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Review Article

Telemedicine and Telehealth in Nursing Homes: An Integrative Review

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A B S T R A C T

Objectives: Telemedicine and telehealth are increasingly used in nursing homes (NHs). Their use was accelerated further by the COVID-19 pandemic, but their impact on patients and outcomes has not been adequately investigated. These technologies offer promising avenues to detect clinical deterioration early, increasing clinician's ability to treat patients in place. A review of literature was executed to further explore the modalities' ability to maximize access to specialty care, modernize care models, and improve patient outcomes.
Design: Whittemore and Knafl's integrative review methodology was used to analyze quantitative and qualitative studies.
Setting and Participants: Primary research conducted in NH settings or focused on NH residents was included. Participants included clinicians, NH residents, subacute patients, and families.
Methods: PubMed, Web of Science, CINAHL, Embase, PsycNET, and JSTOR were searched, yielding 16 studies exploring telemedicine and telehealth in NH settings between 2014 and 2020.
Results: Measurable impacts such as reduced emergency and hospital admissions, financial savings, reduced physical restraints, and improved vital signs were found along with process improvements, such as expedient access to specialists. Clinician, resident, and family perspectives were also discovered to be roundly positive. Studies showed wide methodologic heterogeneity and low generalizability owing to small sample sizes and incomplete study designs.
Conclusions and Implications: Preliminary evidence was found to support geriatrician, psychiatric, and palliative care consults through telemedicine. Financial and clinical incentives such as Medicare savings and reduced admissions to hospitals were also supported. NHs are met with increased challenges as a result of the COVID-19 pandemic, which telemedicine and telehealth may help to mitigate. Additional research is needed to explore resident and family opinions of telemedicine and telehealth use in nursing homes, as well as remote monitoring costs and workflow changes incurred with its use.

Globally, the number of adults aged 85 years and older is projected to increase 351% between 2010 and 2050.[1] As the population ages, the need for specialized facility and home-based care will increase.[2] Even today, nursing homes (NHs) struggle with staff shortages and access to specialty care expertise, while simultaneously facing increased pressures to reduce avoidable hospital admissions and emergency department (ED) visits.[3,4]

Health technology is frequently championed as a modality to improve care delivery in order to meet the demands of providing complex care in the setting of limited internal resources. The United States Office of the National Coordinator for Health Information Technology (ONC) defines telehealth as the use of videoconferencing, remote patient monitoring (RPM), store-and-forward technologies (eg, sending wound images for evaluation), and mobile health (mHealth) applications.[4,5] The term *telemedicine* refers to the use of live synchronized videoconferencing, allowing for interactive video communications between a provider and a patient.[6]

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Telehealth and telemedicine are a potential tool for scaling caregiving capacity and business efficiency for NHs. In the United States, 39% of NHs currently use some form of telehealth or telemedicine,[3] whereas 76% of acute care hospitals use telemedicine and telehealth.[7] The use of these technologies has become even more salient recently as NHs have been in the spotlight as a result of the emergence of coronavirus 2019 (COVID-19). NH residents are among the most at-risk groups for COVID-19 fatality.[8] This combined with stringent infection control practices such as lockdowns, and other concerns such as staffing and availability of specialty care, presents an even greater impetus for exploring telemedicine and telehealth as modalities in the NH setting.[9] One recent approach to COVID-19 used telemedicine and remote monitoring to treat residents in place, resulting in lower hospitalizations and mortality compared with other NHs.[10] Moreover, there have been increasing calls to focus research on the use of technology to enhance care in NHs and other settings from the National Institutes of Health, the IMPACT Collaboratory, Health Resources and Services Administration, and others both previous to and in response to the pandemic.[11–14] Therefore, it is important to synthesize the most recent literature to provide groundwork for the future design, implementation, and expansion of telehealth services in NHs.

Previous systematic reviews have explored the use of technology in the care of older adults with chronic conditions, persons living with dementia in supportive environments, ambulatory care, and in long-term care settings.[15–18] Another international review focused on assistive technology, alarms, and surveillance technology.[16] Outcomes in the reviews were generally positive, though most call for further research. Overall, a gap was found in published reviews of NH telemedicine and technology studies from 2014 to 2020. Given the pace of technology development, a re-evaluation of the current evidence is needed.

The purpose of this integrative review is therefore to evaluate and appraise the outcomes of recent primary research involving telemedicine and telehealth in NHs. This integrative review adds to the knowledge base by evaluating and synthesizing recent studies and will conclude with recommendations for practice and future research.

Methods

Whittemore and Knafl's[19] methodology was used as the framework for this integrative review. Studies capturing clinician, patient, and family feedback on the technology's usability and user experience were analyzed within the context of the Technology Acceptance Model.[20]

Search Strategy

Medline via PubMed, Web of Science, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Excerpta Medica Database (Embase), PsycNET, and the Journal Storage (JSTOR) were searched for relevant articles. A medical librarian was consulted for the search strategy. A combination of the terms *remote patient monitoring*, *telehealth*, *telecare*, *telemonitoring*, *telemedicine*, *videoconferencing*, *skilled nursing facilit**, *SNF*, *long-term care*, *LTC*, and *nursing home* were searched using Boolean logic in these databases. In PubMed, the medical subject heading (MeSH) terms *Skilled Nursing Facilities*, *Nursing Homes*, and *Telemedicine* were used, including their automatic explosion functionality to include a larger array of articles. CINAHL major headings *Nursing Homes+* and *Telehealth+*, as well as Embase subject terms *exp telehealth*/and **nursing home* found additional articles.

Inclusion and Exclusion Criteria

The search included studies in the English language published from January 2014 through October 2020. Because of limited results specific to the United States, international studies were included. Primary quantitative and qualitative studies using telemedicine and telehealth were included. Studies were required to involve NH clinicians or NHs as the primary setting. Exclusion criteria omitted conference abstracts, magazine articles, and protocol proposals. Patient-facing mHealth applications (ie, no direct interactions with clinicians) were excluded.

Search Results

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram is shown in Figure 1.[21] A total of 933 results were screened by study title. Fifty-six were included for full-text review. A final sample of 16 articles meeting inclusion and exclusion criteria were kept for data extraction and evaluation. A Cochrane Systematic Review of telemedicine's effects on health outcomes was referenced but only included studies published before 2013.[6]

Data Evaluation

The final sample of 16 empirical studies in this integrative review included randomized controlled trials (n = 3), nonrandomized experimental studies (n = 4), cohort studies (n = 2), cross-sectional studies (n = 3), mixed methods (n = 2), and qualitative studies (n = 2). Joanna Briggs Institute Checklists aided evaluation of the rigor of experimental and cross-sectional studies (Supplementary Table 1).[22] The Critical Appraisal Skills Programme Qualitative Checklist was used to appraise the qualitative studies (Supplementary Table 2).[23] Appraisal of a quality improvement study was completed with the Revised Standards for Quality Improvement Reporting Excellence tool.

Data Analysis

A constant comparative method was undertaken to discover patterns, themes, variations, and relationships.[19] Table 1 summarizes extracted data by purpose, study design, technology used, and main findings. Because of the variety present in the research studies, a table organizing studies by focus, intervention details, roles involved, and demographics was used to discover common elements (see Table 2).

Results

The NH settings included locations in Canada, France, Italy, Australia, Singapore, and the United States. NH settings were not reliably described for each study, but those that reported spanned across rural, suburban, and urban settings (Table 2). Studies involved patient, family members, and clinician participants.

Telemedicine and Telehealth Processes

Studies varied in regard to patient populations, technology used, and scheduling of telehealth services. Four studies focused on telemedicine consultations with geriatricians[9,26,27,30,31]; another presented telemedicine services delivered by neurologists and psychologists.[37] Palliative care specialists trialed video consultations with patients living with dementia.[39] A quality improvement study implemented a telemedicine group practice offering numerous specialists,[29] and another implemented asynchronous messages between NH providers and 100 consulting specialty groups.[28] The remaining studies enabled access to heart failure, musculoskeletal, and wound care specialists.[24,32,35] Eight studies implemented video capabilities only, whereas 3 studies used Bluetooth stethoscopes for remote auscultation.[29,35,37]

The scheduling of telemedicine was varied. In 2 studies, persons living with dementia received weekly[37] or monthly[36] counseling.

