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Factors influencing long-term care facility performance during the COVID-19 pandemic: a scoping review

Eric Nguemeleu Tchouaket^{1*}, Katya Kruglova¹, Josiane Létourneau¹, Emilie Bélanger¹, Stephanie Robins¹, Maripier Jubinville¹, Fatima El-Mousawi¹, Shiyang Shen², Idrissa Beogo³ and Drissa Sia¹

Abstract

Background The COVID-19 pandemic wreaked havoc on long-term care facilities (LTCFs). Some LTCFs performed better than others at slowing COVID-19 transmission. Emerging literature has mostly described infection prevention and control strategies implemented by LTCFs during the pandemic. However, there is a need for a comprehensive review of factors that influenced the performance of LTCFs in containing COVID-19 spread to inform public health policy.

Objective To build on the existing literature, we conducted a scoping review of factors that influenced LTCF performance during the COVID-19 pandemic using a multidimensional conceptual framework of performance.

Methods We followed the Joanna Briggs Institute's methodology for scoping reviews. We queried CINAHL, MEDLINE (Ovid), CAIRN, Science Direct, Scopus, and Web of Science for peer-reviewed literature in English or French published between January 1st, 2020 and December 31st, 2021. Retrieved records were screened for context (COVID-19 pandemic), population (LTCFs), interest (internal and external factors that influenced LTCF performance), and outcomes (dimensions of performance: equity, accessibility, reactivity, safety, continuity, efficacy, viability, efficiency). Descriptive characteristics of included articles were summarized. Dimensions of performance as well as internal (e.g., facility characteristics) and external (e.g., visitors) factors identified to have influenced LTCF performance were presented.

Results We retained 140 articles of which 68% were classified as research articles, 47% originated in North America, and most covered a period between March and July 2020. The most frequent dimensions of performance were "efficacy" (75.7%) and "safety" (75.7%). The most common internal factors were "organizational context" (72.9%) and "human resources" (62.1%), and the most common external factors were "visitors" (27.1%) and "public health guidelines" (25.7%).

Conclusions Our review contributes to a global interest in understanding the impact of the COVID-19 pandemic on vulnerable populations residing and working in LTCFs. Though a myriad of factors were reported, a lack of randomized controlled trials makes it impossible to establish causality between the identified factors and LTCF performance. The use of a multidimensional framework can be recommended to evaluate healthcare system performance not merely in terms of efficacy and safety, but alongside other critical dimensions such as efficiency and equity.

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*Correspondence:

Eric Nguemeleu Tchouaket
eric.tchouaket@uqo.ca

Full list of author information is available at the end of the article



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Keywords Long-term care facilities, Performance, Infection prevention and control, COVID-19, Residents, Staff, Facilitators, Barriers, Scoping review, Conceptual framework

Background

On March 11th 2020 the World Health Organization declared COVID-19 a pandemic in response to the alarming propagation of the highly transmissible and virulent virus [1, 2]. Residents of long-term care facilities (LTCFs) around the world bore the brunt of the pandemic, experiencing high morbidity and mortality [3]. As of July 2020, LTCF residents represented 47% of COVID-19-related deaths across 12 countries within the Organization for Economic Co-operation and Development (OECD), while in Canada this number approached 80% [4]. In the Canadian province of Québec, between March and July of 2020, more than 90% of all deaths due to COVID-19 occurred among adults over the age of 70, of whom 64% resided in LTCFs [5]. As of February 2021, an average of 41% of COVID-19-related deaths across 25 OECD countries occurred among LTCF residents, with the highest percentage of 75% recorded in Australia, compared to 39% in the United States of America (USA) and 59% in Canada [6]. As of July 2022, 43% of Canada's overall deaths due to COVID-19 were among LTCF residents and staff [7].

Amidst the crisis, some LTCFs performed better than others, slowing COVID-19 transmission more effectively and, as a consequence, experiencing fewer cases and lower mortality [8]. It is critical to understand the reasons behind this differential LTCF performance to inform the prevention of and response to outbreaks in the future. Literature describing COVID-19 in LTCFs has primarily focused on reporting disease outcomes [3], identifying effective infection prevention and control (IPC) strategies [8, 9], and formulating IPC guidance [10]. A growing number of publications have described factors that influenced the effectiveness or failure of implemented IPC strategies to prevent or mitigate COVID-19 outbreaks. Factors associated with more successful control of COVID-19 spread in LTCFs include: strong partnerships between LTCFs, laboratory services, hospitals, and public health officials; greater funding with more care hours per resident; proactive leadership that enforced IPC measures; access to a multidisciplinary IPC team; monitoring of human and material resources; universal testing of residents and staff; and visitor restrictions [11–24]. Less effective responses have been linked to: inadequate national long-term care policies; a lack of integration between LTCFs, hospitals, and the public health sector; chronic underfunding; shortages of material resources and

IPC trained staff; and the failure to detect and manage asymptomatic COVID-19 cases [19, 24–33]. In addition, the magnitude of COVID-19 outbreaks in LTCFs has been positively correlated with larger sized facilities, urban location, lower quality ratings, higher occupancy rooms, a greater proportion of racial/ethnic minority residents, and fewer care hours per resident [34–42].

Given the breadth and heterogeneity of the existing literature, there is a need for a comprehensive review of factors that influenced LTCF performance during the COVID-19 pandemic. Several reviews have been conducted to elucidate these factors. Gmehlin and Munoz-Price [43] offered an overview of the epidemiology, clinical manifestations, and interventions implemented to combat COVID-19 by LTCFs, underscoring the effectiveness of testing and subsequent cohorting of both residents and staff. Similarly, Dykgraaf et al.'s [8] rapid narrative review of strategies that helped limit COVID-19 spread in LTCFs stressed the importance of serial universal screening of residents and staff. A narrative review by Calcaterra et al. [44] synthesized IPC measures used by LTCFs to manage COVID-19 in several Asian countries, noting similarity of measures used elsewhere in the world, such as visitor restrictions. The authors speculated that the effective response demonstrated by LTCFs in these Asian countries may have been due to better integration into the healthcare system and greater preparedness informed by previous experience. In their scoping review, Palacios-Ceña et al. [45] synthesized the qualitative evidence relating to the experiences of LTCF staff, residents, and residents' families during the COVID-19 pandemic. Themes that emerged from the data underscored LTCFs' challenges with managing material and human resources, the emotional toll exerted by the pandemic on residents and staff, as well as the innovative solutions and adaptive strategies implemented by LTCF staff in response to the hardship. Furthermore, Frazer et al.'s [46] rapid systematic review linked the likelihood of experiencing a COVID-19 outbreak in a LTCF to a facility's bigger size, for-profit status, higher crowding index, greater number of employees, and staff working at multiple facilities. In Konetzka et al.'s [47] systematic review of facility characteristics associated with COVID-19-related outcomes, a larger facility size and higher disease prevalence in the community emerged as the strongest

predictors of COVID-19 cases and deaths. A more comprehensive review of factors that drove COVID-19 transmission in LTCFs was performed by Giri et al. [48]. Here, identified factors included: asymptomatic COVID-19 transmission, factors linked to the facilities (e.g., for-profit status), residents (e.g., malnutrition), or staff (e.g., high staff turnover), as well as external factors (e.g., underfunding).

The aforementioned studies offered insight into a range of factors that influenced the performance of LTCFs during the COVID-19 pandemic. However, no studies have applied a multidimensional approach to assessing LTCF performance during this challenging period. Accordingly, to examine LTCF performance during the first 2 years of the COVID-19 pandemic and more broadly, we performed a scoping review using a multidimensional conceptual framework of performance within healthcare systems. For the purposes of this scoping review, the performance of a healthcare system was defined as the system’s ability to achieve its objectives in relation to the population’s health as a function of the following dimensions of performance: equity, accessibility, reactivity, safety, continuity, efficacy, viability, and efficiency [49]. This framework helped to determine factors that could be viewed as either facilitators or barriers to the management of COVID-19 within LTCFs.

Methods

Conceptual framework

Despite being commonly expressed in terms of case numbers and death rates [50, 51], the performance of a healthcare system in the context of the COVID-19 pandemic can be conceptualized in multiple ways. For example, the OECD defines a healthcare system’s performance as the attainment of goals at the lowest possible cost [52], whereas the framework used by the Canadian Institute for Health Information evaluates healthcare system performance by answering the questions “How healthy are Canadians?” and “How healthy is the health system?” [53]. In Québec, the *Ministère de la Santé et des Services Sociaux* (MSSS) adopted a conceptual framework entitled the *Cadre de référence ministériel d’évaluation de la performance du système public de santé et de services sociaux à des fins de gestion*, where a healthcare system’s performance is conceptualized as the system’s ability to reach its objectives in relation to the population’s health, taking into consideration the optimization of resources and the quality and accessibility of services [54].

We chose the MSSS framework as the foundation of our scoping review’s conceptual framework because of its multifaceted approach to assessing healthcare system performance. Thus, the conceptual framework that guided our review encompassed eight dimensions of performance that fell under three fundamental elements of performance: 1) equity and accessibility within the accessibility of services; 2) reactivity, safety, continuity, and efficacy within the quality of services; 3) viability and efficiency within the optimization of resources.

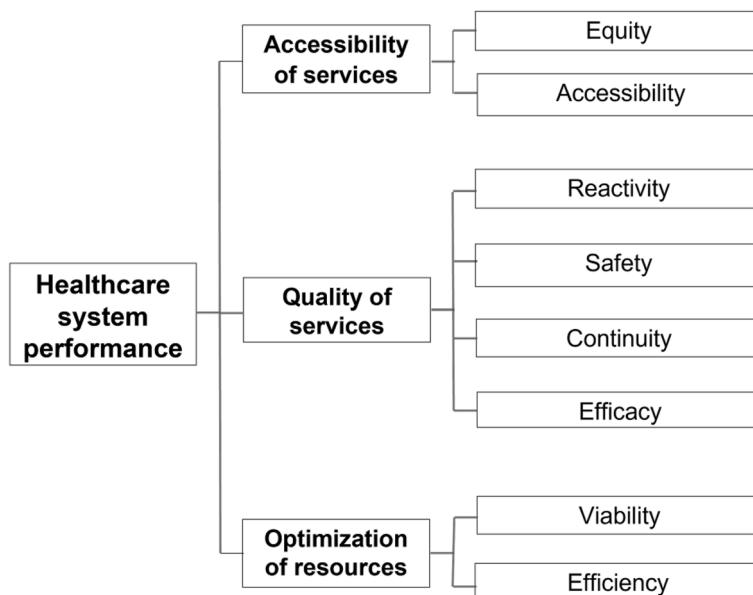


Fig. 1 The conceptual framework of healthcare system performance adapted from the *Cadre de référence ministériel d’évaluation de la performance du système public de santé et de services sociaux à des fins de gestion* developed by the Québec’s *Ministère de la Santé et des Services Sociaux* (19)

and efficacy within the quality of services; and 3) viability and efficiency within the optimization of resources (see Fig. 1).

The definitions of the dimensions of performance included in the original MSSS framework are presented in Table 1. To optimize database queries, we slightly modified the original MSSS framework's dimensions in our search strategies. Specifically, we substituted the dimension of *reactivity* with the terms *adaptability* and *satisfaction*, whose definitions within the databases better aligned with the original MSSS definition of *reactivity*. By the same token, the terms *resource management* and *resource mobilization* were used in our searches in lieu of the dimension of *viability*. In addition, the CINAHL database terms *effectiveness* and *security* were

identified as synonyms of the original MSSS dimensions of *efficacy* and *safety*, respectively, and thus were added to the search strategies to ensure all relevant literature was captured. Throughout the rest of the manuscript, only the original MSSS definitions are used (Table 1).

In addition to the dimensions of performance, the conceptual framework incorporated factors that could influence LTCF performance, as informed by the previous literature [48, 55]. Factors were categorized into eight internal and four external factors, as presented in Table 1.

