0	0
Beliefs about Capabilities	2 ^{37,40}	5
Optimism	1 ³⁶	1
Beliefs about Consequences	2 ^{36,37}	5
Reinforcement	1 ³⁶	1
Intentions	1 ³⁶	7
Goals	0	0
Memory Attention and Decision Process	1 ³⁷	3
Environmental Context and Resources	9 ^{36–39,41–45}	29
Social Influences	0	0
Emotion	0	0
Behavioral Regulation	0	0

was seen as a visual cue for its use,³⁶ and having an inventory of PPE^{43,44} encouraged PPE use. TDF domains and extracted themes for each included study can be viewed in [Tables 3 and 4](#).

Beliefs About Consequences

The beliefs about the consequences domain was referred to in 2 references.^{36,37} The fear of spreading pathogens facilitated glove use. If health care workers understood that a resident had a transmissible disease, they would be more inclined to select PPE appropriately to prevent its spread.³⁶ However, some health care workers were anxious that using PPE would frighten their residents and distress them.^{36,37} It is unclear which components of PPE contributes to the stress.

“Resident distress was particularly apparent for those living with dementia, who were disturbed by social distancing and the visual appearance and impaired communication associated with staff PPE use, although some interviewees reported a degree of accustomisation amongst residents.” (Bunn et al.³⁷)

Knowledge

The TDF domain knowledge was found in 2 references.^{36,39} Knowledge of appropriate PPE selection, specifically the appropriate use of gloves, was coded as a facilitator, because knowing when to use PPE encouraged its use when it should be used.³⁶ Health care workers also felt that unclear guidelines around PPE use hindered them from using it and selecting it appropriately.^{36,39} They felt that guidelines were too ambiguous, were updated too frequently, or lacked consistency or clarity about PPE use in LTC facilities. This barrier applied to the use of overall PPE in both studies, but 1 study³⁶ also reported that ambiguous guidelines on glove use resulted in health care workers not using gloves when they were supposed to.

“There are so many changes that are coming every day, today is one thing tomorrow is another one what are the guidance really? It really confuses and panics me” (Nyashanu et al.³⁹)

Beliefs About Capabilities

Health care workers felt that using PPE interfered with their ability to provide care to LTC residents, including affecting their ability to communicate, causing them difficulty in giving physical care, or preventing them from providing care efficiently and quickly.^{37,40} This barrier applied specifically to masks in both studies, and also applied to general PPE, goggles and face shields, and aprons in one of the studies.³⁷

“You can't go straight up to them anymore like you used to be able to. [...] Having to go get the PPE and then go back, so you're effectively leaving people, which is a challenge [...] because it's not in our nature to leave people” (Bunn et al.³⁷)

Other Domains

A lack of optimism about PPE was a barrier to its use, as some health care workers believed that specifically gowns were ineffective in preventing methicillin-resistant *Staphylococcus aureus* (MRSA) transmission.³⁶ Some health care workers perceived that their LTC facility did not support or reinforce the use of gowns for medically isolated patients.³⁶ The intention to protect oneself facilitated the use of PPE, as some health care workers used gowns and gloves to protect themselves or their clothing from bodily fluids, rather than to prevent infection transmission.³⁶ The memory, attention, and decision processes domain of prioritizing resident care was a barrier to PPE use.³⁷ Health care workers felt that if there was a resident who required their

immediate attention, they would prioritize the resident's care over appropriately selecting and using general PPE and gloves.

"If you see someone falling or fallen, you can't go, 'Hold on a minute, let me get my PPE on' and then help them. [...] So it is literally you just have to help them" (Bunn et al.³⁷)

The TDF domains of skills, social/professional role and identity, goals, social influences, emotion, and behavioral regulation were not identified in any of the included studies.

Discussion

Summary of Evidence

Our findings provided an overview of the research identifying the barriers and facilitators to PPE use by health care workers in LTC settings identified in the gray and published literature without any restrictions on when the literature was written. It was not within the scope of this review to assess the methodological quality of the individual references included in the analysis, as its purpose was to be exploratory and describe existing literature from a wide range of study designs and methods using a broad lens.⁴⁶ A total of 5216 references were identified by the gray and published literature search and 10 studies were included in the review. Most (80%) were conducted during the COVID-19 pandemic. Seven of the 10 studies highlighted barriers or facilitators to specific components of PPE (eg, masks, gloves, gowns).