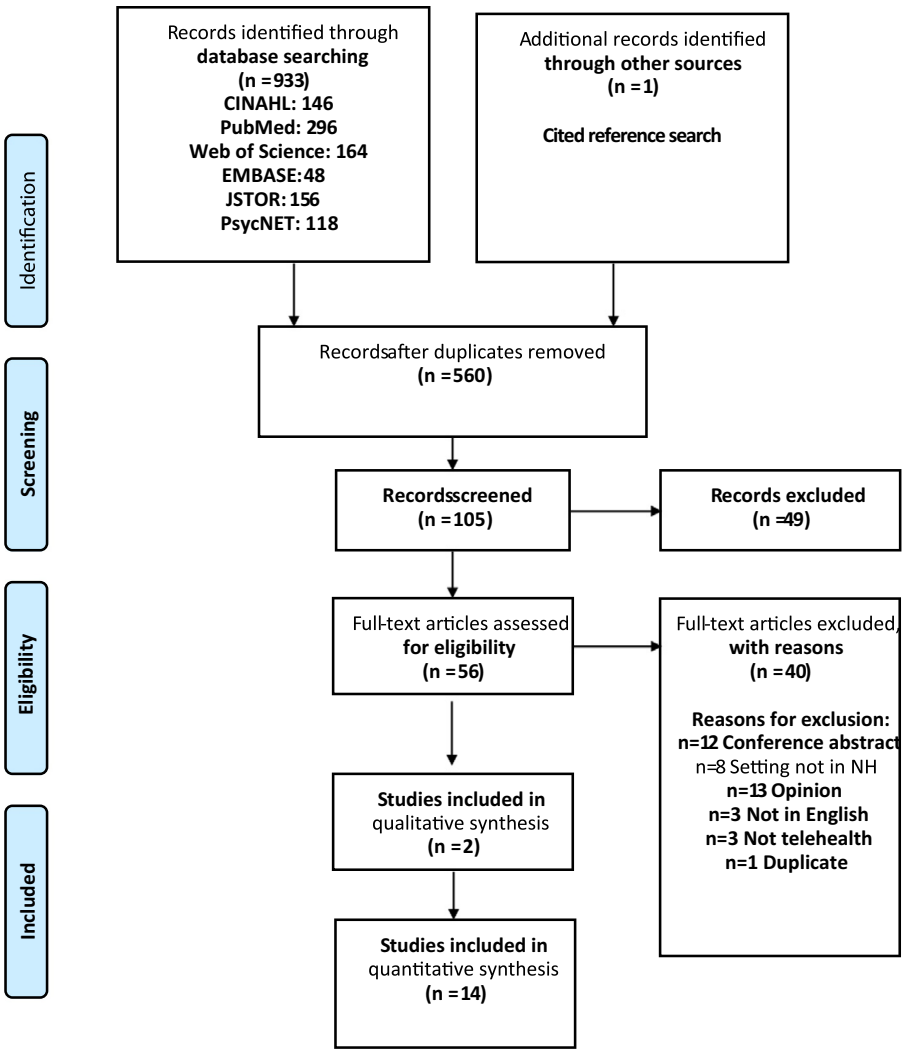

Fig. 1. PRISMA diagram. From Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 2009;6(7):e1000097.

Other programs scheduled geriatrician consults individually as needed.[26,31] Another held biweekly 120-minute case-based teleconsultations where 3 to 4 cases were reviewed between NH providers and specialists at a medical center.[27]

RPM studies undertook varied approaches. Subacute patients collected their own daily weights, pulse oximetry, heart rate, and blood pressure readings in anticipation of discharging to home with the same wireless equipment.[35] The same study deployed multiparameter continuous monitoring patches, point-of-care lab testing, and video visits with heart failure specialists. De Luca et al[37] deployed Bluetooth blood pressure cuffs and pulse oximeters to collect vitals 3 times a week, sending data to a remote-monitored dashboard to supplement the monitoring provided within the NH. Another study used sensors to detect urinary incontinence episodes and display data on a telemonitoring application.[38] An activity monitor was trialed with persons living with dementia.[36]

Clinical Outcomes

Patient-level outcomes

Patients experienced improved self-report measures as well as objective improvements in blood pressure and incontinence. In a study combining psychiatric teleconsultations with remote monitoring, persons living with dementia showed improvement in Geriatric Depression Scale, Brief Psychiatric Rating Scale, and quality of life measurements.[37] Another study combined telemedicine counseling with activity and heart rate monitoring and found that persons living with dementia achieved 92% of the care management program's wellness goals, 89% of behavioral goals, and 82% of cognitive goals.[36] In facilities with access to geropsychiatric specialists via telemedicine, persons living with dementia were 75% less likely to be physically restrained, 17% less likely to be prescribed antipsychotic medications, and 23% less likely to develop a urinary tract infection than similar residents in control facilities.[27]

Clinically significant results were found in reductions in hospitalizations and improved time to intervention.[35] A 10-point decrease in systolic blood pressure ($P < .001$) and heart rate ($P = .02$) was found in an RPM intervention group.[37] This improvement indicated that telehealth provider collaboration with NH staff improved patient care. In a store-and-forward study, telehealth wound care was found to be noninferior to in-person care in relation to wound healing, while incurring substantial cost benefits.[32] Remote monitoring of urinary incontinence showed improved scheduling of toileting assistance with a decrease in incontinence episodes.[38]

Table 1
Study Summary

Lead Author	Purpose	Study Design	Sample and Strategy	Data Collection	Technology Used	Statistical Analysis	Main Findings
Telemedicine Consults							
Cheng et al, 2020[24]	• Evaluate telemedicine in providing care to musculoskeletal care to long-term care patients.	Descriptive cross-sectional study	N = 32 consults • 14 patient surveys • 27 liaison surveys • 1 orthopedic surgeon survey	Telemedicine Satisfaction Scale (TeSS) Telemedicine Usability Questionnaire (TUQ)	Video sessions	• Descriptive statistics	Reporting percentages of survey results only - 64% and 71% patients/liaisons described visual quality as excellent respectively - 79% of patients rated comfort level as excellent with telemedicine - 92% of patients rated attending physician's explanation of treatment and skill as excellent - 59% of liaisons said devices were easy to learn to use - 70% of liaisons said it improved productivity - 70% of liaisons rated consultations as similar to in-person - 81.5% of liaisons strongly agreed would use TeleMSK again Subjectively describes increase in family members joining the appointment; distance previously a barrier
Driessen et al, 2018[25]	• Quantify the specific types of medical specialists that NH providers would request or find useful • Survey attitudes regarding specialty care delivered through telemedicine	Cross-sectional survey	N = 524 physicians and advanced practice providers (APPs) Convenience sample. Survey made available to all attendees of AMDA Long-Term Care Medicine and Annual Care Conference. 41% response rate	Author-developed paper survey measuring likelihood of ordering telemedicine consults for 26 medical specialties. Likelihood ordering ancillary services and nonmedical specialties. Responses related to perceived benefits and concerns. Participant demographics	N/A	• Means and SDs of survey responses	Most likely to use telemedicine for dermatology consults and geriatric psychiatry. Infectious disease, cardiology, and neurology were the next most likely to be requested through telemedicine High level of agreement that subspecialty telemedicine may fill existing service gaps and access to and improve timeliness of care Authors report enthusiasm

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Table 1 (*continued*)

Lead Author	Purpose	Study Design	Sample and Strategy	Data Collection	Technology Used	Statistical Analysis	Main Findings
							for telemedicine but "few respondents actually had access to telemedicine in their facilities." In introduction, quoted to be 40%. Majority of respondents were medical directors
Georgeton et al, 2015[26]	• Determine the factors associated with adherence of general practitioners to recommendations made by specialists in teleconsultation	Prospective cohort study	N = 69 Included patients had received a geriatric teleconsultation and resided at one of 3 NHs	Histories, demographics, and reason for consult Geriatrician's assessment data and recommendations recorded CIRS-G, BMI, ADL, GDS, NPI, history of falls	Dedicated teleconsult room in NH High-definition camera Computer with broadband Internet	• Descriptive statistics • *t* test and χ^2 as appropriate • Univariate and multiple logistic regressions to examine association between adherence to recommendations with patient factors	83% of teleconsults were for neuropsychological reasons. GPs followed recommendations for 58 teleconsults (84%). 86% of patients received pharmacologic recommendations, 78% received nonpharmacologic recommendations, and 7% received expert medical advice (eg, hospitalization, referral to specialist recommendations) Expert medical advice was associated with GP adherence to recommendations (OR = 7.71, 95% CI 1.57-37.98, $P = .04$) Risk of depressive syndrome (OR = 8.00, 95% CI 1.10-58.10, $P = .004$) and expert medical advice recommendation (OR = 17.97, 95% CI 1.10-58.10, $P = .04$) were associated with GP adherence to recommendations Lack of adherence to teleconsult recommendations is a serious potential barrier to effectiveness of telemedicine programs.
Gordon et al, 2016[27]	• Determine ECHO-AGE intervention's impact on quality of care for NH residents with dementia • Determine whether intervention lowers the use of physical and chemical restraints	2:1 prospective matched cohort study	N = 11 NHs in Massachusetts and Maine. Each ECHO-AGE SNF matched with 2 other similar facilities based on size. 115 cases discussed during study period	Minimum Data Set (MDS) outcomes: - Percentage of long-stay residents who were physically restrained - Percentage of long-stay residents who received antipsychotic	Video consult	• Descriptive statistics across 6 quarters • Student *t* test • Logistic regression • Generalized estimating equations to account for clustering within the matched sets and repeated measures over 6 quarters	ECHO-AGE residents were 75% less likely to be physically restrained than in control facility (OR = 0.25, $P = .05$). ECHO-AGE residents were 17% less likely to receive antipsychotic medications than in control facilities (OR = 0.73, $P = .07$) ECHO-AGE residents were

				medication over the last 7 d - Quality measures related to ADL, pain, weight loss, incontinence, UTI, depressive symptoms, and falls			23% less likely to experience UTI during follow up period (OR = 0.77, $P = .01$) Preliminary evidence shows reduction in primary outcomes (physical and chemical restraint usage). Both changed most dramatically between baseline and the first quarter after the intervention's initiation. Antipsychotic use continued to gradually decline throughout the remaining quarters, whereas physical restraints remained lower overall but fluctuated quarter to quarter.
Helmer-Smith et al, 2020[28]	• Evaluate feasibility of the Champlain BASE eConsult service in long-term care	Mixed Methods	N = 64 eConsults requested from • 34 physicians • 18 nurse practitioners	Specialty consulted and response time Specialist billing time PCP responses on mandatory close-out survey Focus groups	Asynchronous communication between NH providers and specialists	• Descriptive statistics	23 specialties contacted: Dermatology (19%), geriatric medicine (11%), infectious disease (9%) Specialists responded in median of 0.6 days with a median billing time of 15 minutes (Can$50/case) Consult results: 60% new course of action, 31% no change. 70% were resolved without face-to-face visit, and 2% initiated new referrals. Perceived value: improved access, cost reductions, enhanced quality of care, reduce transfers, shorter wait periods.
Hofmeyer et al, 2016[29]	• Evaluate eLTC pilot program's impact on decreasing potentially avoidable hospitalizations	Quality improvement pilot study	736 two-way video consultations (they don't count this in participants) 863 telephonic encounters	Utilization of eLTC services Averted transfers as a percentage of total encounters Quality improvement staff surveys	Video consult 2-way stethoscope High-definition camera	• Descriptive statistics	500 potential transfers deemed unnecessary - decreased potentially avoidable hospitalizations (PAHs) - saved $5 million in admission-related charges to CMS Nursing staff believed eLTC improved quality of patient care, positively impacted workload Clinician buy-in achieved with after-hours eLTC support Chief complaints: 24% shortness of breath, 24% skin complaint, 14% upper respiratory infection, 13% fever, 12% neurologic, 10% joint pain, 10% GI complaint, 10% urologic