Methodological framework

We followed the methodology for scoping reviews developed by the Joanna Briggs Institute, which expands on the work done by Arksey and O'Malley as well as Levac

Table 1 Population, Interest, Comparison, Outcome, and Time (PICOT) model

Population	LTCFs
Interest	Internal factors reported to have influenced LTCF performance, including: <ol style="list-style-type: none"> 1. <i>Resident characteristics</i> (e.g., comorbidities, nutrition, cognition, level of dependence on staff) 2. <i>Facility characteristics</i> (e.g., physical space, number of beds, occupation rate, ownership, ventilation system, shared rooms, age of the building) 3. <i>Staff characteristics</i> (e.g., job position, training, experiences, practices, compliance with IPC measures) 4. <i>Human resources</i> (e.g., staffing, staff-to-resident ratio, working at multiple facilities) 5. <i>Material resources</i> (e.g., personal protective equipment, hand hygiene products, screening tests, hygiene/sanitation products) 6. <i>Technological resources</i> (e.g., technological devices, telehealth) 7. <i>Financial resources</i> 8. <i>Organizational context</i> (e.g., training, management, organizational structures, screening, leadership)^a External factors reported to have influenced LTCF performance, including: <ol style="list-style-type: none"> 1. <i>Admissions</i> 2. <i>Visitors</i> 3. <i>Virus circulation in the community</i> 4. <i>Public health policies and/or guidelines</i>
Comparison	Not applicable
Outcome	The performance of LTCFs according to the following dimensions: <ol style="list-style-type: none"> 1. <i>Equity</i>: Ability to provide care and services according to need, without regard for personal characteristics (e.g., income, education, residential area). 2. <i>Accessibility</i>: Ability to provide the required care and services when and where they are needed. 3. <i>Reactivity</i>: Ability to adapt to the expectations, values, and rights of residents. 4. <i>Safety</i>: Ability to minimize risks for residents and staff associated with interventions and the environment. 5. <i>Continuity</i>: Ability to provide the required care and services in an integrated and coordinated way. 6. <i>Efficacy</i>: Ability to improve the health and wellbeing of residents. 7. <i>Viability</i>: Ability to respond to the current and future needs of the population, considering human, material, financial, technological, and informational resources. 8. <i>Efficiency</i>: Ability to use the available resources (human, material, financial, technological, informational) optimally.
Time	Within the COVID-19 pandemic from January 1 st , 2020 to December 31 st , 2021.

^a"Organizational context" was defined as higher-order organizational structures and processes, and thus excluded operating activities pertaining to the management of resources, including human resources (factor 4), material resources (factor 5), technological resources (factor 6), and financial resources (factor 7)

et al. [56, 57]. Accordingly, we followed these nine steps: 1) formulating and aligning the review's objective(s) and question(s); 2) developing eligibility criteria in keeping with the established objective(s) and question(s); 3) describing the approach to database queries, article selection, data extraction, and presentation of findings; 4) searching for the evidence; 5) selecting the evidence; 6) extracting the evidence; 7) analyzing the evidence; 8) presenting the evidence; and 9) summarizing the evidence with respect to the review's objective(s) and question(s), drawing conclusions, and noting potential implications.

To ensure our review included all necessary elements, we completed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) Checklist (see Supplementary File 1) [58]. We also consulted the updated guideline for reporting scoping reviews that was outlined in the PRISMA 2020 Statement [59, 60].

Eligibility criteria

Table 1 presents the eligibility criteria using the Population, Interest, Comparison, Outcome, and Time (PICOT) model.

Data sources and search strategy

The protocol for this review was registered with the Research Registry [researchregistry7026] and published [61]. We queried the databases CINAHL, MEDLINE (Ovid), CAIRN, Science Direct, Scopus, and Web of Science for records that met the eligibility criteria, including the context (COVID-19 pandemic), population (LTCFs), interest (factors that influenced LTCF performance), and outcomes (dimensions of performance: equity, accessibility, reactivity, safety, continuity, efficacy, viability, efficiency). We restricted our searches to peer-reviewed literature written in English or French and published during the first 2 years of the COVID-19 pandemic, between January 1st 2020 and December 31st 2021. We excluded records that focused on infections other than COVID-19 and healthcare settings other than LTCFs. We also excluded records that focused on pharmaceutical treatments or COVID-19 vaccination rates.

Two co-authors (JL, EB) performed database searches independently using strategies developed by our team (see Supplementary Files 2–7). All searches were performed using descriptors with the Boolean operators “AND” and “OR”. Retrieved records were imported to the EndNote software, and duplicates were removed.

Article selection

From Endnote, retrieved records were exported to the Rayyan web platform [62], duplicates were removed, and records were screened in accordance with an algorithm

developed by our research team [63]. Two co-authors (JL, EB) pilot tested the algorithm for reliability by independently screening the titles and abstracts of the first 10% of articles and then comparing results. The screening algorithm was then elaborated upon, for example, by adding the definitions of the dimensions of performance.

Once the algorithm had been tested and refined, the first complete screening round took place, where the titles and abstracts of all records were screened by two co-authors (JL, EB) as well as divided between the other co-authors, such that each record was screened by three co-authors. All three co-authors had to deem a record eligible for it to pass to the second screening round, where each record was read in its entirety by one co-author who decided whether to include or exclude it (see Fig. 2). The decision of whether to retain a record was based on three questions, answered in order: 1) Does the record focus on management activities during the COVID-19 pandemic?; 2) Does the population include residents and/or staff of a single or multiple LTCF(s) during the pandemic?, and 3) Does the record discuss at least one factor (e.g., resident characteristics, financial resources, etc.) that influenced LTCF performance during the pandemic? At this stage, it was not required to identify all factors discussed in each record; once any one factor was identified in a record, the record was retained for data extraction.

Data extraction

Relevant data from retained articles were extracted in three stages. First, descriptive characteristics were extracted using a data charting form developed by two co-authors (JL, EB) and reviewed by the entire research team. These same two co-authors (JL, EB) pilot tested the form, after which data extraction by five co-authors (KK, FEM, SR, JL, EB) occurred using Google Forms. The following data were extracted from each article: citation, year of publication, country of origin, study objectives, design, setting, participants, and framework (if one was used).

Following the first stage, dimensions of performance were extracted using a coding frame, where each dimension was defined as per the adopted conceptual framework. To ensure reliability, two co-authors (KK, SR) were first assigned an identical set of 20% (28/140) of included articles. The co-authors read the articles independently to extract identified dimensions of performance along with verbatim or paraphrased examples (1–3 sentences). For each record, dimensions were coded as “1”, if extracted, or “0”, if not extracted. Inter-coder reliability was calculated by summing the number of dimensions upon which both co-authors had agreed (e.g., *viability* coded as “1” or “0” for both coders), dividing it by eight (total number of dimensions), and multiplying the result by 100% [64, 65].

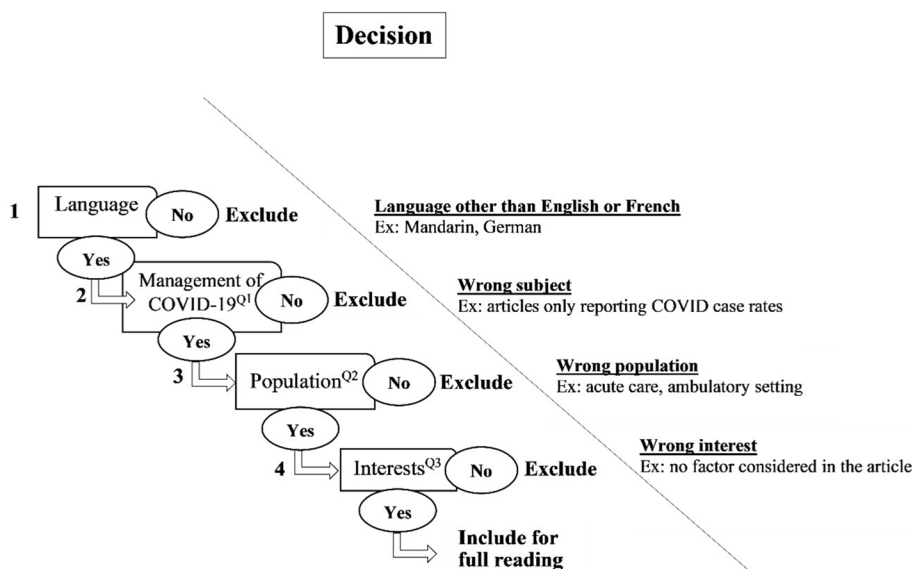


Fig. 2 Screening algorithm. Adapted from previous work by Tchouaket et al. [63]. Legend: ^{Q1} MANAGEMENT OF COVID-19: Is the primary focus of the record on management activities (e.g., organisation, planning, IPC) within a healthcare facility during the COVID-19 pandemic? ^{Q2} POPULATION: Does the record specify its population as LTCFs housing elderly residents or hospice/palliative care services occurring within the context of a single or multiple LTCF(s)? (Synonyms: nursing homes, assisted-living facilities, homes for the aged, aged care homes, retirement homes, long term care). ^{Q3} INTERESTS: Does the record discuss at least one factor related to the management of COVID-19 and outcomes of the pandemic within a single or multiple LTCF(s)? Internal factors: 1) resident characteristics; 2) facility characteristics; 3) staff characteristics; 4) human resources; 5) material resources; 6) technological resources; 7) financial resources; and 8) organizational context. External factors: 1) admissions; 2) visitors; 3) virus circulation in the community; and 4) public health policies/guidelines. Note: All keywords were translated into French for the CAIRN database

Mean inter-coder reliability across the 28 records was 81.3%. The two co-authors (KK, SR) met to share feedback about the coding process, and, in the case of conflicts, a third co-author (ENT) arbitrated. The coding frame was then fine-tuned by specifying what did and did not qualify as supporting evidence for each dimension (see Supplementary File 8). Lastly, the remaining records were randomly allocated to the same co-authors (KK, SR), who completed the extraction of dimensions.

All relevant factors reported to have influenced LTCF performance were extracted from each retained article. To ensure reliability, two co-authors (KK, SR) were first assigned an identical set of 10% (14/140) of records. The co-authors read the articles independently to extract identified factors into an Excel spreadsheet along with verbatim or paraphrased examples (1–3 sentences). In the case of identifying a factor that was not specified in the screening algorithm, the factor was extracted under the category “Other”. The co-authors then met to discuss the coding process and resolve any conflicts. Following this discussion, the remaining articles were randomly allocated to the same co-authors (KK, SR), who completed the extraction of factors.

Data synthesis and presentation

Three co-authors (KK, SR, ENT) analyzed extracted data. Countries of origin were collapsed into geographic regions. Descriptive characteristics were summarized, and the data collection period was extracted to situate the evidence within the temporal progression of the COVID-19 pandemic. Dimensions were extracted and their frequencies displayed in tabular form as were the factors identified to have influenced at least one dimension of LTCF performance. The completed data charting form is provided in Supplementary File 9.

Research team

The principal investigator (ENT) was supported by a registered nurse (JL), who is an expert in the assessment of factors that contribute to outbreaks, IPC, and performance evaluation in nursing. The research team also included two professors (DS, IB) with extensive experience with scoping review methodology in the field of nursing sciences, as well as research professionals (KK, SR, EB, FEM, SS) and a doctoral student in nursing (MJ), who are all proficient in database searches, article selection, and manuscript preparation.