Of the 10 eligible studies included in this review, the most common TDF domain identified was environmental context and resources, which was observed in 9 of the included pieces of literature.^{36–39,41–45} Lack of availability was the most common barrier to PPE use within LTC. Other barriers that were identified within the environmental context and resources domain were staffing requirements, prioritization of acute care, PPE not being fit to purpose, and the cost of PPE. Availability of PPE and appropriate placement of PPE were identified as facilitators to appropriate PPE use. Shortages of PPE leave health care workers dangerously ill-equipped to care for patients safely and also endanger health care workers. Many countries have struggled to protect their health care workers during the COVID-19 pandemic, where shortages of adequate PPE was a daily concern.⁴⁷ As of May 2020, as many as 87% of nurses reported that they had to reuse a single-use disposable mask or N95 respirator, and 27% of nurses reported that, while not wearing appropriate PPE, they were exposed to patients who were confirmed to have COVID-19.⁴⁸ As of January 2022, at least 46 health care workers have died from COVID-19 in Canada alone.⁴⁹ These data are indicative of health care worker exposure to the virus and of the critical role of PPE in LTC.

The remaining TDF domains were identified in only 2 or fewer references, with the domains of skills, social/professional role and identity, goals, social influences, emotion, and behavioral regulation not being identified in any of the included studies. Additional research is necessary to assess the barriers and facilitators to the appropriate use and selection of PPE comprehensively using the TDF, and whether barriers or facilitators to PPE use exist in the TDF domains that were not sufficiently captured in existing literature. According to previous literature conducted in acute care settings,^{21–26} barriers and facilitators exist in the domains of social influences, social/professional role and identity, and emotion; however, it is unclear if these barriers and facilitators to PPE use also exist in LTC settings.

To our knowledge, this review is the first aimed at determining the barriers and facilitators to PPE use by health care workers in LTC settings. There are other reviews that evaluated the barriers and facilitators to general infection prevention and control strategies, such as hand hygiene, isolation practices, and infection prevention and control measures used against specific infectious diseases, but did not

focus on the barriers and facilitators to the appropriate use and selection of PPE itself.^{50–54} Other reviews investigated the barriers and facilitators to PPE use in acute care settings, but not if those barriers and facilitators exist in the context of LTC.^{21–26} LTC is unique from acute care, given the chronic nature of the physical and cognitive challenges facing the residents and the longer-term nature of their residency.

Limitations

At the time when this scoping review was done, 8 of the 10 included research articles were conducted and published during the COVID-19 pandemic.^{37–39,41–45} The recent appearance of these studies may have influenced the findings of this review. For example, during the beginning of the pandemic, severe PPE supply issues were widespread among LTC facilities and other health care facilities.⁵⁵ This may have influenced the reporting that PPE was unavailable or that acquiring PPE was challenging because of the supply issues, thus increasing the number of times that the environmental context and resources domain arose from the included literature. As a result, the findings of this scoping review may overrepresent the severity of the barriers to the appropriate use and selection of PPE associated with the environmental context and resources domain of the TDF and may not be widely generalizable outside of the context of the COVID-19 pandemic. Additional research is required to determine if this continues to be an issue or whether other barriers exist outside the context of the COVID-19 pandemic.

Different types of infections require different types of PPE in order to best prevent health care workers from being exposed.³ Eight of the 10 included studies were conducted during the COVID-19 pandemic, and the barriers and facilitators to the use of PPE were investigated in the context of the pandemic.^{37–39,41–45} These studies identified that masks were more likely to not be an available component of PPE, but did not identify any other barriers and facilitators that were particularly more frequent in one component of PPE over another. One study was conducted to explore the barriers and facilitators to glove and gown use to prevent MRSA transmission.³⁶ This study only investigated glove and gown use, as MRSA only requires contact precautions.³ The final study was conducted in the context of preventing respiratory viral transmission and thus only investigated barriers and facilitators to mask use.⁴⁰ This study, in addition to 1 other,³⁷ identified that masks in particular made communicating with LTC residents more difficult, especially among those with hearing difficulties and those living with dementia in whom the nonverbal communication that typically aids verbal communication was hindered by wearing masks. Some of the studies included descriptions of the PPE they were assessing, whereas others did not. However, none of the studies conducted a comparative analysis of all the barriers and/or facilitators to the different components of PPE. Further research is required to determine how and why different barriers and facilitators differ by the type of PPE.