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Table 1 (*continued*)

Lead Author	Purpose	Study Design	Sample and Strategy	Data Collection	Technology Used	Statistical Analysis	Main Findings
							Highest proportions of CC transfers: 66% of neurologic transferred, 45% GI, 44% shortness of breath
Low et al, 2020[30]	• Describe patient profile, presenting diagnoses, management provided, and processes involved in teleconsults	Descriptive cross-sectional study	N = 1673 consults with 850 unique patients (95% scheduled, 5% ad hoc) All NH patients referred for teleconsult from December 2010 to May 2017	Resident assessment form categorize patients by functional status Data from health record	Video sessions	• Descriptive Statistics	Reason for consult: 27% medication review, 15% behavioral, 15% symptom review, 13% follow-up review Session length: 20-129 min Outcomes: A month after teleconsult, 84% remained in NH, 3.4% passed away, 6.3% referred to outpatient specialist, and 6.2% sent to ED
Perri et al, 2020[14]	• Evaluate telemedicine delivery of palliative care early in resident illness trajectory	Pre-post nonrandomized experimental study	N = 61 residents at 2 pilot facilities Convenience sample that included all residents at the facilities 11 palliative care video consults	Demographics PPS CHESS ADL Surveys for patient and family experience Clinical staff survey on confidence in palliative care, and video satisfaction surveys.	Video consult Dedicated room for video consult Widescreen monitor, video camera, external microphone	• Descriptive statistics • Paired *t* tests • Standardized response means • Pearson correlation	55% of the telemedicine conferences were triggered by quarterly review screening. Next most common triggers were 27% clinical judgement and 18% readmission from acute care 11 families joined by videoconference: - 86%-100% felt technical, privacy, and comfort were satisfactory with video visit. And would use it again. - 70% would have preferred in-person physician - 71% would prefer video consult if their loved one could be seen by a palliative care specialist faster, or more frequently than in-person visits 17 of 22 clinical staff completed survey - Palliative care video conference averaged 45 min - Confidence with introducing supportive care topic to residents and family increased ($P = .03$) - More video sessions clinical staff participated in, the higher they rated visit - 65% reported noise as a barrier; 22% had difficulty receiving

							technical support; 72% said they prefer designated person for technical support
Piau et al, 2020[31]	• Evaluate health workers' perception on telemedicine	Qualitative	N = 10 NHs using geriatrician telemedicine consults for 2 y • Total of 180 sessions across NHs • 90 patients benefited from 2 sessions each	Semistructured interviews	Video sessions	• N/A	Improvements seen in greater involvement of staff in managing neuropsychiatric symptoms, greater involvement of families, and promotion of nonpharmacologic treatments Staff felt telemedicine improves the quality of care; barriers include providers not accepting specialist's advice and lack of time and workforce for telemedicine visits
Stern et al, 2014[32]	• Evaluate clinical and cost-effectiveness of an enhanced multidisciplinary intervention (EMDT) supported by telemedicine vs usual care for the treatment of pressure ulcers in long-term care	Pragmatic stepped-wedge cluster randomized trial	N = 137 SNF residents with PU	Digital wound photography Visual analog scale (VAS)—pain EQ5D (QOL) VAS-pain Rates of hospitalization and ED visits Ethnographic observations and in-depth interviews with NH staff	Stage II or greater pressure ulcers	• Descriptive statistics • Linear mixed effects models • Mixed effects models • Cox proportional hazard frailty models	No difference in rate of healing with and without the EMDT telemedicine intervention Telemedicine-delivered EMDTs found to be cost-effective. Results similar to usual care but less expensive to deliver In-person nurse practitioner visits were preferred by NH staff Concluded that strengthening primary care within the NH is more advantageous than using a multidisciplinary specialty wound care team Qualitative: Inadequate staff time allocated for study implementation; unavailable wound care supplies; frequent staff turnover was prohibitory
After-hours support and remote assessments							
Grabowski and O'Malley, 2014[33]	• Determine whether off-hours physician coverage by telemedicine reduced hospitalizations and investigate cost savings from telemedicine	Randomized controlled trial with pre-post design	Treatment group = 6 NHs Control group = 5 NHs	NH EHR: transfers, demographics, resident days Monthly data from telemedicine provider CMS NH's 5-star rating, number of beds	Not specified	• Descriptive statistics on frequency and type of telemedicine calls • Difference-in-differences • Poisson regression model • Classify NHs by engaged or not engaged with intervention	Did not observe statistically significant difference between telemedicine intervention group and usual care. When intervention NHs were classified into high-engagement and low-engagement with telemedicine, the authors found a significant decrease. An SNF with 180 hospitalizations per year

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Table 1 (*continued*)

Lead Author	Purpose	Study Design	Sample and Strategy	Data Collection	Technology Used	Statistical Analysis	Main Findings
							could see a decrease by 15.1 hospitalizations per year (8.4%). Average savings to Medicare that were more engaged with telemedicine intervention were $151,000 per NH per year.
Stephens et al, 2020[34]	• Explore formal and informal caregiver perspectives on challenges transferring NH patients to the ED and the role of emerging health care technology.	Exploratory qualitative – grounded theory	N = 8 focus groups with an average of 5 participants Purposive sampling to construct groups of NH nurses. After themes arose, focus groups then convened with providers, families, and other stakeholders together.	Focus groups	N/A	• N/A	Focus group results support that telehealth would be useful in NHs to aid communication between family members and staff to avert avoidable ED transfers when care could be provided in the NH environment.
Remote monitoring							
Dadosky et al, 2018[35]	• Evaluate whether continuous monitoring via telehealth would decrease rehospitalizations and improve patient self-care knowledge and satisfaction. • Determine if incorporating the use of point-of-care (POC) testing within the SNF would allow for quicker medical intervention.	Prospective nonrandomized trial	Convenience sample – patients screened on admission Intervention group: n = 49 Historical comparison group: n = 92	Patient satisfaction questionnaire Self-care knowledge questionnaire Number or type of video conferences Number of on-site visits by SNF provider Number of patient transports Number of provider office visits Length of stay from hospital and NH EHR	Video sessions Chest patch (HR, RR, body position, single-lead ECG) BP cuff, weight scale, pulse-oximeter Cloud-based clinician dashboard Bluetooth stethoscope i-STAT labs (BNP, Chem 8+/BMP) Tablet with video camera	• Parametric (*t* tests) • Nonparametric (χ^2) • Multiple regression analysis using generalized linear model fitting	17.39% of case group rehospitalized within 30 days post discharge in comparison with 23.9% of control group Telemedicine group had 6.51% absolute risk reduction and 27.24% relative risk reduction 70% of patients felt telehealth intervention was “good”; 30% rated as “excellent” Time to intervention for medication adjustment significantly reduced (clinically significant but not statistically significant due to sample size): - From 1080 to 6 min for ACE-I - 5760 to 5 min for beta blocker - 3641 to 5 min for diuretics Time to ED reduced from 84 to 15 min New diagnoses of atrial fibrillation and pneumonia through video session assessment, ECG, and stethoscope
De Vito et al, 2020[36]	• Examine acceptability and feasibility of wearable devices and	Mixed methods	n = 18 residents n = 6 caregivers	Bristol ADL NPI-Q QoL-AD	Fitbit activity monitor Video sessions	• Descriptive statistics	88% daytime adherence to wearing activity monitor across 6 mo; poor adherence

	monthly telemedicine sessions in dementia care			QUALIDEM Activity monitor Outcomes tracked: Falls, hospitalizations, medication changes, behavioral episodes Caregiver interviews			at night. >90% adherence to monthly telemedicine intervention; 92% of medical wellness goals, 89% of behavioral goals, and 82% of cognitive goals were met. Caregivers liked the ability to check the resident's heart rate and step counts; could encourage exercise if they noted a low step count. Residents liked to compare the number of steps they took. Additional time of 5 min per patient required to clean and charge the devices.
De Luca et al, 2016[37]	Develop telehealth care model and evaluate its effectiveness. Include multiparametric vital sign monitoring and teleconsulting for neurologic and psychological conditions	Randomized controlled trial	N = 59 residents Randomly divided into 2 groups in order of recruiting: tele-dementia care vs standard care	MMSE ADL IADL GDS BPRS BANSS EuroQoL VAS	PC with webcam and microphone Bluetooth pulse-oximeter, BP cuff, ECG Bluetooth stethoscope audio files	• Mann-Whitney *U* test • χ^2 tests for equality of proportions between means • Wilcoxon signed-rank test to detect changes in scores between 2 time points	Experimental group - Statistically significant reduction of GDS ($P < .01$) and BPRS ($P < .05$) - Quality of life scores improved in both groups, but more significant for experimental group ($P < .001$) than control group ($P < .01$) - Reduced BP ($P < .001$) and HR ($P < .05$) Admission to health care service was higher in the control group than experimental group ($\chi^2 = 3.96$, $P < .05$) Telemedicine may improve individual's neurobehavioral symptoms and quality of life Presence of telehealth care professional may help local nurses and caregivers manage clinical symptoms and vital signs