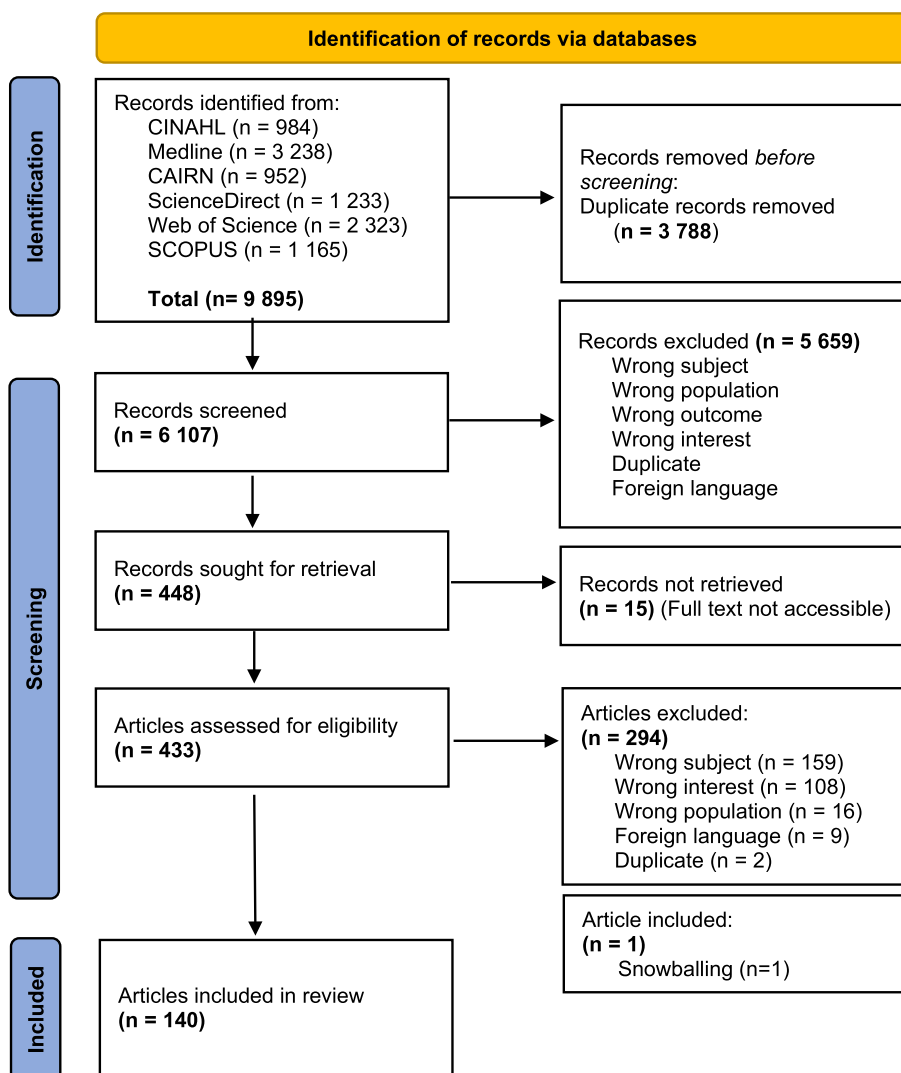


Fig. 3 PRISMA flow chart, outlining the identification and selection stages of this review. Adapted from The PRISMA 2020 statement: An updated guideline for reporting systematic reviews [59]. The term “report” signifies “a document (paper or electronic) supplying information about a particular study”, such as a journal article or government report, while the term “record” signifies “The title or abstract (or both) of a report indexed in a database or website” [59]

Results

Article selection

Results of the selection process are summarized in a PRISMA flow chart (see Fig. 3). After removing duplicates and screening titles and/or abstracts, 448 of the 9,895 retrieved records underwent full-text assessment. After eliminating 15 records for which full text was not accessible, 433 records were read in their entirety, of which 139 were retained. Reasons for exclusion included: addressing a wrong subject ($n=159$), having a wrong interest ($n=108$), focusing on a wrong population ($n=16$), being in a language other than English or French ($n=9$), and being a duplicate ($n=2$). In addition, one

record was added using a snowballing approach for the total of 140 articles.

Characteristics of retained articles

Table 2 summarizes descriptive characteristics of the 140 retained articles, including publication type, study design, setting, participants, data collection/analysis period, month/year of publication, country and region of origin, and framework (if one was used).

Countries and regions of origin

North America was the most represented region with 66 out of 140 (66/140, 47.1%) articles, of which 53 (80.3%)

Table 2 Article characteristics (N = 140)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
1	Abbasi, 2020 [25]	Medical news & perspective (medical news article)					July, 2020	USA	North America	
2	Abe et al., 2020 [66]	Preliminary report (research article)	Descriptive study (descriptive epidemiological study)	A 100-bed LTCF in Ibaraki, Japan	Residents and staff (17 confirmed cases including 14 residents and 3 health care professionals)	March 26–June 24, 2020		Japan	Asia	
3	Abrams et al., 2020 [41]	Brief report (research article)	Regression analysis (case-control study)	NHs from all U.S. states that reported COVID-19 cases at the facility-level	9,395 NHs from 30 US states (6,446 without COVID-19 and 2,949 with COVID-19)	As of May 11, 2020		USA	North America	
4	Agostinis et al., 2021 [67]	Original article (research article)	Observational study (prospective cohort study)	A NH in Paluzza, Italy, 65 km from the Udine University Hospital assigned to care for COVID-19 patients	121 residents, (males = 27, females = 94; median age = 85) and 118 staff	March 22–July 31, 2020		Italy	Europe	
5	Alawi, 2021 [68]	Short communication (research article)	Case report (prospective cohort study)	A private long-term nursing center comprising a 100-bed nursing home and a 6-bed intensive care and cardiovascular unit in South Jeddah, Saudi Arabia	Residents and staff	April 9–23, 2020		Saudi Arabia	Middle East	
6	Amore et al., 2021 [69]	Scientific report (research article)	Quantitative study, correlation analysis (cross-sectional study)	Municipalities in Italy	Data from: 7,904 municipalities on COVID-19 cases and deaths; and 7,357 municipalities on daily mortality	February 24–April 15, 2020		Italy	Europe	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
7	Archbald-Panone et al., 2020 [70]	Pragmatic innovation (research article)	Implementation research	Between 2 and 35 post-acute and LTCFs (number varied depending on the component of the program implemented)	Administrators, directors, directors of nursing, infection control practitioners, medical directors, all-facility licensed independent practitioners	March 13-May, 2020		USA	North America	
8	Arlotti et al., 2021 [26]	Article (policy analysis)					May, 2021	Italy	Europe	
9	Aykaç et al., 2021 [71]	Research (research article)	Cross-sectional study	Istanbul Hospice Directorate, Turkey's largest care and nursing home comprising 9 housing units with total bed capacity of 1,066	679 residents (average age = 70.2; male-to-female ratio = 1.5) and 926 staff	March 1-May 31, 2020		Turkey	Europe	
10	Bach-Mortensen et al., 2021 [72]	Short report (research article)	Cross-sectional analysis (cross-sectional study)	Care homes within upper tier local authorities (n = 149), England	Data from 149 care homes on outbreaks (n = 6,622), COVID-19-related deaths (n = 17,509), and all-cause deaths (n = 45,468)	March 9-June 21, 2020		England	Europe	
11	Bakaev et al., 2020 [73]	Letter to the editor (letter to the editor)		Hebrew Rehabilitation Center providing long-term care (625 beds) and post-acute rehabilitation (98 beds) services in Massachusetts, USA			June, 2020	USA	North America	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
12	Baughman et al., 2021 [74]	Special article (research article)	Implementation research	295 NHs in Massachusetts, USA grouped into 9 cohorts of 30–33 homes	Medical directors, directors of nursing and infection preventionists, frontline clinical staff including nurses, and certified nurse assistants	November 2020–March 2021 (personal communication with corresponding author)		USA	North America	
13	Bayle et al., 2021 [23]	Short communication (research article)	Employee screening study (cross-sectional study)	4 NHs in France (Paris, Amiti�e et Portail, Antoine Gobelins)	241 staff	April 16–29, 2020		France	Europe	
14	Beaulieu et al., 2021 [27]	Viewpoint (policy analysis)					May, 2021	Canada	North America	
15	Belmin et al., 2020 [75]	Original investigation (research article)	Retrospective cohort study (retrospective cohort study)	17 NHs that implemented staff confinement and 9,513 NHs from a national survey in France	1250 residents and 794 staff of the NHs that implemented staff confinement as well as 695,060 residents and 385,290 staff of the NHs from a national survey	March 1–May 11, 2020		France	Europe	
16	Benin et al., 2021 [76]	Original study (research article)	Ecological analysis (case-control study)	Centers for Medicare and Medicaid Services-certified NHs from all U.S. states	6,051 NHs (2,843 with a vaccination clinic and 3,216 without a vaccination clinic)	December 28, 2020–January 31, 2021		USA	North America	
17	Benvenuti et al., 2021 [77]	Original article (research article)	Descriptive study (repeated cross-sectional study)	21 NHs (Wave 1) and 43 NHs (Wave 2) in Florence, Italy	1,159 residents (Wave 1) and 2,448 residents (Wave 2)	March 1–April 30, 2020 (Wave 1) & October 1, 2020–January 31, 2021 (Wave 2)		Italy	Europe	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
18	Bernadou et al., 2021 [28]	Research article (research article)	Prospective cohort study	A NH in the Nouvelle-Aquitaine region of France	88 residents and 104 staff; 109 cases identified during the study period (58 residents and 47 staff)	March 7–May 1, 2020		France	Europe	
19	Bertrand et al., 2020 [78]	Original article (discussion paper)		An EHPAD (residential care home) in France		October, 2020		France	Europe	
20	Bigelow et al., 2021 [11]	Letter (research article)	Point-prevalence surveys (cross-sectional study)	11 LTCFs in Maryland, USA	893 residents	April 2–May 4, 2020 (personal communication with corresponding author)		USA	North America	
21	Blain et al., 2020 [79]	Special article (guidelines)		NHs in the USA	11,470 NHs	May 17–July 2, 2020	November, 2020	Europe	Europe	
22	Braun et al., 2020 [50]	Original investigation (research article)	Cross-sectional study (cross-sectional study)					USA	North America	
23	Burugorri-Pierre et al., 2021 [80]	Research letter (research article)	Cohort study (retrospective cohort study)	A 77-bed NH in Biscarrosse, France	74 residents (22.2% male; mean age = 87.8) and 102 health-care professionals	March 19–April 18, 2021		France	Europe	
24	Caramanica & O'Rourke, 2021 [81]	Original article (discussion paper)					July, 2021	USA	North America	Ernst and Chrobot-Mason's boundary spanning leadership
25	Cazzoletti et al., 2021 [82]	Article (research article)	Retrospective cohort study (retrospective cohort study)	NHs excluding those for people with disabilities and hospital-based long-term care located in the Autonomous Province of Trento, Italy	57 NHs (5145 beds)	March 1–June 1, 2020		Italy	Europe	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
26	Chan et al., 2021 [83]	Original research article (policy analysis)					March, 2021	Australia / UK	Australia / Europe	
27	Chapman & Harrington, 2020 [29]	Guest editorial (discussion paper)					October, 2020	USA	North America	
28	Chen, 2020 [84]	Letter to the editor (letter to the editor)		A LTCF in Taiwan			July, 2020	Taiwan	Asia	
29	Cheng, 2021 [85]	Commentary (discussion paper)					August, 2021	Hong Kong	Asia	
30	Chu et al., 2021 [86]	Article (policy analysis)					May, 2021	Brazil, Canada, China, Japan, Switzerland, USA	Global	
31	Cigler, 2021 [30]	Case study (discussion paper)					June, 2021	USA	North America	
32	Coulongeat et al., 2021 [87]	Pragmatic innovation (research article)	Survey (cross-sectional study)	22 NHs in France	27 staff members (13 directors, 8 coordinating physicians, and 6 coordinating nurses)	December 7, 2020–January 16, 2021		France	Europe	
33	Daly, 2020 [88]	Original article (policy analysis)					August, 2020	England	Europe	
34	Das Gupta et al., 2021 [89]	Research article (research article)	Secondary analysis (retrospective cohort study)	NHs in the USA	12,415 NHs	June 1, 2020–January 31, 2021		USA	North America	
35	Dawson et al., 2021 [90]	Original scholarship (policy analysis)					June, 2021	USA	North America	
36	de Man et al., 2021 [91]	Letter to the editor (research article)	Cross-sectional study	A NH in the Netherlands	21 residents and 34 health-care workers	June 23–July 7, 2020		The Netherlands	Europe	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
37	Dean et al., 2020 [92]	Research article (research article)	Cross-sectional regression analysis (cross-sectional study)	NHs in New York State, USA	355 NHs (primary analyses examining unionization) and 399 NHs (secondary analyses examining access to personal protective equipment)	March 1–May 31, 2020		USA	North America	
38	Deschacht et al., 2021 [31]	Letter to the editor (discussion paper)					February, 2021	Belgium	Europe	
39	Dias et al., 2020 [93]	Article (research article)	Empirical and theoretical research (mixed-methods study)	20 long-term care organizations in Rio de Janeiro, Brazil	Healthcare professionals	May, 2020		Brazil	South America	
40	Dichter et al., 2020 [94]	Commentary (discussion paper)					May, 2020	Germany	Europe	
41	Doetter et al., 2021 [95]	Special issue article (policy analysis)					May, 2021	Austria, Germany, Ireland, Spain, Denmark, Sweden	Europe	
42	Dolveck et al., 2021 [96]	Original article (research article)	Retrospective study (retrospective pre-post study)	8 LTCFs in the Ile de France region of France	770 residents	March 26–May 7, 2020		France	Europe	
43	Dykgraaf et al., 2021 [8]	Review article (research article)	Rapid narrative review	NHs and LTCFs	80 papers describing 77 studies	Database search up to November 24, 2020		Global	Global	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
44	Echeverria et al., 2020 [97]	Original paper (research article)	Implementation study (implementation research)	196 care centers (169 nursing homes and 27 institutions for people with physical and mental disabilities) in collaboration with 64 primary care teams from Barcelona, Catalonia	10,347 residents and up to 4000 health care workers	April 1–30, 2020		Spain	Europe	
45	Eckardt et al., 2020 [12]	Brief report (research article)	Serial point-prevalence studies (repeated cross-sectional study)	A 120-bed LTCF (Life Care Centre) in Washington, USA	Residents and staff (number of screening tests = 769, number tested positive = 25)	April 7–May 6, 2020		USA	North America	
46	Escobar et al., 2021 [13]	Brief report (research article)	Case report (descriptive epidemiological study)	A 135-bed NH in Pennsylvania, USA	84 residents (83 male, average age = 74) and 279 staff	April 10–23, 2020		USA	North America	
47	Estévez-Abe & Ide, 2021 [98]	Commentary (policy analysis)					May, 2021	Japan	Asia	
48	"Eye of the storm", 2020 [99]	Magazine article (professional journal article)					June, 2020	Australia	Australia	
49	Figueroa et al., 2020 [100]	Letter (research article)	Logistic regression analysis (cross-sectional study)	NHs across 8 U.S. states: California, Connecticut, Florida, Illinois, Maryland, Massachusetts, New Jersey, Pennsylvania	4,254 NHs	January 1–June 30, 2020		USA	North America	
50	Finger et al., 2021 [14]	Article (research article)	Performance improvement initiative (prospective cohort study)	Coler Rehabilitation and Nursing Care Center in New York City, USA	208 residents	March 1–June 30, 2020		USA	North America	Plan-Do-Study-Act Cycle