This scoping review did not exclude any study methodologies and did not limit itself to quantitative or qualitative research. Four of the included studies used surveys as their primary data collection method.^{40,43–45} Although surveys are easy to administer, can be developed quickly, and are cost-effective data collection tools, surveys can lack depth and breadth, and can potentially not fully capture complex information on participants' thoughts, feelings, behaviors, and beliefs. Although they are an appropriate data collection method to address a wide array of research questions, a more nuanced approach may be necessary to address the objective of identifying the barriers and facilitators to the appropriate use and selection of PPE. A qualitative approach would be more appropriate to address this research objective. Future qualitative research is required to better understand the thoughts, feelings, behaviors, and beliefs of health care workers in LTC

settings about the barriers and facilitators to the appropriate use and selection of PPE.

In several included studies,^{37–45} PPE was not the main research focus, but data regarding PPE were still recorded in these studies, as they investigated infection control measures generally or had a study aim focused on addressing different research questions regarding the COVID-19 pandemic. Further research is required to specifically identify the barriers and facilitators to the appropriate use and selection of PPE within LTC.

Conclusions and Implications

The aim of this scoping review was to identify the barriers and facilitators to the appropriate use and selection of PPE within LTC. Identified barriers to PPE use in LTC settings primarily related to the environmental context and resources, including lack of availability, staffing requirements, prioritization of acute care, PPE not being fit to purpose, and the cost of PPE. Other barriers to PPE use include difficulty providing care, and anxiety about frightening patients. PPE being readily available facilitated its use. Although some barriers and facilitators to PPE were identified by the included studies, further study is required to determine barriers and facilitators to PPE use in LTC across other behavioral domains. Understanding the barriers and facilitators to PPE use in LTC settings is needed to inform future implementation interventions focused on improving PPE use.

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Supplementary Material

Supplementary Table 1

Search strategies for the included published databases

#	Embase
1	Long-Term Care/ or rehabilitation centers/ or sheltered workshops/ or substance abuse treatment centers/ or residential facilities/ or assisted living facilities/ or group homes/ or homes for the aged/ or nursing homes/ or intermediate care facilities/ or skilled nursing facilities/ or halfway houses/ or senior centers/ or adult day care centers/
2	(long term care or assisted living or continuing care or extended care).tw,kf
3	(residential or nursing or senior* or disabled or disabilit* or old age or geriatric* or elder* or rehab* or group or substance abuse or drug abuse or substance treatment or drug treatment) adj3 (lodge* or facilit* or home* or residence* or center* or centre*).tw,kf
4	1 or 2 or 3
5	health personnel/ or faculty, nursing/ or medical staff/ or nurses/ or nursing staff/ or personnel, hospital/ or allied health personnel/ or licensed practical nurses/ or nursing assistants/
6	(health personnel or medical staff or nurs* or hospital personnel or allied health personnel or lpn* or health personnel or health-personnel or health provider* or medical staff or medical personnel or medical professional* or medical worker* or personal support aide* or personal support worker*).tw,kf.
7	((healthcare or health care) adj2 (aide* or worker* or personnel or provider*).tw,kf
8	5 or 6 or 7
9	personal protective equipment/ or eye protective devices/ or masks/ or protective clothing/ or respiratory protective devices/ or gloves, protective/
10	(mask* or don or donning or doff* or gown* or coverall* or protective layer* or surgical toga* or apron* or smock* or hazmat suit*).tw,kf.
11	(hazmat and suit).tw,kf.
12	(filtering face piece* or filtering facepiece* or goggle* or visor* or facial protection equipment or safety glass* or safety spectacle or ppe or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or surgical hood* or hood* or eye protection or personal protect* or respiratory hygiene or respirator*).tw,kf
13	(protective adj2 (cloth* or garment* or device* or equipment)).tw,kf.
14	(protective or preventive) adj2 (procedure* or behavior* or behaviour*).tw,kf.
15	9 or 10 or 11 or 12 or 13 or 14
16	4 and 8 and 15
#	Embase
1	Long Term Care/ or Nursing home/ or assisted living facility/ or rehabilitation center/ or residential home/
2	(long term care or assisted living or continuing care or extended care).tw,kf
3	((residential or nursing or senior* or disabled or disabilit* or old age or geriatric* or elder* or rehab* or group or substance abuse or drug abuse or substance treatment or drug treatment) adj3 (lodge* or facilit* or home* or residence* or center* or centre*).tw,kf.
4	1 or 2 or 3
5	Clinician/ or health workforce/ or hospital personnel/ or lay health worker/ or medical personnel/ or nursing home personnel/ or nursing home staff/ or advanced practice nurse/ or expert nurse/ or licensed practical nurse/ or male nurse/ or practical nurse/ or registered nurse/ or staff nurse/
6	(health personnel or medical staff or nurs* or hospital personnel or allied health personnel or lpn* or health personnel or health-personnel or health provider* or medical staff or medical personnel or medical professional* or medical worker* or personal support aide* or personal support worker*).tw,kf.
7	((healthcare or health care) adj2 (aide* or worker* or personnel or provider*).tw,kf
8	5 or 6 or 7
9	Aerosol box/ or eye protective device/ or protective glasses/ or protective clothing/ or respiratory protection/ or surgical hood/ or face shield/ or protective glove/