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Table 1 (*continued*)

Lead Author	Purpose	Study Design	Sample and Strategy	Data Collection	Technology Used	Statistical Analysis	Main Findings
Yu et al, 2014[38]	• Explore telemonitoring system's effects on UC assessment • Investigate whether individualized UC care plans based on data were effective	Nonrandomized quasi-experimental field design	N = 32 SNF residents	ACFI Sensor recorded time onset of urinating event for 72-h period per patient Staff manually entered toileting events, time continence aid was changed, whether successful in voiding in toilet, weight of pad, and fluid intake Care plan adherence measures	Sensor placed in continence aid Clinical dashboard	• Paired *t* test for normally distributed data • Wilcoxon *U* test for comparing differences between pre and post groups	Incontinence void was lower in the post implementation group ($P = .015$) Baseline (preintervention) only 44% compliance with prescribed toilet visits. After the intervention, compliance with care plan was 106% ($P = .033$) because of some patients being offered trips to toilet more than ordered Fewer prescribed toilet visits after implementation ($P = .015$) More frequent actual toilet visits ($P \leq .001$) Increased number of successful toilet visits ($P = .011$)

ACE-I, angiotensin-converting enzyme inhibitor; ACFI, Aged Care Funding Instrument; ADL, activities of daily living; AMDA, American Medical Directors Association; APPs, advanced practice providers; BANSS, Bedford Alzheimer Nursing Severity; BMI, body mass index; BMP, basic metabolic panel; BNP-B, type natriuretic peptide; BP, blood pressure; BPRS, Brief Psychiatric Rating Scale; CC, critical care; CHESS, Changes in Health, End-stage disease, Signs and Symptoms scale; CIRS-G, Cumulative Illness Rating Scale-Geriatric; CMS, Centers for Medicare & Medicaid Services; ECG, electrocardiogram; ECHO-AGE, Extension for Community Healthcare Outcomes; EHR, electronic health record; eLTC, electronic long-term care; GDS, Geriatric Depression Score; GI, gastrointestinal; GP, general practitioner; HR, heart rate; IADL, instrumental activities of daily living; MMSE, Mini-Mental State Examination; MSK, musculoskeletal; N/A, not applicable; NPI, Neuropsychiatric Inventory; OR, odds ratio; PC, personal computer; PCP, primary care physician; POC, point of care; PPS, Palliative Performance Scale; PU, pressure ulcer/injury; QOL, quality of life; RR, respiratory rate; SNF, skilled nursing facility; UTI, urinary tract infection; VAS, visual analog scale.

Provider-level outcomes

One study found NH providers to be enthusiastic regarding telemedicine's ability to fill service gaps, and were most likely to use telemedicine for dermatology and geriatric psychiatry consults.[40] In another, specialist recommendations were more likely to be followed if residents were at risk for depression [odds ratio (OR) = 8.00, $P = .04$] and in cases where the geriatrician was providing medical advice such as a decision to transfer to the hospital (OR = 17.97, $P = .04$).[26] There was a trend toward shortened time to new medication orders and new diagnoses of atrial fibrillation and pneumonia,[35] though results were not statistically significant. Asynchronous consults, in which NH providers sent written questions to specialists, found that 60% resulted in a new course of action and 30% of requests were resolved without the need for a face-to-face visit.[28]

Increased telemedicine use was associated with decisions to treat residents in place, as telemedicine consultants deemed potential transfers unnecessary.[29] Results of this study are harmonious with qualitative work indicating that telemedicine may help address lack of on-site medical expertise and communication challenges.[34] NH nurses reported that on-call physicians often do not trust nurse assessments, and the use of video may validate their assessment and prevent a transfer to a hospital.[34] In an example of a perceived lack of parity between telemedicine and face-to-face care, a wound care study concluded that strengthening a primary team would be more advantageous than implementing a multidisciplinary team over telemedicine.[36]

Facility-level outcomes

Reductions in preventable ED and hospital transfers was a common outcome in 5 of the studies. In one multisite telemedicine consultation program, reductions in hospitalizations were clinically and statistically significant using a derived categorical variable indicating high and low engagement.[33] Staff in high-engagement facilities used the after-hours and weekend telemedicine support program more frequently. The decrease in hospitalizations was 8.4% lower at high-engagement than low-engagement facilities.[33] Another report found a clinically significant absolute risk reduction of 6.51% and a relative risk reduction of 27.24% in hospital readmissions.[35] Admission to a health care service was higher in the control group than in the experimental group ($\chi^2 = 3.96$, $P < .05$).[37] Over a period of 3 years, 500 potential transfers were deemed unnecessary within 20 NH pilot telemedicine sites.[29] Conversely, a remote wound care team study found that the mean ED visit rate was 1.3 times larger during the intervention period, though this result was not statistically significant.[32]

Billing claims, medical record data, and facility reporting were used to track outcomes in 2 studies.[33,35] Savings to the Centers for Medicare & Medicaid Services were frequently reported. One after-hours and weekend telemedicine service cost $30,000 per NH annually.[33] The study found that a 170-bed NH with 180 hospitalizations per year saw a reduction of 15 hospitalizations per year, and generated a net Medicare savings of $120,000.[33] By another measure, 500 avoided transfers over a 3-year program prevented more than $5 million in admission-related charges.[29] The other 2 studies calculated savings and costs on a per-resident level. Itemized direct care cost savings from wound care nurse practitioners accumulated to Can$649 per Canadian resident, though the authors flagged uncertainties in their calculation.[32] One study's continuous monitoring and other telehealth equipment cost $1386 per patient, with hospital savings of $9234, though the analysis was not provided.[35]

Clinician, Family, and Resident Perspectives

Feedback from clinicians, families, and residents was collected in several studies (Tables 3 and 4). NH providers responded that they

Table 2
Intervention Details

Study	Focus	Intervention Details	Diagnoses	Roles Involved	Resident Mean Age in Study, y	NH Beds	Setting	Country
Telemedicine Consults								
Cheng et al, 2020[24]	• Access to orthopedic specialist • Patient and Provider perceptions of quality and utility of telemedicine	• 32 musculoskeletal consults delivered over videoconferencing telemedicine solution • Included 26 long-term care facilities • 8-mo study period (September 2018 through April 2019)	• Musculoskeletal	• Orthopedic surgeon (n = 1) • NH RN • Patient and patient family (n = 14) • Unknown ("representatives from Ontario Telehealth Network")	—	26 NHs	Rural	Canada
Driessen et al, 2018[25]	• Provider perceptions of quality and utility of telemedicine	• N/A (study is reviewing results from a survey distributed at a conference)	• Interest in teleconsults	• NH providers (N = 524)	—	—	—	United States
Georgeton et al, 2015[26]	• Telemedicine access to geriatrician specialists • Adherence to specialist advice and recommendations	• Dedicated rooms with high-def cameras in 3 NHs • Teleconsultations between patients and remote geriatricians and advice for GPs. • 8-mo study period (July 2013 to March 2014)	• Dementia • High burden of comorbidities	• Residents (N = 69) • General practitioners • Geriatricians • Telemedicine assistant (undefined)	86	220 beds (across 3 NHs)	—	France
Gordon et al, 2016[27]	• Access to geriatricians and geropsychiatric specialists • Focus on quality measure results between telemedicine and control groups • Physical and chemical restraint usage	• 120-min biweekly case-based video consultation • Connecting frontline NH staff with Beth Israel Medical Center in Boston • 3-4 NH residents presented each session • 18-mo study period	• Dementia • Restraint use	• Geriatricians • Geropsychiatrists • Nurses • Nursing assistants • Activities directors • Social workers	—	16 NHs (min 46, max 335 beds)	—	United States
Helmer-Smith et al, 2020[28]	• Asynchronous eConsults	• Online application allows NH providers to submit nonurgent questions to specialists from 100 specialty groups.	• Not limited	• Residents (n = 64) • NH providers (n = 52) • Administrators • Nurse champion	80	3400 beds (across 18 NHs)	—	Canada
Hofmeyer et al, 2016[29]	• Access to infectious disease, wound care, cardiology, nephrology, and other specialists • Decreasing preventable hospitalizations	• 24/7 pilot model of telephone- and video-based consultations in rural areas • 2-way video, stethoscope, high-definition camera • Specialties included infectious disease, wound care, cardiology, nephrology, and others • Used interventions to reduce acute care transfers tool • 3-y study period (2012-2015)	• Transfers for syncope, neurologic issues, respiratory distress	• Residents (N = 736) • Director of eLTC • Service line manager • Advanced practice providers • Specialist physicians • Registered nurses	-	5000 beds (across 34 NHs)	Rural	United States
Low et al, 2020[30]	• Clinical workings of teleconsult program	• 1673 consults • 8 NHs • 6.5-y study period (December 2010 through March 2017)	• Not limited	• Hospital doctors (N = 6) • NH senior nurses	77	1600 beds (across 8 NHs)	Urban	Singapore

(*continued on next page*)

Table 2 (*continued*)