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
51	Frazer et al., 2021 [46]	Original research (research article)	Rapid systematic review	LTCFs	38 studies (40 papers)	Database search up to July 27, 2020		Global	Global	
52	Gibson & Greene, 2021 [101]	Clinical investigation (research article)	Cross-sectional logistic regression analysis (cross-sectional study)	NHs in the USA	NHs (weekly sample sizes ranged from 14,937–15,148)	June 7, 2020–March 7, 2021		USA	North America	
53	Gilman & Basett, 2021 [102]	Letter to the editor (research article)	Cross-sectional study	85% of all the NHs in the USA (NHs in the country)	13,104 NHs	May 25–December 20, 2020		USA	North America	
54	Giri et al., 2021 [48]	Review (research article)	Scoping review	NHs	76 articles	Database search: March 1, 2020–January 31, 2021		Global	Global	
55	Gmehlin & Muñoz-Price, 2020 [43]	Review (research article)	Literature review	LTCFs	20 studies	As of July 30, 2020		Global	Global	
56	Gmehlin et al., 2021 [103]	Original study (research article)	Retrospective cohort study (retrospective cohort study)	NHs in Wisconsin, USA	363 NHs	June 1–October 31, 2020		USA	North America	
57	Gopal et al., 2021 [34]	Original research (research article)	Cross-sectional study (cross-sectional study)	NHs in California, USA	713 NHs	As of May 1, 2020		USA	North America	
58	Gorges & Konezka, 2020 [35]	Brief report (research article)	Logistic regression analysis (cross-sectional study)	NHs in the USA	13,167 NHs	As of June 25, 2020		USA	North America	
59	Gorges & Konezka, 2021 [36]	Original investigation (research article)	Cross-sectional study (cross-sectional study)	NHs in the USA	13,312 NHs	July 28–December 18, 2020		USA	North America	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
60	Goto et al., 2021 [15]	Concise communication (research article)	Cross-sectional study	20 community living center units; described as being equivalent to private LTCFs, located at 8 campuses in 5 U.S. states (Iowa, Minnesota, Nebraska, North and South Dakota)	Residents (average daily census across the units was 472.1 residents)	March 1–August 31, 2020		USA	North America	
61	"Hard-hit nursing homes", 2020 [104]	News (medical news article)					September, 2020	USA	North America	
62	Harrington et al., 2020 [37]	Article (research article)	Regression analysis (cross-sectional study)	NHs in California, USA	1,091 NHs; 272 reported COVID-19 infection in residents and 819 did not	March 15–May 4, 2020		USA	North America	
63	Havaei et al., 2021 [16]	Case study (research article)	Qualitative study; part of a larger mixed-methods case study (qualitative study)	Louis Brier Home and Hospital, a LTCF in British Columbia, Canada (publicly funded, not-for-profit; remained COVID-19 free)	4 members of the executive leadership team responsible for HR management, facility and quality and safety	mid-August, 2020		Canada	North America	A modified version of the BC Centre for Disease Control document representing required practice and policy changes for prevention and/or mitigation of COVID-19 in LTCFs
64	Heckman et al., 2021 [42]	Controversies in care (conference proceedings paper)			130 conference attendees		April, 2021	Global	Global	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
65	Heudorf et al., 2020 [105]	Research article (research article)	Case reports (cross-sectional study)	LTCFs in Frankfurt am Main, Germany with a focus on 3 facilities with 89, 209, and 99 residents, respectively	Residents and staff	March 2–August 28, 2020		Germany	Europe	
66	Ibrahim et al., 2021 [106]	Research article (research article)	Population-based cross-sectional study (cross-sectional study)	NHs in Victoria, Australia	766 NHs housing 48,824 residents with a subgroup of nursing homes ($n = 74$) with at least one confirmed COVID-19 case among residents	July, 7–November 13, 2020		Australia	Australia	
67	Kain et al., 2021 [107]	Original study (research article)	Retrospective chart review; longitudinal study (retrospective cohort study)	A LTCF in Ontario, Canada	113 residents (average age = 78.3) and 130 staff	March 1–May 21, 2020		Canada	North America	
68	Khairat et al., 2021 [38]	Original study - Brief report (research article)	Cross-sectional study (cross-sectional study)	Medicaid- and Medicare-certified NHs in the USA	15,390 NHs	May 25–December 20, 2020		USA	North America	
69	Konetzka & Gorges, 2021 [108]	Letter to the editor (research article)	Cross-sectional study	NHs in 6 U.S. states: Idaho, Montana, North Dakota, South Dakota, Utah, and Wisconsin	778 NHs	May 29–October 25, 2020		USA	North America	
70	Konetzka et al., 2021 [47]	Review article (research article)	Systematic review	NHs and assisted living communities in the USA	36 studies	Database search: January 1, 2020–June 15, 2021		USA	North America	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
71	Krone et al., 2021 [17]	Outbreaks (research article)	Non-controlled retrospective observational study (retrospective cohort study)	A NH in Germany consisting of 3 buildings: A (3 storeys with 45 beds); B (6 storeys with 105 beds); and C (3 storeys with 24 beds)	160 residents (average age = 86) and 135 staff	March 8–May 4, 2020		Germany	Europe	
72	Lamb et al., 2021 [109]	Pragmatic innovation (research article)	Survey (implementation research/cross-sectional study)	7 LTCFs and 10 retirement homes in Ontario, Canada	Medical directors, directors of care, administrators, general managers, and IPC leads (37 responses)	April 28–June 30, 2020		Canada	North America	
73	Li et al., 2020a [39]	Clinical investigation (research article)	Cross-sectional analysis (cross-sectional study)	NHs in the USA	12,576 NHs	As of the week of May 25, 2020		USA	North America	
74	Li et al., 2020b [110]	Clinical investigation (research article)	Cross-sectional analysis (cross-sectional study)	All NHs in Connecticut, USA	215 NHs	As of April 16, 2020		USA	North America	
75	Li et al., 2021 [111]	Brief report (research article)	Retrospective observational study (cross-sectional study)	NHs in the USA, including both skilled nursing facilities and NHs	14,602 NHs	May 24–June 21, 2020		USA	North America	
76	Liang & Xu, 2021 [112]	Clinical investigation (research article)	Survey (cross-sectional study)	90 private NHs, 45 public-private partnership NHs, and 65 state-owned NHs in China	200 administrators	February 1–10, 2020		China	Asia	Fuzzy comprehensive evaluation method; the organizational crisis management theory
77	Lingum et al., 2021 [113]	Original study (research article)	Mixed-methods evaluation (mixed-methods pre-post evaluation study)	140 NHs in Canada (mainly Ontario)	160 interprofessional healthcare professionals	April–July 2020 ^g		Canada	North America	
78	Lipsitz et al., 2020 [18]	Clinical investigation (research article)	Longitudinal cohort study (prospective cohort study)	NHs in Massachusetts, USA	360 NHs, of which 123 received targeted support	May 10–July 5, 2020		USA	North America	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
79	Liu et al., 2020 [24]	Analysis (policy analysis)					September, 2020	Canada	North America	
80	Louie et al., 2021 [114]	Brief report (research article)	Outbreak investigation (descriptive epidemiological study)	4 LTCFs including 3 skilled nursing facilities and 1 assisted living facility in San Francisco, California, USA	Residents and staff (431 people were tested)	March 30–April 30, 2020		USA	North America	
81	Lum et al., 2020 [115]	Perspective (policy analysis)						Hong Kong	Asia	
82	Lyng et al., 2021 [116]	Research (research article)	Qualitative exploratory case study (qualitative study)	NHs and home care services in a large city municipality in Norway	Healthcare leaders: 13 (1st phase) and 22 (2nd phase)	September–November, 2020		Norway	Europe	Macrae and Wiig's resilience framework
83	MacCannell et al., 2021 [117]	Major article (research article)	Clinical investigation (prospective cohort study)	6 LTCFs in California, USA: 4 skilled nursing facilities and 2 assisted-living facilities with memory care services	491 COVID-19 cases among residents (n = 312) and staff (n = 179)	March 18–July 31, 2020		USA	North America	
84	Malikov et al., 2021 [118]	Research letter (research article)	Population-based cohort study (retrospective cohort study)	NHs in Ontario, Canada	37,274 COVID-19 cases across the province, among which 5,545 cases were among NH residents	March 1–July 16, 2020		Canada	North America	
85	Marossy et al., 2021 [119]	Major article (research article)	Point-prevalence survey (cross-sectional study)	37 care homes in London (17 nursing homes, 13 residential homes, 1 mixed residential and nursing home, and 6 extra care housing facilities)	1,034 residents and 1,421 staff	May 1–20, 2020		England	Europe	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
86	Marshall et al., 2021 [120]	Research article (research article)	Qualitative study (qualitative study)	Care homes in the East Midlands, England	10 care home managers	June–July, 2020		England	Europe	An adapted organisational framework analysis approach with a focus on social ties and interdependencies between organisations and individuals
87	McBee et al., 2020 [121]	Morbidity and mortality weekly report (morbidity and mortality weekly report)					August, 2020	USA	North America	
88	McGarry et al., 2020 [122]	Author manuscript (research article)	Cross-sectional study	NHs	15,035 NHs	May 18–June 14, 2020 and June 24–July 19, 2020		USA	North America	
89	McGarry et al., 2021 [123]	Letter (research article)	Cross-sectional study	NHs	15,065 NHs	August 16–September 27, 2020		USA	North America	
90	McGilton et al., 2021 [124]	Research article (research article)	Exploratory qualitative study (qualitative study)	LTCFs	14 nurse practitioners	August–October, 2020		Canada	North America	
91	McGregor et al., 2020 [125]	Commentary (discussion paper)		LTCFs			August, 2020	Canada, USA	North America	
92	Miller et al., 2021 [126]	Major article (research article)	Validation study (cross-sectional study based on computational modeling)	A skilled nursing facility in the Life Plan Community, Lancaster County, Pennsylvania, USA (the study focused on one hall consisting of 13 beds within 7 rooms)	Residents and staff	May 14–21, 2020		USA	North America	
93	Mills et al., 2020 [127]	Pragmatic innovation (research article)	Implementation research	101 assisted living facilities in Ohio, USA	1,794 residents	January 20–April 30, 2020		USA	North America	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
94	Miralles et al., 2021 [128]	Special article (research article)	Narrative review	LTCFs	Older population in 6 European countries: Belgium, France, Italy, Poland, Spain, and United Kingdom	March–July, 2020		6 European countries	Europe	
95	Montoya et al., 2021 [19]	Brief report (research article)	Outbreak investigation; point-prevalence surveys (prospective cohort study)	3 NHs in Michigan, USA (total beds = 356)	215 residents	March 23–April 23, 2020		USA	North America	
96	Mor et al., 2021 [129]	Clinical investigation (research article)	Matched-pair analysis (case-control study)	NHs in 21 U.S. states	280 NHs (136 early vaccinated NHs with 12,157 residents and 144 late vaccinated NHs with 13,221 residents)	December 18, 2020–January 18, 2021		USA	North America	
97	Moraes et al., 2020 [130]	Article (discussion paper)		LTCFs	Residents and staff		September, 2020	Brazil	South America	
98	Morris et al., 2020 [131]	Concepts (discussion paper)		LTCFs in Washington State, USA			June, 2020	USA	North America	
99	Murti et al., 2021 [132]	Research (research article)	Outbreak investigation (retrospective cohort study)	A LTCF facility in Ontario, Canada	65 residents and 67 staff	March 18–May 14, 2020		Canada	North America	
100	Obayashi et al., 2021 [133]	Letter to the editor (letter to the editor)					June, 2021	Japan	Asia	
101	Ochi et al., 2021 [134]	Article (policy analysis)			Expert meeting: n = 16; guideline review: n = 4; steering committee: n = 4	March, 2020		Japan	Asia	Determinants of the risk of severe infection; deep defense in infection control
102	Ohta et al., 2021 [135]	Article (research article)	Interventional study (interventional pre-post study)	Rural nursing home in Japan	96 residents and staff	April 1, 2019–March 31, 2021		Japan	Asia	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/ Year ^f	Country	Region	Framework
103	Palacios-Ceña et al., 2021 [45]	Review (research article)	Scoping review	NHs and LTCFs	16 studies	Database search: March 11, 2020–February 15, 2021		Global	Global	Health and social care framework based on the experiences and perspectives of residents, families, and LTCF employees during the COVID-19 pandemic
104	Park., 2020 [20]	Brief report (research article)	Investigation (descriptive epidemiological study)	3 LTCFs in Korean metropolitan areas (2 nursing hospitals and 1 NH)	Residents and staff	January 20–April 20, 2020		South Korea	Asia	
105	Piet et al., 2021 [136]	Article (research article)	Cross-sectional survey (cross-sectional study)	74 NHs in the Auvergne-Rhône-Alpes region of France	5,891 residents and 4,652 staff	March 1–May 31, 2020		France	Europe	
106	Poltavskiy et al., 2021 [137]	Short report (research article)	Logistic regression analysis (cross-sectional study)	NHs in California, USA	1,184 NHs (cumulative number of residents with COVID-19 = 9650)	April 17–May 31, 2020		USA	North America	
107	Poupin et al., 2021 [21]	Brief report (research article)	Implementation research/cross-sectional study	A 100-resident NH in Tours, France	100 residents and 60 staff	April 8, 2020		France	Europe	
108	Powell et al., 2020 [138]	Essay (discussion paper)					June, 2020	USA	North America	
109	Power & Carson, 2021 [32]	Original article (discussion paper)					September, 2021	Global (mostly Canada)	Global	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
110	Pue et al., 2021 [139]	Research article	Regression analysis (cross-sectional study)	Long-term care homes in Ontario, Canada	608 long-term care homes (LTCHs) from the Ontario Ministry of Health and Long Term Care database and 491 LTCHs from the Government of Ontario LTCH outbreaks database	May 27, 2020–February 11, 2021		Canada	North America	
111	Rada, 2020 [140]	Feature article (discussion paper)					April, 2020	Spain	Europe	
112	Relias Media, 2020 [141]	News article (medical news article)					June, 2020	USA	North America	
113	Rios et al., 2020 [142]	Research (research article)	Rapid review	LTCHs	9 articles	Database search up to July 31, 2020		Global	Global	
114	Shallcross et al., 2021 [143]	Article (research article)	Cross-sectional survey (cross-sectional study)	LTCHs	5126 LTCHs (data on 160,033 residents and 248,594 staff)	May 26–June 19, 2020		England	Europe	
115	Shea et al., 2020 [144]	Letter to the editor (letter to the editor)					May, 2020	Hong Kong	Asia	
116	Shi et al., 2021 [145]	Research article (research article)	Cross-sectional study (cross-sectional study)	484 NHs in China (1.5% of all NHs in the country)	NH managers (average age = 43); final sample included 461 responses	February 7–29, 2020		China	Asia	
117	Shih et al., 2020 [146]	Letter to the editor (letter to the editor)		A NH in Taiwan			November, 2020	Taiwan	Asia	