(continued)

Supplementary Table 1 (continued)

#	Embase
10	(mask* or don or donning or doff* or gown* or coverall* or protective layer* or surgical toga* or apron* or smock* or hazmat suit*).tw,kf.
11	(hazmat and suit).tw,kf.
12	(filtering face piece* or filtering facepiece* or goggle* or visor* or facial protection equipment or safety glass* or safety spectacle or ppe or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or surgical hood* or hood* or eye protection or personal protect* or respiratory hygiene or respirator*).tw,kf
13	(protective adj2 (cloth* or garment* or device* or equipment)).tw,kf.
14	(protective or preventive) adj2 (procedure* or behavior* or behaviour*).tw,kf.
15	9 or 10 or 11 or 12 or 13 or 14
16	Infection control/ or communicable disease control/
17	(infect* or communicable) adj2 (control or prevention).tw,kf
18	16 and 17
19	4 and 8 and 15
#	CINAHL
1	AB "long term care" or "assisted living" or "continuing care" or "extended care"
2	TI "long term care" or "assisted living" or "continuing care" or "extended care"
3	TI (residential or nursing or senior* or disabled or disabilit* or "old age" or geriatric* or elder* or rehab* or group or "substance abuse" or "drug abuse" or "substance treatment" or "drug treatment") N3 (lodge* or facilit* or home* or residence* or center* or centre*)
4	AB (residential or nursing or senior* or disabled or disabilit* or "old age" or geriatric* or elder* or rehab* or group or "substance abuse" or "drug abuse" or "substance treatment" or "drug treatment") N3 (lodge* or facilit* or home* or residence* or center* or centre*)
5	S1 OR S2 OR S3 OR S4
6	TI "health personnel" or "medical staff" or nurs* or "hospital personnel" or "allied health personnel" or lpn* or "health personnel" or health-personnel or "health provider*" or "medical staff" or "medical professional*" or "medical worker*" or "personal support aide*" or "personal support worker*"
7	AB "health personnel" or "medical staff" or nurs* or "hospital personnel" or "allied health personnel" or lpn* or "health personnel" or health-personnel or "health provider*" or "medical staff" or "medical professional*" or "medical worker*" or "personal support aide*" or "personal support worker*"
8	TI ((healthcare or "health care") N2 ("aide*" or "worker*" or "personnel" or "provider*"))
9	AB ((healthcare or "health care") N2 ("aide*" or "worker*" or "personnel" or "provider*"))
10	S6 OR S7 OR S8 OR S9
11	TI mask* or don or donning or doff* or gown* or coverall* or "protective layer*" or "surgical toga*" or apron* or smock* or "hazmat suit*"
12	AB mask* or don or donning or doff* or gown* or coverall* or "protective layer*" or "surgical toga*" or apron* or smock* or "hazmat suit*"
13	TI hazmat and suit
14	AB hazmat and suit
15	TI "filtering face piece*" or "filtering facepiece*" or goggle* or visor* or "facial protection equipment" or "safety glass*" or "safety spectacle" or ppe or overshoe* or "shoe cover*" or "rubber boot*" or "head cover*" or "face shield*" or "surgical hood*" or hood* or "eye protection" or "personal protect*" or "respiratory hygiene" or respirator*
16	AB "filtering face piece*" or "filtering facepiece*" or goggle* or visor* or "facial protection equipment" or "safety glass*" or "safety spectacle" or ppe or overshoe* or "shoe cover*" or "rubber boot*" or "head cover*" or "face shield*" or "surgical hood*" or hood* or "eye protection" or "personal protect*" or "respiratory hygiene" or respirator*
17	TI (protective) N2 (cloth* or garment* or device* or equipment)
18	AB (protective) N2 (cloth* or garment* or device* or equipment)
19	TI (protective or preventive) N2 (procedure* or behavior* or behaviour*)
20	AB (protective or preventive) N2 (procedure* or behavior* or behaviour*)
21	S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20
25	S5 AND S10 AND S21 AND S24