Study	Focus	Intervention Details	Diagnoses	Roles Involved	Resident Mean Age in Study, y	NH Beds	Setting	Country
Perri et al, 2020[14]	• Access to palliative care specialists • Patient and provider perceptions of quality and utility of telemedicine	• Clinical staff at 2 pilot sites monitored residents weekly for predefined events that trigger a palliative care consult • Gold Standard Framework Pro-active Identification Guidance tool used to evaluate palliative care needs • Dedicated conference room at NH with videoconferencing included computer, widescreen monitor, external microphone, high-definition camera • Family given choice to join via videoconference or in person • 6-mo study period (November 2017−April 2018)	• Dementia	• Residents (n = 61) • Clinical staff (n = 22) • Medical doctors • Registered nurses • Social workers • Palliative care specialists • Patient families	87	472	Urban	Canada
Piau et al, 2020[31]	• Management of neuropsychiatric symptoms via telemedicine	• Telemedicine consult visits within 72 h of disruptive neuro-psychiatric symptom between NH and geriatricians at expert memory centers • Interview NH staff before and after telemedicine experience • 2-y study period (2015-2017)	• Neuropsychiatric symptoms	• Residents (N = 90) • NH providers • NH nurses • NH psychologists • Consulting geriatricians	—	10 NHs (min 60, max 133 beds)	—	France
Stern et al, 2014[32]	• Access to wound care specialists • Outcomes were reduction in pressure ulcer (PU) surface area, time to complete healing, PU incidence, PU prevalence, and wound pain	• Each facility appointed wound care lead to be primary contact for study team • Wound care nurse practitioner in person for phase 1 (3 mo) • NP was primarily remote and provided wound care via digital photos, video visits, e-mail, and phone conversations (1-11 mo) • Compared usual care to intervention	• Pressure injury	• Residents (N = 137) • Advanced practice n urses specialized in wound care • NH registered nurses	82	1992 beds (across 12 NHs)	-	Canada
After-Hours Support and Remote Assessments								
Grabowski and O'Malley, 2014[33]	• Coverage of nights and weekend hours for NHs • Impact of telemedicine on num-ber of residents hospitalized. • Comparing NH data	• Provider coverage for NHs through telemedicine group to cover urgent and emergent weeknight calls from 5p-11pm, and weekend day coverage (10am-7pm). • Cart with videoconferencing and high-res camera • NH providers not informed that would be studying hospitalizations • 13 month study period (October 2009 through November 2010)	• Reducing hospitalizations • Financial savings	• NH physicians (primary group practices typically covered off-hours care) • Telemedicine group r egistered nurse, nurse practitioner, physician • NH-level patient data	-	11 NHs (min 140, max 175 beds)	-	United States

Stephens et al, 2020[34]	• Explore experiences of NH resident transfers to ED through qualitative methods	• Initial focus groups were of like individuals (eg, NH nurses) • After recurrent themes emerged, focus groups of mixed stakeholders were held. • Semi-structured interview • Focus groups viewed video demo of telehealth consult flow • Participants asked how technology may change ED transfer experience	• Transfers from NH to ED	• NH resident family members (n = 6) • NH providers and nursing staff (n = 30) • ED and hospital providers (n = 5) • NH administrators	—	—	Urban, suburban, and semirural	United States
Remote monitoring								
Dadosky et al, 2018[35]	• Access to HF specialists • Decreasing hospital readmissions • Improving time to intervention in SNF • Collaboration between HF clinic, SNF, and HHC • Evaluate patient provider acceptance of telehealth	• HF clinicians in office setting assessed patient in SNFs with telemedicine sessions. • A sensor worn on the chest provided HR, RR, body position, and single-lead ECG. • BP, pulse-oximeter, and weight were monitored via Bluetooth devices. • The HF and SNF providers used a Bluetooth stethoscope to remotely auscultate heart and lung sounds. • POC lab testing used to measure BNP, BMP • Data viewable on dashboard for SNF and HF clinic clinicians • 21-mo study period (March 2014–December 2015)	• Heart failure	• Patients (N = 141) • HF office clinicians (unknown roles) • NH providers • NH nursing staff • HHC staff	81	—	Suburban	United States
De Luca et al, 2016[37]	• Access to neurology and psychology specialists • Telehealth impact on psychological measures, quality of life, and neurobehavioral symptoms • Improving vital signs and clinical management	• BP, pulse-oximeter, ECG via Bluetooth devices • Recorded sounds from Bluetooth stethoscope • Dashboard for providers • Videoconferencing solution for telemedicine visits • Study period undefined, T0 = before telecare protocol T1 = after telecare protocol	• Dementia • Depression	• Residents (N = 59) • Neurologist • Psychologist • NH nursing staff	80	—	—	Italy
De Vito et al, 2020[36]	• Activity monitors and monthly wellness telemedicine visits with PLWD	• Activity monitor to track steps, HR, and sleep data • Monthly telemedicine visits with neuropsychologists and PLWD and their caregiver: setting wellness goals, care recommendations • Monthly questionnaires • 6-mo study period	• Dementia	• Residents (n = 18) • NH caregiver (n = 6) • Neuropsychologists (n = 1)	84	—	—	United States

(*continued on next page*)

Table 2 (*continued*)

Study	Focus	Intervention Details	Diagnoses	Roles Involved	Resident Mean Age in Study, y	NH Beds	Setting	Country
Yu et al, 2014[38]	• Using telehealth and sensors to record incontinence episodes • Using technology insights to develop clinical care plans	• Use sensor to collect baseline data of incontinence episodes and time • Dashboard allowed SNF staff to see when sensor activated • Manually collect other voiding events • Consultant used data to develop individualized urinary continence care plans • Outcomes of the intervention were recorded by using sensor to collect incontinence data and SNF staff manually recording voiding events. • 12-week study period (in 2011)	• Urinary incontinence	• Personal care workers • Residents (N = 31) • Continence consultants from vendor	81	120	Urban	Australia

BMP, basic metabolic panel; BNP, B-type natriuretic peptide; BP, blood pressure; ECG, electrocardiogram; GP, general practitioner; HF, heart failure; HHC, home health care; HR, heart rate; N/A, not available; NP, nurse practitioner; PLWD, person living with dementia; POC, point of care; PU, pressure ulcer/injury; RN, registered nurse; RR, respiratory rate; SNF, skilled nursing facility.

would be most likely to use telemedicine for dermatology, geriatric psychiatry, infectious disease, cardiology, and neurology consults.[25] NH staff who did not use telemedicine opined that it would be a powerful tool to influence medical decision making.[34] Palliative care specialists and NH physicians, nurses, personal support workers, and rehabilitative therapists' knowledge of using palliative care ($r = 0.565$, $P = .018$), confidence in using palliative telemedicine ($r = 0.673$, $P = .003$), and overall telemedicine acceptance ($r = 0.698$, $P = .002$) was positively correlated with an increased number of videoconferences.[39] More frequent usage seemed to improve satisfaction with the modality.

Two studies collected feedback from NH residents directly, who reported their experiences as positive.[24,35] Family perspectives were explored in 3 of the articles.[24,34,35] Family members considered telemedicine visits advantageous if they resulted in quicker access to a provider or resulted in more frequent visits.[34,39] There was also agreement that families would benefit from joining consultations through videoconferencing.[24,34]

Facilitators and Barriers

Clinician-identified facilitators to telehealth implementation included having adequate technical support, integration into the electronic health record, and strong facility leadership.[24,28,32,39] Perceived benefits included improved timeliness of resident's care, elevated productivity, improved access to specialist advice, increased connection opportunities between NH nurses and providers, and subjective gains from involving families in care.[25,28,31,34] Resident- and family-identified facilitators included being able to see a provider sooner, high-quality audio and video, and functionality to allow family participation during visits.[24,34,39]

Clinician-identified barriers included poor audio quality, missing functionality, technical difficulties slowing time to connect, time required to clean and charge devices, reimbursement challenges, and lack of workforce allocation for telemedicine.[24,25,31,32,36,39] Residents and families noted barriers as charging devices, preferences for in-person visits, and difficulties in connecting to Wi-Fi or cellular broadband.[35,39]

Discussion

This integrative review of 16 international studies illustrates the modes in which telemedicine and telehealth potentially expand access, cover gaps in care, improve resident outcomes, reduce unnecessary trips to the hospital, and generate cost savings for NHs. Throughout the studies, there is consensus in benefits to patient care, and enthusiasm or at least curiosity for its use from providers, residents, and family. In no study was there unequivocal evidence that telemedicine or telehealth negatively affected resident outcomes or presented an excessive cost burden.

This appraisal finds wide methodologic heterogeneity and low generalizability because of small sample sizes with poorly described characteristics, and study designs that fail to collect or report sufficient intervention data. These aspects impair the ability to construct overarching evidence-based recommendations and highlight the need for conducting future research with more comprehensive and consistent study designs.

Geriatric, wound care, psychiatric, and palliative specialist teleconsults were found most effective in this review. Some NH clinicians preferred in-person wound care nurse practitioners and palliative care providers over telemedicine providers.[32,39] Results suggests that telemedicine enables rapid specialist consultations and allows on-call NH providers to evaluate residents from home. Similarly, ED telemedicine research programs found reductions in unnecessary

Table 3
Analysis of Clinician Perspectives in Accordance with the Technology Acceptance Model