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
118	Shimotsu et al., 2021 [147]	Research letter (research article)	Surveillance exercise (prospective cohort study)	A LTCF (Twin Pines) in Pennsylvania, USA	Residents, staff, and frequent visitors such as delivery drivers were evaluated by nasal swab ($n = 5,625$)	June 23–October 1, 2020		USA	North America	
119	Simoni-Wastila et al., 2021 [148]	Original study (research article)	Cross-sectional analysis (cross-sectional study)	NHs in the USA	13,156 NHs	September 28–December 27, 2020		USA	North America	
120	Song et al., 2020 [149]	Original article (research article)	Epidemiological investigation (descriptive epidemiological study)	5 nursing facilities in Gyeong-san-si, Republic of Korea	296 staff and residents (79 cases)	February 27–March 24, 2020		South Korea	Asia	
121	Steiner, 2021 [150]	Feature article (discussion paper)					April, 2021	USA	North America	
122	Stocker et al., 2021 [151]	Original research (research article)	Qualitative interview study (qualitative study)	Clinical Commissioning Group area in the North-East of England	17 staff: 10 from the care home sector across 7 care homes and 7 from the National Health Service	May, 2020		England	Europe	
123	Stratil et al., 2021 [55]	Rapid review (research article)	Rapid review	LTCFs	22 studies	Database search up to January 22, 2021		Global	Global	
124	Sunner et al., 2021 [152]	Original article (research article)	Qualitative study (qualitative study)	18 Residential Aged Care Facilities in metropolitan areas and 10 in rural areas of New South Wales, Australia	31 Residential Aged Care Facility clinical managers (4 males and 27 females)	May–June, 2020		Australia	Australia	
125	Szczerbińska, 2020 [153]	Editorial (discussion paper)					July, 2020	Global	Global	Behrens and Naylor's operational framework for a coordinated response to COVID-19

Table 2 (continued)

#	Author, Year	Publication Type ^a	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/ Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
126	Tan & Seetharaman, 2020 [154]	Letter to the editor (letter to the editor)		A geriatric centre in Singapore			April, 2020	Singapore	Asia	
127	Tan & Seetharaman, 2021 [155]	Letter to the editor (letter to the editor)					February, 2021	Singapore	Asia	
128	Telford et al., 2021 [40]	Brief report (research article)	Public health surveillance activity (prospective cohort study)	LTCFs in Fulton County, Georgia, USA	24 LTCFs representing 2,580 residents, among whom 39% were infected with COVID-19	June–July, 2020		USA	North America	Infection Prevention and Control Assessment and Response (ICAR) Tool
129	Vijh et al., 2021 [22]	Original article (research article)	Quasi-experimental before-and-after study (quasi-experimental before-and-after study)	75 LTCFs within the Vancouver Coastal Health region, British Columbia, Canada	LTCFs (each ranging between 108–259 staff and 107–210 residents)	February 28–May 24, 2020		Canada	North America	
130	Viray et al., 2021 [156]	Brief communication (communication)		6 Residential Aged Care Facilities in Victoria, Australia			February, 2021	Australia	Australia	
131	“Vital COVID lessons ignored”, 2020 [157]	Magazine article (professional journal article)					October, 2020	Australia	Australia	
132	Vogazianos et al., 2021 [158]	Research article (research article)	Impact assessment (complex intervention with a prospective cohort/pre-post study)	165 LTCFs in 5 districts of Cyprus	3,100 residents and 2,015 staff	mid-November–end of December, 2020		Cyprus	Europe	
133	Wagner, 2020 [159]	Discussion & Opinion paper (discussion paper)					September, 2020	USA	North America	
134	Wang et al., 2020 [160]	Editorial (discussion paper)					June, 2020	China	Asia	
135	Wang, 2021 [161]	Research (research article)	Quantitative and qualitative analyses (mixed-methods study)	Senior-living facilities in Shanghai, Zhengzhou, and Kaifeng, China	6 senior-living facility managers	May, 2020		China	Asia	Barker’s behavior setting theory

Table 2 (continued)

#	Author, Year	Publication Type ^e	Study Design ^b	Setting ^c	Participants ^d	Period of Data Collection/Analysis ^e	Publication Month/Year ^f	Country	Region	Framework
136	Watts et al., 2021 [162]	Research article (research article)	Retrospective cohort study (retrospective cohort study)	Skilled nursing facility in a Western, mostly rural, U.S. state	325 residents (average age = 77) and 296 staff	March 1–August 31, 2020	USA	USA	North America	Vulnerable population conceptual framework
137	Yang et al., 2021 [163]	Research article (research article)	Qualitative study (qualitative study)	NHs in Wuhan, China	7 front-line medical staff	March 25–31, 2020	China	China	Asia	
138	Yau et al., 2021 [164]	Full length article (research article)	Qualitative study (qualitative study)	LTCFs in British Columbia, Canada	23 key informants (public health, health authority leadership for long-term care, infection prevention and control, long-term care operators, and frontline staff)	June–July, 2020	Canada	Canada	North America	
139	Zheng et al., 2021 [165]	Commentary (discussion paper)		A Residential Aged Care Facility in Sydney, Australia accommodating 114 residents and 130 staff			February, 2021	Australia	Australia	
140	Zollner-Schwetz et al., 2021 [33]	Major article (research article)	Retrospective outbreak analysis; retrospective chart review (retrospective cohort/cross-sectional study)	3 LTCFs of the Geriatric Health Centres of Graz, Austria	277 residents and 214 staff	March 22–April 14, 2020	Austria	Austria	Europe	

LTCF Long-term care facility, NH Nursing home

^a Publication type is listed as defined by journal, while the classification given by the authors is in italics

^b Study design: presented for research articles only (*n* = 87). followed by authors' classification in italics; if no design was specified in the article, only authors' classification is provided in italics

^c Setting: presented for research articles only (*n* = 87), with few exceptions when the setting was clearly defined

^d Participants: presented for research articles only (*n* = 87)

^e Period of data collection/analysis: presented for research articles only (*n* = 87)

^f Publication month/year: extracted and presented for non-research articles (*n* = 42)

^g Personal communication with corresponding author

originated in the USA [11–15, 18, 19, 25, 29, 30, 34–41, 47, 50, 70, 73, 74, 76, 81, 89, 90, 92, 100–104, 108, 110, 111, 114, 117, 121–123, 126, 127, 129, 131, 137, 138, 141, 147, 148, 150, 159, 162], 12 (18.2%) came from Canada [16, 22, 24, 27, 107, 109, 113, 118, 124, 132, 139, 164], and one (1.5%) article covered both the USA and Canada [125]. North America was followed by Europe with 34 out of 140 (24.3%) articles, of which nine (26.5%) originated in France [21, 23, 28, 75, 78, 80, 87, 96, 136], six (17.6%) in England [72, 88, 119, 120, 143, 151], five (14.7%) in Italy [26, 67, 69, 77, 82], three (8.8%) in Germany [17, 94, 105], two (5.9%) in Spain [97, 140], and three (8.8%) covered several European countries [79, 95, 128], while the rest represented one country each, including Austria [33], Belgium [31], Cyprus [158], Norway [116], the Netherlands [91], and Turkey [71]. Nineteen of the 140 articles (13.6%) came from Asia, of which six (31.6%) originated in China [112, 115, 145, 160, 161, 163], five (26.3%) in Japan [66, 98, 133–135], two (10.5%) in Hong Kong [85, 144], two (10.5%) in Singapore [154, 155], two (10.5%) in South Korea [20, 149], and two (10.5%) in Taiwan [84, 146]. Australia was represented by six (4.3%) articles [99, 106, 152, 156, 157, 165], South America by two (1.4%) articles both coming from Brazil [93, 130], and the Middle East by one (0.7%) article originating in Saudi Arabia [68]. In addition, one (0.7%) article covered both Europe and Australia [83], and 11 (7.9%) articles—including seven reviews—adopted a global perspective [8, 32, 42, 43, 45, 46, 48, 55, 86, 142, 153].