#	medRxiv
1	(long term care or nursing home) and (healthcare workers or staff) and (personal protective equipment or ppe)
#	CENTRAL
1	Long-Term Care/ or rehabilitation centers/ or sheltered workshops/ or substance abuse treatment centers/ or residential facilities/ or assisted living facilities/ or group homes/ or homes for the aged/ or nursing homes/ or intermediate care facilities/ or skilled nursing facilities/ or halfway houses/ or senior centers/ or adult day care centers/
2	(long term care or assisted living or continuing care or extended care).tw,kw
3	(residential or nursing or senior* or disabled or disabilit* or old age or geriatric* or elder* or rehab* or group or substance abuse or drug abuse or substance treatment or drug treatment) adj3 (lodge* or facilit* or home* or residence* or center* or centre*).tw,kw
4	1 or 2 or 3
5	health personnel/ or faculty, nursing/ or medical staff/ or nurses/ or nursing staff/ or personnel, hospital/ or allied health personnel/ or licensed practical nurses/ or nursing assistants/
6	(health personnel or medical staff or nurs* or hospital personnel or allied health personnel or lpn* or health personnel or health-personnel or health provider* or medical staff or medical personnel or medical professional* or medical worker* or personal support aide* or personal support worker*).tw,kw.
7	((healthcare or health care) adj2 (aide* or worker* or personnel or provider*).tw,kw
8	5 or 6 or 7
9	personal protective equipment/ or eye protective devices/ or masks/ or protective clothing/ or respiratory protective devices/ or gloves, protective/
10	(mask* or don or donning or doff* or gown* or coverall* or protective layer* or surgical toga* or apron* or smock* or hazmat suit*).tw,kw.
11	(hazmat and suit).tw,kw.
12	(filtering face piece* or filtering facepiece* or goggle* or visor* or facial protection equipment or safety glass* or safety spectacle or ppe or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or surgical hood* or hood* or eye protection or personal protect* or respiratory hygiene or respirator*).tw,kw
13	(protective adj2 (cloth* or garment* or device* or equipment)).tw,kw.
14	(protective or preventive) adj2 (procedure* or behavior* or behaviour*).tw,kw.
15	9 or 10 or 11 or 12 or 13 or 14
16	4 and 8 and 15
#	Cochrane Systematic
1	(long term care or assisted living or continuing care or extended care).tw,kf
2	(residential or nursing or senior* or disabled or disabilit* or old age or geriatric* or elder* or rehab* or group or substance abuse or drug abuse or substance treatment or drug treatment) adj3 (lodge* or facilit* or home* or residence* or center* or centre*).tw,kf
3	1 or 2
4	(health personnel or medical staff or nurs* or hospital personnel or allied health personnel or lpn* or health personnel or health-personnel or health provider* or medical staff or medical personnel or medical professional* or medical worker* or personal support aide* or personal support worker*).tw,kf.
5	((healthcare or health care) adj2 (aide* or worker* or personnel or provider*).tw,kf
6	4 or 5
7	(mask* or don or donning or doff* or gown* or coverall* or protective layer* or surgical toga* or apron* or smock* or hazmat suit*).tw,kf.
8	(hazmat and suit).tw,kf.
9	(filtering face piece* or filtering facepiece* or goggle* or visor* or facial protection equipment or safety glass* or safety spectacle or ppe or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or surgical hood* or hood* or eye protection or personal protect* or respiratory hygiene or respirator*).tw,kf
10	(protective adj2 (cloth* or garment* or device* or equipment)).tw,kf.
11	(protective or preventive) adj2 (procedure* or behavior* or behaviour*).tw,kf.
12	7 or 8 or 9 or 10 or 11
13	3 and 6 and 12