Concept	Facilitators and Benefits	Barriers and Disadvantages
Experience	• As providers used telemedicine more frequently, their satisfaction scores increased (Perri et al[14])	—
Job relevance	• Improve timeliness of resident's care (Driessen et al[25]) • Improve service gap (Driessen et al[25]) • Increased connection and validation between NH nurses and providers (Stephens et al[34]) • Better valuation of NH staff's work (Piau et al[31])	• Difficulty coping with change, feeling of intrusion (Piau et al[31])
Output quality	• Improves productivity (Cheng et al[24]) • Able to see each other, comfort level appropriate (Perri et al[14])	• Audio quality—unable to hear each other (Perri et al[14])
Result demonstrability	• Majority of providers in the study said they were willing to use telemedicine again (Perri et al[14]) • Clinicians initially feared dehumanization of medicine, but did not report this after 2 y of use (Piau et al[31]) • Involvement of families in care (Piau et al[31])	• Unable to complete all functions clinician wants done (Cheng et al[24])
Perceived Usefulness	• Measured by TUQ (Cheng et al[24]) • Aid making decision to transfer (Stephens et al[34]) • Patient may be able to see provider more often (Stephens et al[34]) • Improved access to specialist advice, cost reductions, improved quality of care (Helmer-Smith et al[28]) • Tackles lack of specialized care in remote areas (Piau et al[31]) • Able to use resident's activity monitor to easily check heart rate; more aware of sleep patterns (De Vito et al[36])	• NH staff preferred in-person wound care visits and were more engaged (Stern et al[32])
Perceived ease of use	• 81% found software easy or moderately easy to learn (Cheng et al[24]) • Ease of sending a message to a specialist; increased confidence in care decisions (Helmer-Smith et al[28])	• Amount of time it takes to connect, adds median 3 min (Perri et al[14]) • Challenges in capturing resident complexity in a written question (Helmer-Smith et al[28]) • Activity monitor cleaning and charging added 5 min per resident during their shift (De Vito et al[36])
Intention to use	• Technical support person available in the moment (Perri et al[14]) • Integration into electronic health record greatly improved uptake of asynchronous eConsults (Helmer-Smith et al[28])	• Physician and APP reimbursement and licensure (Driessen et al[25]) • Lack of time and workforce for telemedicine (Piau et al[31])
Usage behavior	• Facility leadership critical to ensuring implementation (Stern et al[32])	• Inadequate allocation of staff time to implementation (Stern et al[32]) • Residents more frequently removed activity monitors in late afternoon or evening due to agitation (De Vito et al[36])

APP, advanced practice provider; TUQ, Telemedicine Usability Questionnaire.

transfers and that 18% to 66% of teleconsultations influenced patient diagnosis or management.[41]

Limited qualitative work explores telemedicine and telehealth in the NH setting. This scarcity may be due to the technologies' relatively recent emergence in the NH setting. Qualitative research emphasizes the experiences of residents, clinicians, and other users, which is beneficial to technology developers improving the usability and utility of systems. Although limited in this setting, in other settings, patients

Table 4
Analysis of Resident and Family Perspectives in Accordance with the Technology Acceptance Model

Concept	Facilitators and Benefits	Barriers and Disadvantages
Experience	• Technical, privacy, and comfort met (Perri et al[14]) • Feel comfortable and respected during visit (Perri et al[14])	—
Output quality	• Visual and audio quality rated as excellent (Cheng et al[24])	—
Result demonstrability	• Willing to use it again (Perri et al[14]) • Some patients did not want intervention to end (Dadosky et al[35])	—
Perceived usefulness	• Measured by TeSS (Cheng et al[24]) • Ability of family to join patient in consultation (Cheng et al[24]) • Potential to include family in decision to transfer to hospital and increase trust in provider decision (Stephens et al[34]) • Liked activity monitor because it also served as a watch (De Vito et al[36])	—
Perceived ease of use	• Measured by TUQ (Cheng et al[24])	• Bothered by changing battery, charging the tablet, taking daily vital signs (Dadosky et al[35])
Intention to use	• Would prefer videoconference if it meant their loved one could be seen by palliative care faster, or more often than in person visits (Perri et al[14]) • Be able to see provider sooner, increase trust in NH (Stephens, et al[34]) • Residents enjoyed comparing the number of steps they took (De Vito et al[36])	• Prefer to see provider in person if given option (Perri et al[14]) • Some residents appeared neutral or had no awareness of activity monitor (De Vito et al[36])
Usage behavior	• 88% daytime compliance wearing activity monitor (De Vito et al[36])	• Difficulty connecting to Wi-Fi or 4G connections (Dadosky et al[35])

4G, fourth-generation broadband cellular; TeSS, Telemedicine Satisfaction Scale; TUQ, Telemedicine Usability Questionnaire; Wi-Fi, wireless fidelity.

and caregivers have highly rated telehealth's impact on information sharing, consumer focus, and overall satisfaction.[40] However, given the NH setting's unique nature, future work is needed to better understand these issues.

Difficulties related to staff turnover introduce training issues that impair the consistent implementation of telehealth interventions.[32] Despite such issues, there appear to be numerous opportunities for telehealth and telemedicine in NH settings, especially given the relatively low rollout and operational costs. According to the survey data included in this integrative review, participants are generally enthusiastic toward the use of telemedicine and telehealth in NHs.

The results of the present review are consistent with the Society for Post-Acute and Long-Term Care Medicine's standards document that guides NHs on the use of telemedicine to evaluate and manage changes of condition for residents.[42] Reductions in hospitalizations and emergency visits in particular are further supported by this review. This review adds new perspectives on remote monitoring in NHs and potential new metrics such as reductions in restraint use.

An earlier systematic review of telemedicine services for residents in NHs from 1990 to 2013 found that dermatology, geriatrics, psychiatry, and other specialties were successfully delivered via telemedicine while also showing economic savings.[17] This review extends this prior work's findings as our included studies also found financially and clinically efficacious results with asynchronous dermatology teleconsultations,[35] geriatric specialist teleconsultations,[24,28,30,37] and psychiatric care delivered over telemedicine.[37]

COVID-19 has brought new difficulties as NH residents are at high risk because of resident age, comorbidities, and proximity to other residents and staff.[9] Visitation restrictions meant to limit potential contagion from unnecessary in-person contact created a push for telehealth to enable family visitation, mental health services, and allow remote assessments by specialists. Hospital COVID-19 programs indicate that telemedicine helps preserve personal protective equipment, limits exposures bidirectionally, encourages fast triage, and allows a specialist group to service multiple facilities.[43] A COVID-19 collaborative model between an academic hospital and NH enabled telemedicine consultations, infection advisory consultations, and nursing liaisons to prevent or limit outbreaks.[44]

Limitations of the Included Studies

Overall, there was a general lack of rigorous experimental study designs. Studies using a historical group for comparison lacked matching procedures or propensity scores, which results in a risk of a study's internal validity due to selection bias. A large number of studies used author-developed surveys, which present risks of measurement bias. In other cases, advanced statistical methods may have given more robust results by for example using Poisson regression models for the analysis of count data and multiple hospitalizations. This would have permitted predictions around the effectiveness of the intervention.[45]

No studies in this sample used a theoretical framework to guide their approach. Sampling strategies frequently were not described. Baseline characteristics of samples were poorly described, with few consistently captured demographic, psychometric, and physiological measures. This limited the analysis of person-level differences between groups. Inclusion of these data could help to identify disparities related to rurality, socioeconomics, or language barriers.

Sample sizes were frequently small, with one study reporting results from a single orthopedic surgeon.[24] Most studies involved a small number of sites, thus limiting generalizability. Others involved multiple co-occurring treatments (eg, RPM, telemedicine, point-of-care testing) but lacked representation as independently measured covariates. A full critical analysis may be reviewed in Supplementary Tables 1 and 2.

Limitations of this Review

Encouraging telepharmacy, teledentistry, and telerehabilitation studies exist in NH settings but were out of scope for this review because of its focus on the medical-nursing nexus of telemedicine. This review used the ONC's definition of telehealth and did not include surveillance technology, passive monitoring, and robotics, though these are promising areas of research.[16,46] Videoconferencing for connection between NH residents and family was not included. Telehealth support of family caregivers of persons living with dementia in residential care was not included, though interesting work is ongoing in this area.[47]

Implications

Practice

Stakeholders may choose to implement a pilot program to validate telehealth's suitability for their NH. Quality improvement outcomes such as number of unnecessary hospital transfers, satisfaction surveys, and changes in selected clinical measures may be the most appropriate outcomes to track.[42] Further, technology implementations are more readily accepted when they are interoperable with existing system architecture.[48]

Geriatric psychiatry and dermatology teleconsultations specialties can be effectively delivered through telemedicine.[25–27,32] Other work suggests after-hours telemedicine services help facilities maintain census and decrease patient transportation costs.[49]

Research

NH resident perceptions of telemedicine are absent from recent literature. Only 1 study used a patient-focused questionnaire.[35] Community-based studies eliciting feedback from older participants indicated that telehealth was well-received.[50] Similar studies may be undertaken in NHs. Furthermore, given the small size of many of the studies, performing embedded pragmatic clinical trials of those technologies with an underlying evidence base could provide more generalizable outcomes as well as information on effective implementation methods and intervention fidelity. Qualitative research could illuminate specifications for types of alerts that may be most beneficially triggered from RPM-collected data for NH residents.

Conclusions and Implications

This integrative review presents a comprehensive synthesis of empirical evidence regarding the state of the science on telemedicine and telehealth in NHs. There is evidence that telemedicine and telehealth may improve outcomes for patients, staff, and administrators in NHs, provide broader full-time coverage, and decrease costs. Telemedicine may help reduce the exposure to COVID-19 in NHs and decrease unnecessary hospitalizations. As may be expected, certain kinds of diagnostic support are better suited to remote settings than others. The research is far from comprehensive, indicating that this is a nascent field for future investigations into the implementation and adoption of these technologies.