Publication types

Of the 140 retained articles, 95 (67.9%) were classified as research articles and included, for example original articles, reviews, and brief reports [8, 11–23, 28, 33–41, 43, 45–48, 50, 55, 66–72, 74–77, 80, 82, 87, 89, 91–93, 96, 97, 100–103, 105–114, 116–120, 122–124, 126–129, 132, 135–137, 139, 142, 143, 145, 147–149, 151, 152, 158, 161–164]. In addition to research articles, our sample included 18 (12.9%) discussion papers [29–32, 78, 81, 85, 94, 125, 130, 131, 138, 140, 150, 153, 159, 160, 165]; 11 (7.9%) policy analysis papers [24, 26, 27, 83, 86, 88, 90, 95, 98, 115, 134]; seven (5.0%) letters to the editor [73, 84, 133, 144, 146, 154, 155]; three (2.1%) medical news articles [25, 104, 141]; two (1.4%) professional journal articles [99, 157]; one (0.7%) communication [156]; one (0.7%) guideline [79]; one (0.7%) conference proceedings paper [42]; and one (0.7%) morbidity and mortality weekly report [121].

Designs of research articles

The 95 research articles included 39 (41.1%) studies that analyzed secondary quantitative data [13, 18, 20, 34–39, 41, 50, 66, 69, 71, 72, 76, 77, 80, 89, 92, 100–103, 105–108,

110, 111, 118, 122, 123, 129, 132, 137, 139, 148, 162], 38 (40.0%) studies that used primary quantitative data [11, 12, 14, 15, 17, 19, 21–23, 28, 33, 40, 67, 68, 70, 74, 75, 87, 91, 93, 96, 97, 109, 112–114, 117, 119, 126, 127, 135, 136, 143, 145, 147, 149, 158, 161], eight (8.4%) qualitative studies [16, 112, 120, 124, 151, 152, 163, 164], one (1.1%) study that used both primary and secondary quantitative data [82], as well as nine (9.5%) reviews, including three rapid reviews [8, 55, 142], two scoping reviews [45, 48], one systematic review [47], one rapid systematic review [46], one literature review [43], and one narrative review [128].

The 39 studies that analyzed secondary quantitative data encompassed 24 (61.5%) cross-sectional studies [34–39, 50, 69, 71, 72, 92, 100–102, 105, 106, 108, 110, 111, 122, 123, 137, 139, 148], seven (17.9%) retrospective cohort studies [80, 89, 103, 107, 118, 132, 162], three (7.7%) case-control studies [41, 76, 129], three (7.7%) descriptive epidemiological studies [13, 20, 66], one (2.6%) repeated cross-sectional study [77], and one (2.6%) prospective cohort study [18].

The 38 studies that collected primary quantitative data included 10 (26.3%) cross-sectional studies [11, 15, 23, 87, 91, 112, 119, 136, 143, 145], eight (21.1%) prospective cohort studies [14, 19, 28, 40, 67, 68, 117, 147], four (10.5%) implementation research studies [70, 74, 97, 127], two (5.3%) implementation research/cross-sectional studies [21, 109], two (5.3%) descriptive epidemiological studies [114, 149], two (5.3%) mixed-methods studies [93, 161], two (5.3%) retrospective cohort studies [17, 75], one (2.6%) cross-sectional study based on computational modeling [126], one (2.6%) mixed-methods pre-post evaluation study [113], one (2.6%) quasi-experimental before-and-after study [22], one (2.6%) repeated cross-sectional study [12], one (2.6%) retrospective cohort/cross-sectional study [33], one (2.6%) retrospective pre-post study [96], one (2.6%) complex intervention with a prospective cohort/pre-post study [158], and one (2.6%) interventional pre-post study [135].

Settings and participants of research articles

Of the 38 studies that used primary quantitative data, 27 (71.1%) were based on evidence from multiple LTCFs with the number of facilities ranging from 2 to 5,126 [11, 15, 19, 22, 23, 33, 40, 70, 74, 75, 87, 93, 96, 97, 109, 112–114, 117, 119, 127, 136, 143, 145, 149, 158, 161], whereas 11 (28.9%) focused on a single facility [12, 14, 17, 21, 28, 67, 68, 91, 126, 135, 147]. Of the 39 studies that were based on secondary quantitative data, 32 (82.1%) pooled evidence from multiple LTCFs with the number of facilities ranging from 3 to 15,390 [18, 20, 34–39, 41, 50, 69, 72, 76, 77, 89, 92, 100–103, 105, 106, 110, 111, 118, 122, 123, 129, 137, 139, 108, 148],

whereas seven (7.7%) centered on a single facility [13, 66, 71, 80, 107, 132, 162]. Of the eight qualitative studies, seven (87.5%) presented evidence from multiple facilities [116, 120, 124, 151, 152, 163, 164] and one (12.5%) described the experiences of a single facility [16]. The one study based on both primary and secondary quantitative data used evidence from multiple facilities [82].

Of the 38 studies that relied on primary quantitative data, 20 (52.6%) included both residents and staff as participants [12, 17, 21, 28, 33, 67, 68, 75, 91, 97, 114, 117, 119, 126, 135, 136, 143, 147, 149, 158], 10 (26.3%) focused on staff [23, 70, 74, 87, 93, 109, 112, 113, 145, 161], six (15.8%) focused on residents [11, 14, 15, 19, 96, 127], and two (5.3%) collected facility-level data [22, 40]. Of the 39 studies that analyzed secondary quantitative data, 27 (69.2%) used facility-level data [18, 34–39, 41, 50, 76, 89, 92, 100–103, 106, 108, 110, 111, 118, 122, 123, 129, 137, 139, 148], nine (23.1%) included both residents and staff as participants [13, 20, 66, 71, 80, 105, 107, 132, 162], one (2.6%) focused on residents [77], one (2.6%) employed municipal- and facility-level data [69], and one (2.6%) used facility- and resident-level data [72]. The one study that combined primary and secondary quantitative data performed a facility-level analysis [82]. All participants in the eight qualitative studies were staff members [16, 116, 120, 124, 151, 152, 163, 164].

COVID-19 pandemic timeframe

To situate the evidence within the temporal progression of the COVID-19 pandemic, we plotted the period of data collection or analysis for the 95 research articles (see Fig. 4). Most research articles (81/95, 85.3%) used one or more consecutive weeks/months during 2020 as their period of data collection or analysis [8, 11–23, 28, 33–41, 43, 46, 50, 66–72, 75, 82, 91–93, 96, 97, 100, 102, 103, 105–114, 116–120, 122–124, 126–128, 132, 136, 137, 142, 143, 145, 147–149, 151, 152, 158, 161–164]. In addition, of the 95 research articles, eleven (11.6%) articles used a period beginning in 2020 and extending into 2021 [45, 47, 48, 55, 74, 76, 87, 89, 101, 129, 139], one (1.1%) article focused on a 2-month period in 2021 [80], one (1.1%) article reported results of an interventional study conducted between April 2019 and March 2021 [135], and one (1.1%) article covered two non-consecutive periods, one corresponding to the first wave of the pandemic in 2020 and the other to the second wave in 2021 [77].

Frameworks

Of the 140 articles, 12 (8.6%) applied a conceptual or theoretical framework, including: a checklist of measurable IPC practices adapted from guidelines for managing COVID-19 in LTCFs [16]; an adapted organizational framework analysis focusing on social ties and the interdependency between individuals and

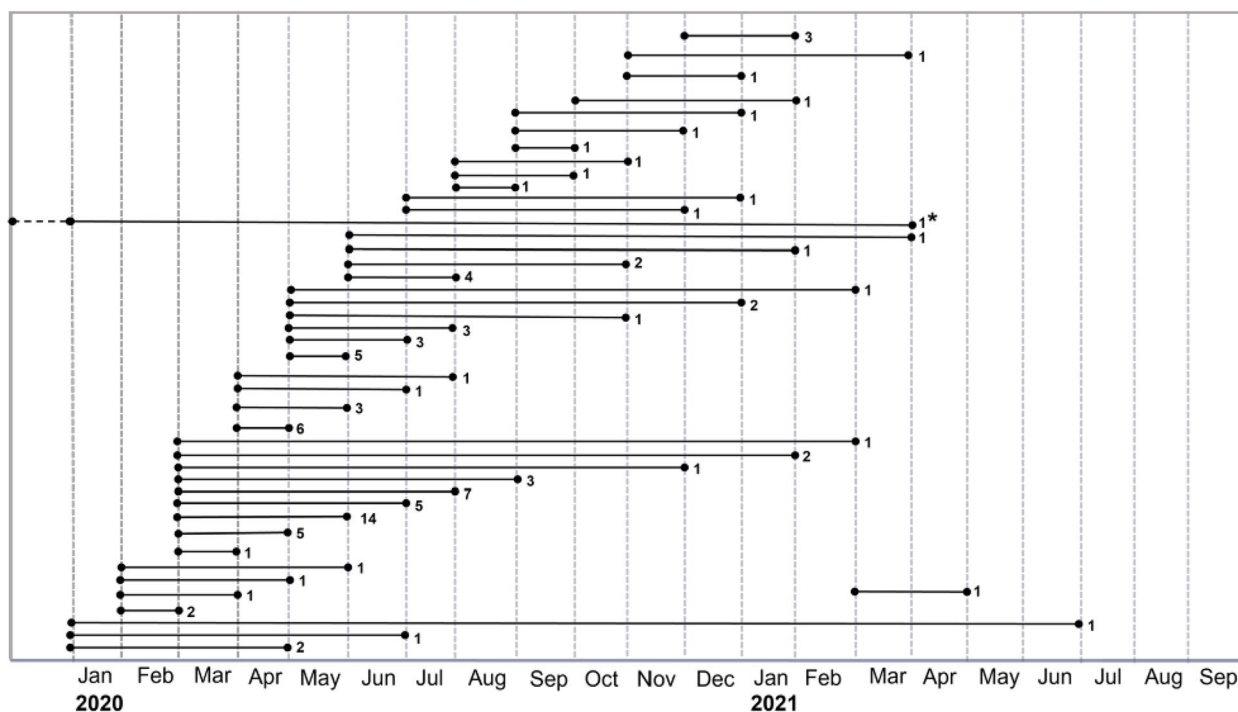


Fig. 4 Plot of the period of data collection/analysis for research articles (n = 95); numbers represent the number of articles covering each period. *Data collection began in 2019

organizations [120]; Barker's behavior setting theory [161]; Ernst and Chrobot-Mason's framework of boundary spanning leadership [81]; a "fuzzy comprehensive evaluation method" that integrates internal and external factors to evaluate performance in terms of IPC [112]; the organizational crisis management theory [112]; the health and social care framework [45]; the Infection Prevention and Control Assessment and Response Tool [40]; the Plan-Do-Study-Act Cycle [14]; Macrae and Wiig's resilience framework [116]; the vulnerable population conceptual framework [162]; Behrens and Naylor's operational framework for a coordinated response to the COVID-19 pandemic [153]; and the framework of the determinants of the risk of severe infection in conjunction with the concept of deep defense within infection management [134].

Dimensions of LTCF performance

Table 3 displays dimension(s) of LTCF performance extracted from all retained articles. *Efficacy* and *safety* were the most frequently discussed dimensions; these were extracted from 106 (75.7%) of the 140 articles each, followed by *viability* (81/140, 57.9%), *continuity* (43/140, 30.7%), *accessibility* (38/140, 27.1%), and *reactivity* (37/140, 26.4%). *Equity* and *efficiency* were the least frequently addressed dimensions; these were extracted from 19 (13.6%) and 18 (12.9%) articles, respectively.