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Supplementary Table 1
Quantitative Study Critical Appraisal

Study	Purpose	Methods	Variables and Measures	Statistical Analyses	Results	Discussion
Cheng et al, 2020[24]						
Strengths	• Clear focus on one specialty (orthopedics and musculoskeletal) • Purpose clearly stated to evaluate utility of telemedicine for MSK care to long-term care patients	• Wide range of respondents: surveyed providers, nurses, patients, and families • Study setting includes descriptor of rural area	• Used validated telemedicine satisfaction questionnaires, which shows effort toward objective measurement	• Survey results presented visually	• Survey results clearly described in percentages with specific reference to the survey question	• Discusses lack of generalizability due to small sample size (population validity) and rural setting (ecological validity)
Weaknesses	• No theoretical framework proposed	• No sampling strategy described, potential for selection bias • Inclusion and exclusion criteria not reported • Confounding factors not identified • Participants were from 26 different facilities, not described	• No demographic data collected • Only 1 provider (surgeon) was surveyed • Potential for information bias due to unclear measurement of exposure (diagnosis, time of consult not reported)	• No descriptive statistics reported • No inferential statistics • No comparisons between groups for different facilities	• Study subjects poorly described • No demographic data reported • Visualizations fail to reliably describe members of sample included in each graph (varied between patients, provider, liaisons)	• Interpretation section includes statements unrelated to study's results • Potential bias due to TeleMSK initiative, though authors were not paid and did not own stock in company or institution • Does not discuss potential for reporting bias except to emphasize that only 1 provider was surveyed
Dadosky et al, 2018[35]						
Strengths	• Objectives clearly stated • Identifies gap in research (telehealth across continuum of care)	• Power analysis for moderate effect size and 0.8 power (target sample population 143) • Historical comparison group	• Clearly defined independent and dependent variables • Collected data on readmissions from hospital EHRs in addition to SNF data • Collected data on patient self-care knowledge and satisfaction	• *t* tests and χ^2 tests to detect differences between groups • Multiple regression analysis with clear independent variables and dependent variable (30-d readmission) • Risk reduction calculations for each group's likelihood for readmission	• Outcome variable for regression was 30-d readmission events, clearly reported electrolyte imbalance as predictor in both groups • Other outcome variables reported but not statistically significant Reports clinically significant results	• Transparently reports that some measurements were not frequently recorded, such as time to intervention • Describes limitations of study, including sample size
Weaknesses	• Background and problem identification not clearly described • Used many types of technology in 1 study, may affect ability to report outcomes • No theoretical framework presented	• Only 49 patients met criteria • Matching not effectively used, several statistical differences between intervention and comparison group (threat to internal validity)	• Some measures did not have results reported (eg, number on-site visits by SNF provider) • Control group did not have mortality or HF-cause rehospitalization data collected, no opportunity for comparison though results for intervention group were reported (threat to internal validity) • Study design purports to follow patient from SNF to home, measures do not clearly state which data are from SNF and which from home setting; potential measurement error	• Demographic variables not collected beyond age and sex • No use of stratification by age or other variables to control for confounders • Study lacks a table clearly showing regression analysis, r^2 not reported • No use of instrumental variables to compare interventions (TM, RPM, ECG) and control for difference • Threats to validity due to failure to reach target sample size	• Did not indicate if some variables (eg, comorbidities, age) were included in statistical analyses • Stratified results would have improved interpretability and demonstrated controlling for confounders	• Because of low power of study, in some cases results are reported as clinically significant, though they were not statistically significant • Limited generalizability and threat to external validity due to small sample size • Implications do not recommend areas for future research

De Luca et al, 2016[37]						
Strengths	• Strong background describes challenges and knowledge gaps • Clearly stated purpose and objectives	• Clearly described setting • Experimental telehealth treatments thoroughly described	• Used psychometric tests with evidenced validity and reliability • MMSE scores were similar between groups	• Mann-Whitney *U* test to evaluate homogeneity between experimental and control groups • χ^2 test to compare equality of proportions between groups	• Clearly describes significant reduction in GDS and BPRS scores between 2 time periods for experimental group	• Describes novelty of the approach, which explains lack of comparison to existing research • Describes implications for practice
Weaknesses	• Length of study period undefined No theoretical framework presented	• Randomization was poorly described; reports it was achieved in order of recruiting (risk for selection bias) • Participant blinding to treatment assignment unclear (risk for information bias) • Attempts to blind data collectors not described • Power analysis not reported • Usual care of control group not specified	• Treatment groups were not identical; the mean age, BANSS, and BPRS scores between groups were significantly different • Treatment group received weekly teleconsultation with neurologist or psychologist. Unclear what face-to-face consultations the comparison group received. • No measure of length of teleconsultation visits	• Unclear if researchers completing outcomes assessment were blinded to treatment group • Statistical power analysis not performed • No use of propensity score matching to control for confounding	• Selective outcome reporting; unclear what treatments the standard care group received • Intervention group received teleconsultations as well as multiparametric vital sign monitoring, not differentiated in results	• Limitations not reported by authors • Limited generalizability due to sample size • Implications for policy and education not described • Recommendations for future research not stated
De Vito et al, 2020[36]						
Strengths	• Addresses a gap in literature around use of multicomponent telehealth in NHs	• Treatment period, data collection, variables well described • Intervention characteristics well described	• Outcomes described in detail • Variables of interest and questionnaires are well described	• Statistical methods described; mostly descriptive, so no discussion of confounders • Describes loss to follow-up	• Gives reasons for nonparticipation (eg, not wearing sensor at night due to sundowning) • Provides descriptive data	• Major findings discussed in relation to study objectives • Limitations are reported and comprehensive • Appropriately gives cautious interpretation of results
Weaknesses	• Theoretical framework not stated	• Eligibility criteria and recruitment not described • NH residents' attitudes toward devices were not directly collected • Setting not described	• NH residents' opinions of usability of devices were not directly collected	• Missing data not described	• Residents in the sample were all white and well-educated individuals	• Opinions of residents were not collected directly and other research covering the topic not cited
Driessen et al, 2018[25]						
Strengths	• Clear description of problem and purpose	• Setting and respondents well described	• Twenty-question survey responses clearly described with 7-point Likert scale description	• Descriptive statistics including means and SDs as measures of central tendency	• Described approach to dealing with missing data • Included percentage of respondents who currently use telemedicine in nursing home	• Authors describe majority of respondents are medical directors not direct care providers (addressing potential response bias) • Adequately describes limitations of convenience sample
Weaknesses	• Survey available only at conference, did not describe attempts to broaden audience or rationale why limited to conference	• Convenience sample; inclusion and exclusion criteria not described • Potential for over- or under-reporting due to self-reported survey responses only • Potential for nonresponse bias (41% response rate to survey)	• Author-developed survey (validity and reliability unknown)	• Did not use regression to compare independent variables such as respondent demographics with dependent survey result variables	• Findings did not include characteristics such as whether respondents were in resource-poor communities or rural and urban settings	• Some potential sources of bias not described such as potential for nonresponse bias

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Supplementary Table 1 (*continued*)

Study	Purpose	Methods	Variables and Measures	Statistical Analyses	Results	Discussion
Georgeton et al, 2015[26]						
Strengths	• Strong introduction and background • Clear statement of purpose	• Reported following STROBE guidelines	• Patient baseline characteristics including BMI, dementia, falls, CIRS, ADL, GDS measured	• *t* tests and χ^2 to compare between-group comparisons of outcome Yes/No following recommendations per each clinical dependent variable • Univariate and multiple logistic regression to examine outcome variable with dependent variables	• Statistically significant results around increased likelihood of following expert medical advice clearly reported • Logistic regression results showed risk of depressive syndrome associated with GP likelihood of following geriatrician recommendations	• Results are compared to existing research around GP adherence • Discussed results within context of other studies • Includes discussion of limitations: small sample size, assessed only complete adherence to recommendations instead of each recommendation individually, lack of data on verbal and written communications between GP and geriatrician
Weaknesses	• No theoretical framework	• Setting poorly described; residents from 3 different nursing homes but details not reported • Twelve GPs' adherence to recommendations as outcome, but no description of GPs provided (unknown familiarity with telemedicine, years in practice, training) • Sampling strategy not clear (potential for selection bias)	• Inclusion of reasons recommendations not followed would have been ideal though understandably difficult to collect • Characteristics of GPs not described	• No controlling for potential confounder of differences between GPs • No stratification of results between nursing homes (potential for confounder bias)	• Reasons for GP nonadherence not reported	• The abstract and discussion describe study as cohort study, but the methods section describes it as cross-sectional study • Authors describe their higher percentage of GP adherence due to "good relationship between GP and geriatrician" but this is not measured or elsewhere described
Gordon et al, 2016[27]						
Strengths	• Clear description of problem and purpose	• Matching criteria described (each intervention facility matched with 2 similar facilities with number of beds, for-profit status, region, nursing home chain status, staff rating, 5-star quality rating) • Described inclusion criteria of intervention facilities having at least 1 case and 1 follow-up case	• Described length of telemedicine sessions and format • Details of MDS quality measure outcome data included	• *t* tests to evaluate differences between intervention and control groups, statistically significant higher number patients with pressure ulcers in intervention group • Logistic regression to examine relation between each intervention and quality measure • Accounted for clustering across repeated measures over time with generalized estimating equations	• Clear tables reporting statistical methods, results, and *P* values • Preliminary statistically significant evidence showing telemedicine intervention associated with decreased restraint usage	• Thorough discussion of limitations including potential for selection bias due to nonrandomized nature, potential confounders, and sources of bias such as not matching on baseline physical restraint or antipsychotic usage • Emphasizes repeated measures over time, 2:1 prospective matching design, matching of controls • Recommendations for further research included