Factors that influenced COVID-19 management in LTCFs

Factors that were discussed in relation to the management of COVID-19 within LTCFs were extracted from all 140 articles (see Table 4). Among internal factors, "organizational context" and "human resources" were the most frequently reported factors; these were extracted from 102 (72.9%) and 87 (62.1%) of the 140 articles, respectively, followed by "material resources" (63/140, 45.0%), "facility characteristics" (53/140, 37.9%), "staff characteristics" (52/140, 37.1%), "resident characteristics" (37/140, 26.4%), "technological resources" (26/140, 18.6%), and "financial resources" (18/140, 12.9%) (see Table 4). Among external factors, "visitors" and "public health policies/guidelines" were the most frequently reported factors; these were extracted from 38 (27.1%) and 36 (25.7%) of the 140 articles, respectively, followed by "virus circulation in the community" (22/140, 15.7%), and "admissions" (17/140, 12.1%). Sixteen (11.4%) articles reported factors that were extracted under the category "Other". These included asymptomatic or atypical presentation of COVID-19, the lack of knowledge about COVID-19 symptoms, and vaccination.

Discussion

This scoping review identified and synthesized factors that could influence LTCF performance by analyzing a vast body of international literature from early in the COVID-19 pandemic until the end of 2021. By applying a multidimensional conceptual framework of healthcare system performance, this study brings to light various factors that were reported to have influenced the accessibility and quality of healthcare services during the pandemic, how the available resources were optimized, and how these parameters contributed to overall LTCF performance.

LTCF performance during the COVID-19 pandemic

The majority of included articles considered the performance of a single or multiple LTCF(s) along the dimensions of *efficacy* (75.7%) and *safety* (75.7%). As per this review's conceptual framework, these two dimensions gauge healthcare system performance in terms of the quality of the services provided. This finding reflects the urgency of the pandemic response demanded from LTCF management around the world, which led to the prioritization of the delivery of safe care amidst a public health crisis. *Efficacy* was predominantly discussed in terms of the degree to which IPC interventions implemented by LTCFs were successful at decreasing the transmission of COVID-19 or managing COVID-19 outbreaks once they occurred. Effective reduction of COVID-19 incidence, morbidity, and mortality was linked to early implementation of and adherence to IPC measures, including: the use of personal protective equipment (PPE), hand hygiene, sanitation, isolation, universal serial testing of residents and staff, cohorting, vaccination, visitor restrictions, and the availability of IPC trained staff (e.g., [11, 12, 15–18, 43, 71, 73, 76, 79, 80, 85, 105, 115, 121, 129]). Furthermore, close integration between acute and long-term care, communication between LTCFs and public health authorities, and access to a multidisciplinary clinical team emerged as strategies that contributed to a more successful COVID-19 response (e.g., [8, 21, 31, 81, 109, 124]). In terms of *safety*, IPC measures put in place by LTCFs to limit viral spread were most commonly reported. Multiple publications provided evidence of how LTCF staff acted as vectors of COVID-19 introduction and transmission, for example when working at multiple facilities or when not using PPE properly, if at all, due to severe resource shortages (e.g., [24, 79, 141]). Safety risks associated with LTCF staff working at multiple facilities can be addressed by asking staff to reside with residents under isolation, which was reported to be effective at reducing COVID-19 incidence and mortality [48, 75]. However, the implementation of any IPC protocol must be weighed against its potential impact on the

Table 3 Dimensions of performance (N = 140)

#	Author, Year	Accessibility of services		Quality of services				Optimization of resources	
		Accessibility	Equity	Efficacy	Safety	Continuity	Reactivity	Viability	Efficiency
1	Abbasi, 2020 [25]			x	x			x	
2	Abe et al., 2020 [66]			x	x			x	
3	Abrams et al., 2020 [41]				x				
4	Agostinis et al., 2021 [67]	x		x	x	x	x	x	
5	Alawi, 2021 [68]			x	x		x	x	
6	Amore et al., 2021 [69]			x					
7	Archbald-Pannone et al., 2020 [70]	x		x		x		x	
8	Arlotti et al., 2021 [26]			x				x	
9	Aykaç et al., 2021 [71]			x	x		x	x	
10	Bach-Mortensen et al., 2021 [72]		x						
11	Bakaev et al., 2020 [73]			x	x			x	
12	Baughman et al., 2021 [74]						x	x	
13	Bayle et al., 2021 [23]				x				
14	Beaulieu et al., 2021 [27]	x		x	x		x	x	x
15	Belmin et al., 2020 [75]			x	x		x		x
16	Benin et al., 2021 [76]	x		x	x	x			
17	Benvenuti et al., 2021 [77]	x			x	x	x	x	
18	Bernadou et al., 2021 [28]			x	x			x	
19	Bertrand et al., 2020 [78]	x				x		x	
20	Bigelow et al., 2021 [11]			x	x				
21	Blain et al., 2020 [79]	x		x	x	x	x	x	
22	Braun et al., 2020 [50]							x	
23	Burugorri-Pierre et al., 2021 [80]			x					
24	Caramanica & O'Rourke, 2021 [81]			x	x	x		x	x
25	Cazzoletti et al., 2021 [82]			x					
26	Chan et al., 2021 [83]	x		x					
27	Chapman & Harrington, 2020 [29]			x	x			x	
28	Chen, 2020 [84]	x			x	x			
29	Cheng, 2021 [85]			x	x	x	x		
30	Chu et al., 2021 [86]				x		x	x	
31	Cigler, 2021 [30]		x	x	x	x		x	
32	Coulongeat et al., 2021 [87]	x		x			x		
33	Daly, 2020 [88]					x		x	
34	Das Gupta et al., 2021 [89]		x	x				x	
35	Dawson et al., 2021 [90]	x	x		x	x	x	x	x
36	de Man et al., 2021 [91]				x				
37	Dean et al., 2020 [92]			x				x	
38	Deschacht et al., 2021 [31]			x		x		x	
39	Dias et al., 2020 [93]			x					
40	Dichter et al., 2020 [94]	x			x		x	x	
41	Doetter et al., 2021 [95]	x		x	x			x	
42	Dolveck et al., 2021 [96]	x		x	x	x		x	
43	Dykgraaf et al., 2021 [8]		x	x	x	x	x	x	
44	Echeverria et al., 2020 [97]	x		x	x	x		x	
45	Eckardt et al., 2020 [12]			x	x	x		x	
46	Escobar et al., 2021 [13]			x	x			x	
47	Estévez-Abe & Ide, 2021 [98]			x	x				x
48	"Eye of the storm", 2020 [99]		x					x	x
49	Figueroa et al., 2020 [100]			x				x	

Table 3 (continued)

#	Author, Year	Accessibility of services		Quality of services				Optimization of resources	
		Accessibility	Equity	Efficacy	Safety	Continuity	Reactivity	Viability	Efficiency
50	Finger et al., 2021 [14]	x	x	x	x		x	x	
51	Frazer et al., 2021 [46]			x	x				
52	Gibson & Greene, 2021 [101]				x			x	
53	Gilman & Basett, 2021 [102]				x				
54	Giri et al., 2021 [48]	x	x	x	x	x	x	x	
55	Gmehlin & Muñoz-Price, 2020 [43]		x	x	x			x	
56	Gmehlin et al., 2021 [103]		x	x					
57	Gopal et al., 2021 [34]			x	x			x	x
58	Gorges & Konetzka, 2020 [35]		x		x				
59	Gorges & Konetzka, 2021 [36]		x						
60	Goto et al., 2021 [15]			x	x				x
61	"Hard-hit nursing homes", 2020 [104]				x			x	
62	Harrington et al., 2020 [37]			x					
63	Havaei et al., 2021 [16]			x	x	x	x	x	x
64	Heckman et al., 2021 [42]	x		x	x			x	x
65	Heudorf et al., 2020 [105]	x		x	x		x	x	
66	Ibrahim et al., 2021 [106]			x					
67	Kain et al., 2021 [107]			x	x	x			
68	Khairat et al., 2021 [38]				x			x	
69	Konetzka & Gorges, 2021 [108]			x				x	
70	Konetzka et al., 2021 [47]		x	x	x	x		x	x
71	Krone et al., 2021 [17]			x	x	x		x	
72	Lamb et al., 2021 [109]			x	x	x		x	
73	Li et al., 2020a [39]		x						
74	Li et al., 2020b [110]		x					x	
75	Li et al., 2021 [111]							x	
76	Liang & Xu, 2021 [112]	x		x		x		x	
77	Lingum et al., 2021 [113]			x			x		
78	Lipsitz et al., 2020 [18]			x		x			
79	Liu et al., 2020 [24]	x		x	x	x		x	
80	Louie et al., 2021 [114]			x	x				x
81	Lum et al., 2020 [115]			x	x			x	
82	Lyng et al., 2021 [116]	x		x	x	x	x	x	x
83	MacCannell et al., 2021 [117]				x				
84	Malikov et al., 2021 [118]							x	
85	Marossy et al., 2021 [119]	x		x	x				
86	Marshall et al., 2021 [120]			x		x	x	x	x
87	McBee et al., 2020 [121]			x	x				
88	McGarry et al., 2020 [122]				x			x	
89	McGarry et al., 2021 [123]				x				
90	McGilton et al., 2021 [124]	x		x	x	x	x	x	
91	McGregor et al., 2020 [125]			x	x				
92	Miller et al., 2021 [126]			x	x				x
93	Mills et al., 2020 [127]	x		x	x			x	
94	Miralles et al., 2021 [128]	x	x	x	x		x	x	
95	Montoya et al., 2021 [19]			x	x	x			
96	Mor et al., 2021 [129]			x					
97	Moraes et al., 2020 [130]			x	x			x	
98	Morris et al., 2020 [131]	x		x	x			x	

Table 3 (continued)

#	Author, Year	Accessibility of services		Quality of services				Optimization of resources	
		Accessibility	Equity	Efficacy	Safety	Continuity	Reactivity	Viability	Efficiency
99	Murti et al., 2021 [132]			x	x			x	
100	Obayashi et al., 2021 [133]	x		x	x		x		
101	Ochi et al., 2021 [134]	x			x	x		x	
102	Ohta et al., 2021 [135]			x	x	x	x		
103	Palacios-Ceña et al., 2021 [45]	x		x	x	x	x	x	
104	Park., 2020 [20]				x				
105	Piet et al., 2021 [136]			x	x				
106	Poltavskiy et al., 2021 [137]			x					
107	Poupin et al., 2021 [21]	x		x	x	x	x	x	x
108	Powell et al., 2020 [138]	x	x		x		x	x	
109	Power & Carson, 2021 [32]			x	x		x	x	
110	Pue et al., 2021 [139]			x					
111	Rada, 2020 [140]	x	x	x	x		x	x	
112	Relias Media, 2020 [141]				x				
113	Rios et al., 2020 [142]			x	x				
114	Shallcross et al., 2021 [143]			x	x				
115	Shea et al., 2020 [144]			x	x				
116	Shi et al., 2021 [145]			x	x			x	
117	Shih et al., 2020 [146]			x	x				
118	Shimotsu et al., 2021 [147]			x	x				
119	Simoni-Wastila et al., 2021 [148]			x	x				
120	Song et al., 2020 [149]			x	x	x			
121	Steiner, 2021 [150]	x		x	x			x	
122	Stocker et al., 2021 [151]	x		x	x	x		x	x
123	Stratil et al., 2021 [55]			x	x				
124	Sunner et al., 2021 [152]	x		x	x	x	x	x	
125	Szczerbińska, 2020 [153]	x		x	x		x	x	
126	Tan & Seetharaman, 2020 [154]			x	x				
127	Tan & Seetharaman, 2021 [155]			x	x				
128	Telford et al., 2021 [40]			x	x				
129	Vijh et al., 2021 [22]			x	x	x			
130	Viray et al., 2021 [156]	x		x	x			x	
131	"Vital COVID lessons ignored", 2020 [157]				x	x		x	
132	Vogazianos et al., 2021 [158]			x	x				
133	Wagner, 2020 [159]				x			x	
134	Wang et al., 2020 [160]			x	x	x	x		
135	Wang, 2021 [161]				x		x	x	
136	Watts et al., 2021 [162]		x	x	x		x	x	x
137	Yang et al., 2021 [163]			x	x	x	x	x	
138	Yau et al., 2021 [164]			x	x	x		x	
139	Zheng et al., 2021 [165]			x	x	x	x	x	
140	Zollner-Schwetz et al., 2021 [33]			x	x				
	Total	38	19	106	106	43	37	81	18
	Percentage (N = 140)	27.1%	13.6%	75.7%	75.7%	30.7%	26.4%	57.9%	12.9%

Table 4 (continued)

#	Author, Year	Internal Factors						External Factors					Other Factors
		Organizational Context ^a	Human Resources	Material Resources	Facility Characteristics	Staff Characteristics	Resident Characteristics	Technological Resources	Financial Resources	Visitors	Public Health Policies/Guidelines	Virus Circulation in the Community	
48	"Eye of the storm", 2020 [99]		x	x		x					x		
49	Figueroa et al., 2020 [100]	x											
50	Finger et al., 2021 [14]	x	x	x	x		x						
51	Frazer et al., 2021 [46]	x		x						x			
52	Gibson & Greene, 2021 [101]	x	x	x	x		x				x	x	
53	Gilman & Basett, 2021 [102]	x	x	x			x		x		x	x	
54	Giri et al., 2021 [48]	x	x	x	x	x	x			x	x		x
55	Gmehlín & Muñoz-Price, 2020 [43]	x	x	x	x	x		x			x		x
56	Gmehlín et al., 2021 [103]	x		x							x		
57	Gopal et al., 2021 [34]	x	x	x							x		
58	Gorges & Konezka, 2020 [35]	x									x		
59	Gorges & Konezka, 2021 [36]			x			x				x		
60	Goto et al., 2021 [15]	x	x	x				x					x
61	"Hard-hit nursing homes", 2020 [104]	x	x	x	x	x	x					x	

Table 4 (continued)

#	Author, Year	Internal Factors							External Factors				Other Factors	
		Organizational Context ^a	Human Resources	Material Resources	Facility Characteristics	Staff Characteristics	Resident Characteristics	Technological Resources	Financial Resources	Visitors	Public Health Policies/Guidelines	Virus Circulation in the Community		Admissions
62	Harrington et al., 2020 [37]	x	x		x									
63	Havaei et al., 2021 [16]	x	x	x		x		x						
64	Heckman et al., 2021 [42]	x	x	x	x							x		x
65	Heudorf et al., 2020 [105]	x		x		x				x				
66	Ibrahim et al., 2021 [106]	x			x									
67	Kain et al., 2021 [107]	x	x	x	x									
68	Khariat et al., 2021 [38]	x	x		x			x					x	
69	Konetzka & Gorges, 2021 [108]	x	x											
70	Konetzka et al., 2021 [47]	x	x		x	x		x					x	
71	Krone et al., 2021 [17]	x	x	x		x					x			
72	Lamb et al., 2021 [109]	x	x											
73	Li et al., 2020a [39]			x	x	x		x						
74	Li et al., 2020b [110]	x		x	x			x						
75	Li et al., 2021 [111]		x		x									
76	Liang & Xu, 2021 [112]	x		x	x	x		x				x		
77	Lingum et al., 2021 [113]	x				x								
78	Lipsitz et al., 2020 [18]	x	x	x				x				x		x

Table 4 (continued)

#	Author, Year	Internal Factors							External Factors					Other Factors
		Organizational Context ^a	Human Resources	Material Resources	Facility Characteristics	Staff Characteristics	Resident Characteristics	Technological Resources	Financial Resources	Visitors	Public Health Policies/Guidelines	Virus Circulation in the Community	Admissions	
129	Vijh et al., 2021 [22]	x	x	x	x	x							x	
130	Viray et al., 2021 [156]	x	x	x										
131	"Vital COVID lessons ignored", 2020 [157]	x	x	x										
132	Vogazianos et al., 2021 [158]	x		x	x	x								
133	Wagner, 2020 [159]	x	x	x	x	x		x						
134	Wang et al., 2020 [160]	x	x			x					x			
135	Wang, 2021 [161]	x	x	x	x	x		x			x		x	
136	Watts et al., 2021 [162]	x	x	x				x						
137	Yang et al., 2021 [163]	x	x	x	x	x					x			
138	Yau et al., 2021 [164]	x	x	x		x						x		
139	Zheng et al., 2021 [165]	x											x	
140	Zollner-Schwetz et al., 2021 [33]	x				x							x	
Total		102	87	63	53	52	37	26	18	38	36	22	17	16
Percentage (N = 140)		72.9%	62.1%	45.0%	37.9%	37.1%	26.4%	18.6%	12.9%	27.1%	25.7%	15.7%	12.1%	11.4%

^a Organizational context refers to organizational structures and processes, such as training, management, organizational structures, screening, and leadership

mental health of residents and staff and on overall quality of life. One proposed antidote to negative mental health outcomes as a consequence of strict IPC measures was a person-centered approach to long-term care, where the delivery of care is negotiated between the LTCF resident and the healthcare professional and delivered in a personalized and respectful manner [94].

Approximately 13% of the included articles considered LTCF performance along the dimensions of *efficiency* and *equity*, which evaluate performance in terms of the optimization of resources and the accessibility of services, respectively. Staff producing their own PPE, allocation of unused areas for staff self-confinement, storage of material supplies by pharmacies for distribution to multiple LTCFs, and technological innovations, such as portable infection equipment trolleys, were highlighted as strategies employed by some LTCFs to ensure an efficient use of available resources (e.g., [75, 81, 116, 120]). In relation to *equity*, several articles, most of which originated in the USA, noted how the COVID-19 pandemic put a spotlight on the existing health inequities and, in some cases, exacerbated them among already vulnerable populations, notably low-income individuals and communities of color (e.g., [72, 90, 162]). An association was commonly reported between a LTCF housing a greater proportion of racial/ethnic minority residents and a higher probability of COVID-19 cases (e.g., [35, 39, 43, 48]).

The two most frequently extracted dimensions of performance, *efficacy* and *safety*, are strongly linked to the two factors most commonly reported by the included articles—organizational context (72.9%) and human resources (62.1%). This finding underscores the pressing need for increased investment in long-term care infrastructure and workforce globally to ensure satisfactory working conditions, job security, decent pay, and adequate levels of staff who are competent in IPC, geriatrics, and palliative care [166]. Enforcement of safety standards and continuous human resource development are necessary steps towards reductions in staff absenteeism and turnover rates, better continuity of care, and improved care delivery [166].

About one in nine (11.4%) articles included in the review noted unexpected factors, including: the initial lack of knowledge about the virus and the symptoms it causes [42, 78, 132]; the difficulty detecting and managing asymptomatic and atypical COVID-19 cases [13, 43, 48, 68, 94, 114, 134] which was subsequently addressed by universal serial testing of residents and staff [23, 73, 130]; and the ability to curb COVID-19 transmission with early administration of vaccines [32, 129].

Our findings are in line with a scoping review by Giri et al. [48], which showed that the ability of LTCFs to contain COVID-19 outbreaks was influenced by an interplay

of various internal (related to residents, staff, and facilities) and external (material resources and public health policies) factors, as well as asymptomatic transmission of COVID-19. Building on Giri et al.'s classification of factors, our review provides a more fine-grained understanding of why some LTCFs performed better than others by extracting a greater number of factors and linking these factors to multiple dimensions of performance using a conceptual framework. Furthermore, our findings emphasized the contribution of the LTCF's organizational structure and the quality of its leadership to the facility's capacity to effectively respond to the COVID-19 pandemic. Organizational challenges leading to shortages of staff and material resources during the first wave of the pandemic were also highlighted by Palacios-Ceña et al.' [45] scoping review of qualitative evidence. Consistent with our findings, this narrative synthesis found evidence of LTCF staff taking initiative in procuring supplies by cultivating connections within the community.

Directions for future research

The descriptive characteristics of the articles included in our scoping review revealed a gap in the existing knowledge pertaining to the performance of LTCFs during the COVID-19 pandemic. First, except for one quasi-experimental pre-post study [22], all research articles included in our review were non-experimental studies, which precludes the establishment of causality between the identified factors and LTCF performance. Therefore, experimental studies should be prioritized in the future to help understand which factors could predict LTCF performance during the ongoing COVID-19 pandemic or future outbreaks. When experimental designs are not feasible, qualitative studies can help gain a deeper, more nuanced understanding of the various factors that facilitated or hindered the management of COVID-19 in LTCFs by gleaning perspectives of diverse stakeholders, such as facility leadership and staff, residents and their families, and public health officials [167]. Second, the majority of research articles in our review were cross-sectional, thus providing only a snapshot of LTCF response to COVID-19, with the bulk of evidence coming from the first wave of the pandemic (between March and July 2020). The skewness towards the early phases of the pandemic might have been behind *efficacy* and *safety* being the most commonly reported dimensions of performance, reflecting the urgency to provide care to LTCF residents in a safe and effective manner amidst a public health crisis. Additional population-based longitudinal studies are warranted to explore long-term impacts of the reported factors on LTCF performance [168]. Third, only 9% of the included articles used a framework to guide their inquiry. We recommend future studies adopt

a framework to help understand complex healthcare systems, as it would allow for inter-study comparability and a fine-grained analysis of structures and processes that influence the delivery and outcomes of care [169]. Fourth, a few articles included in our review discussed LTCF performance as a function of the dimensions of *efficiency* and *equity*. Thus, more research is needed to examine LTCF performance in terms of the optimization of available resources and fair access to services both in the context of the COVID-19 pandemic and more broadly. Fifth, the reviewed qualitative literature mostly examined the practices and perspectives of LTCF staff. Studies exploring LTCF residents' experiences in the pandemic context, for example with respect to their feelings of loneliness, may provide valuable information that could help maintain and improve residents' quality of life (e.g., [170, 171]). Lastly, of the 11 Canadian-based studies included in our review, 10 originated in the provinces of Ontario and British Columbia, and only one came from Québec. This represents a substantial knowledge gap given that Québec experienced the highest COVID-19 mortality rate in Canada between March 2020 and October 2021 [172]. Future work should examine the failures of IPC in hard-hit regions of the world to obtain insight into the causes and mechanisms of inadequate healthcare, as well as provide opportunities to innovate and apply higher quality care in the future [173, 174].

Limitations and strengths

Due to the evolving nature of the COVID-19 pandemic, the results of this review may not reflect the current public health profile. Furthermore, because our review focused on the management of COVID-19, the findings may not fully capture indirect effects of the IPC measures implemented by LTCFs that have, nonetheless, had an influence on residents' mental health. For example, the restriction or prohibition of family visits and group activities in LTCFs resulted in residents experiencing social isolation and loneliness [175–177]. Though six databases were used for queries we could have included more. We did not search for articles written in languages other than English or French, and French articles that were retrieved were screened and excluded.

Despite these limitations, our study offers a comprehensive review of various factors reported to have influenced the management of COVID-19 within LTCFs by applying a multidimensional conceptual framework of performance. The adopted framework guided us throughout the entire review process by providing a clear focus on our review's aim and objectives. In addition to the conceptual framework, adherence to the JBI methodology for scoping reviews helped us maintain

the overall rigor of the study. This work may inform the development of more effective IPC interventions to help prevent or mitigate future outbreaks in LTCFs, while being sensitive to the needs, preferences, and values of residents and staff. The lessons learned thus far should be considered on an evolving basis when developing IPC programs specific to long-term care.

Abbreviations

DS	Drissa Sia
EB	Emilie Bélanger
ENT	Eric Nguemeleu Tchouaket
IPC	Infection prevention and control
IS	Idrissa Beogo
JBI	Joanna Briggs Institute
JL	Josiane Létourneau
KK	Katya Kruglova
LTCFs	Long-term care facilities
MJ	Maripier Jubinville
MSSS	Ministère de la Santé et des Services Sociaux
OECD	Organisation for Economic Co-operation and Development
PRISMA-P	Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews
SR	Stephanie Robins
SS	Shiyang Shen

Supplementary Information

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Supplementary Material 1.
Supplementary Material 2.
Supplementary Material 3.
Supplementary Material 4.
Supplementary Material 5.
Supplementary Material 6.
Supplementary Material 7.
Supplementary Material 8.
Supplementary Material 9.

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Patient and public involvement

This scoping review did not involve any patient or public involvement.

Authors' contributions

ENT, KK, JL, EB, SR, MJ, FEM, SS, IB, and DS were all involved in the conception, drafting, and revision of this manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable, as ethical approval for this review was not required since it utilized data that had been previously published.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Department of Nursing, Université du Québec en Outaouais, St-Jérôme Campus, 5, rue Saint-Joseph, Office J-2204, Saint-Jérôme, QC J7Z 0B7, Canada. ²Faculty of Medicine and Health Sciences, McGill University, 3605 Rue de la Montagne, Montréal, QC H3G 2M1, Canada. ³School of Nursing, Faculty of Health Sciences, University of Ottawa, 200 Lees Avenue, Ottawa, ON K1N 6N5, Canada.

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