Weaknesses	• No theoretical framework	• Potential confounding variables between nursing homes not described • Total number of facilities small, underpowered to detect small effect sizes	• Nursing home characteristics not described (eg, Medicare/ Medicaid/Commercial insurance, socioeconomic features)	• Missing data presence and handling not described	• Potential for selective outcome reporting	• Lack of discussion of results in context of related studies
Grabowski and O'Malley, 2014[33]						
Strengths	• Clear purpose statement and objectives	• Randomization of SNFs to telemedicine vs standard on-call coverage • Study outcomes concealed from telemedicine and SNF providers	• Descriptive characteristics of nursing homes including 5-star rating, number of beds, resident demographic and health data, hospital transfers, resident days in facility per month • Intervention and control groups did not have significant differences in characteristics measured, which improved internal validity	• Poisson regression model using distributed random variable of number of hospitalizations in a month • Created variable "more engaged" and "less engaged" to demonstrate usage of telemedicine • Generalized estimating equations to account for clustering within nursing homes	• Outcome variable: number of residents hospitalized • Outcomes measured reliably and were measured in same way between treatment groups	• Limitations discussed such as lack of generalizability due to study within single for-profit chain • Recommendations for future research provided
Weaknesses	• Brief background and significance would have been strengthened with more cited references and statistics	• Randomization process not described	• Outcome variable did not differentiate hospitalizations that occurred during daytime, evening, or weekend hours	• Power analysis not performed • Effect size not described	• Unclear if outcomes assessors were blind to treatment assignment	• Lack of discussion of results in context of related studies • Feedback from providers not discussed
Helmer-Smith et al, 2020[28]						
Strengths	• Novel approach to using asynchronous eConsults in NH setting	• Setting and study period are well described	• Clearly describes measures collected • Definitions and context provided • Provides detailed interview guide	• Descriptive statistics	• Data visualizations for descriptive results • Reports numbers of outcome events from NH provider closeout survey	• Key results summarized in reference to study objectives • Limitations are discussed
Weaknesses	• Background information is brief and lacks detail to provide strong rationale	• Study design not clearly stated • Some elements of methodology unclear	• Potential confounders not described • Resident demographics and clinical context not provided, clinical significance unclear	• Limited quantitative analysis due to confounders and inferential statistics not described or attempted	• More detail regarding types of questions sent to consultant would have been appreciated • Characteristics of residents and providers not described	• Potential sources of bias not discussed • Generalizability not deliberated
Hofmeyer et al, 2016[29]						
Strengths	• Clear background and summary of available knowledge	• Contextual elements describe rural areas access issues and review of historical cases where hospitalizations were potentially avoidable	• Time effectively used as a variable • Operational definitions provided • Staffing and equipment thoroughly described	• Percentages of chief complaints that resulted in avoidable transfers	• Timeline diagram provided Technical and cultural challenges and impact on outcomes discussed • Missing data described	• Describes key economic findings • Details adjustment period as clinician buy-in was achieved
Weaknesses	• No explicit purpose statement • No theory or framework	• Ethical considerations not described	• Only variables presented in tables were no. of eLTC consults, no. of transfers, and no. of no-transfers • Validity and reliability of outcome data not described	• 14 NHs included but not described in terms of beds and patient population or providers • Poorly described inferential methods	• Results not compared with previous literature • Impact on patient experience not described	• Unsupported descriptions of LTC staff training and empowerment • Limitations not reported
Low et al, 2020[30]						
Strengths	• Effectively presents relevant background to support rationale	• Study period of ~6.5 mo • Authors state data collection form available (TCF)	• Data collected on each resident participant clearly stated and appears comprehensive	• Descriptive statistics	• Relatively large data set allows for interesting summaries of reasons for referral and management plans • Describes demographics of residents • Describes length of teleconsults and other characteristics	• Relates observed results in reference to rationale for study • Discusses limitations • Reports results cautiously and recommends randomized controlled trials to evaluate effectiveness

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Supplementary Table 1 (*continued*)

Study	Purpose	Methods	Variables and Measures	Statistical Analyses	Results	Discussion
Weaknesses	• Objectives and purpose not explicitly stated; goal of study not specific	• Cases for teleconsults selected by senior nurses but inclusion or exclusion criteria not described	• Inconsistent documentation between providers • Missing data	• Limited quantitative analysis; inferential statistics not reported	• Outcome measures self-reported by NHs	• Potential sources of bias not listed • External validity not stated
Perri et al, 2020[14]						
Strengths	• Adequate background and significance • Address sensitivity of delivering palliative care over telemedicine	• Multiple measurement of outcome both pre- and postintervention	• Use GSF-PIG screening tool as valid and reliable measure • Solicit feedback from family and clinical staff	• Descriptive statistics • Group differences measured with independent *t* test • Pearson correlation to examine associations	• Clear discussion of technical implementation factors • States family responses should be interpreted with caution because of small sample	• Limitations summarized including low generalizability of results • Results compared to existing research • Provides suggestions for future research
Weaknesses	• No theoretical framework	• Pre-post study design weaker than RCT • No control group	• Surveys subject to selection bias because of tendency to respond if results favorable • Surveys not tested for reliability and validity	• Low survey response rate but no description of handling of missing data	• Staff outcome data measures confidence, which is subject to selection bias • Family survey were yes/no responses, data not rich	• Implications for policy and education not discussed
Stern et al, 2014[32]						
Strengths	• Clearly gives background and rationale for telemedicine EMDT	• Clearly described randomization process • Statement that blinding of residents and staff not possible • Adhered to methodologic recommendations for comparative effectiveness research	• Clear description of wound healing rate measurement • Outcomes measured in the same way for treatment groups	• Includes study powered to detect 40% difference in rate of healing • Linear mixed effects models • Cox proportional hazard frailty models • Kaplan-Meier method	• Reflexive and descriptive interpretations • Detailed cost-benefit analysis and economic evaluation	• Transparency; reports large proportion of censored observations (53%) • Limitations described in discussion • Practice, policy, education, and future research implications suggested
Weaknesses	• Theoretical framework not used to guide study design	• Control groups not treated identically (NH had different "usual care" wound care norms)	• Each SNF had different wound care teams, so the usual care was likely varied between those practitioners and not accounted for in the article	• Missing data not described	• Frequent NH staff turnover and insufficient managerial attention affected results	• Results may not be generalizable • Limited to 1 expert wound care team
Yu et al, 2014[38]						
Strengths	• Aims clearly described • Hypothesis clearly stated	• Clear inclusion criteria • Power analysis conducted	• Clear description of data collected related to continence • Sensor used to determine patient elimination habits	• Paired *t* test and Wilcoxon U-test	• 6 outcome measures reported for pre/post with *P* values • Describes increase in offered toilet assistance from 2 to 6 times in 24 hrs	• Describes ambiguity/multiple sources of outcome: training, the act of measuring voiding symptoms, or feedback from telemonitoring system • Reports limitations
Weaknesses	• Theoretical framework not used to guide study design	• Exclusion criteria not stated • Efforts to reduce bias not described No control group	• Role of continence consultant unclear—description of care plan incomplete • Pre-post design, no control group data collected	• Regression analysis not completed • Confounder not discussed • Participants not described • Causal methods not described	• High risk of research participant bias, personal care assistants knew it was study and offered more toilet trips than care plan stated • Postimplementation assessment was at 5 wk, unclear if staff blinded	• Software and clinical dashboard not well described • Recommendations for future research, policy, and education not discussed

ADL, activities of daily living; BANSS, Bedford Alzheimer Nursing Severity; BMI, body mass index; BPRS, Brief Psychiatric Rating Scale; CIRS, Cumulative Illness Rating Scale; ECG, electrocardiogram; EHR, electronic health record; EMDT, enhanced multidisciplinary teams; GDS, Geriatric Depression Score; GP, general practitioner; GSF-PIG, Gold Standards Framework Proactive Identification Guidance; HF, heart failure; MDS, Minimum Dataset; MMSE, Mini-Mental State Examination; MSK, musculoskeletal; NH, Nursing home; RCT, Randomized controlled trial; RPM, remote patient monitoring; SD, standard deviation; SNF, skilled nursing facility; STROBE, Strengthening the reporting of observational studies in epidemiology; TM, telemedicine.

Appraisal tools used: The Joanna Briggs Institute's (JBI) Checklist for Randomized Controlled Trials was used to evaluate 3 RCTs included in the review (JBI, 2020). Nonrandomized experimental studies were evaluated with the JBI Checklist for Quasi-Experimental Studies. Research engaging cross-sectional study designs were evaluated with JBI's Checklist for Analytical Cross-Sectional Studies. JBI's Checklist for Cohort Studies aided the evaluation of cohort studies, and the Critical Appraisal Skills Programme (CASP) Qualitative Checklist was used to appraise the qualitative study (CASP, 2018). Critical appraisal of a quality improvement was completed with the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE) tool.

Supplementary Table 2
Qualitative Study Critical Appraisal

CASP Checklist Item	Stephens et al, 2020[34]		Piau et al, 2020[31]	
	Strengths	Weaknesses	Strengths	Weaknesses
Was there a clear statement of the aims of the research?	• Interpretive approach evidenced by statement of exploratory qualitative approach • Importance of topic well supported in introduction	• Philosophical perspective not stated	• Background describes neuropsychiatric symptoms in the setting of PLWD in nursing homes • Describes paucity of research of NH staff perspectives, need for sociological considerations	• Purpose statement not stated directly
Is a qualitative methodology appropriate?	• Clear description of grounded theory methodology • Inductive reasoning enables findings to emerge from data	• Did not directly explain why grounded theory approach was selected over other methodologies	• Used conventional content analysis and summative qualitative content analysis	• Background focuses on neuropsychiatric symptoms (NPS), mixed methods may have allowed deeper analysis of program impact on NPS
Was the research design appropriate to address the aims of the research?	• Grounded theory congruent with stated purpose and objectives • Clear description of focus group and inclusion of demo video • Excerpts from focus group guide were provided and in line with aims of research	• Unclear description of decision to include emergency department provider perspectives and if asked different questions • Voice of the patient is absent; not recruited in the study (expressed by authors as limitation)	• Novel use of social evaluation approach • Compares 2 regions	• Did not discuss alternative design approaches such as mixed methods • Staff participants not adequately described (unclear sample size and roles)
Was the recruitment strategy appropriate to the aims of the research?	• Purposive sampling appropriate for aims • Allows for multivocality due to inclusion of family members, nurses, nurse practitioners, physicians, and administrators	• Snowball sampling may have increased risk of individuals self-selecting due to interest in technology • Did not describe why some individuals chose not to take part	• Half-day interviews in face-to-face group setting; described as staff meeting	• Staff participant recruitment strategy not described
Was the data collected in a way that addressed the research issue?	• Focus group method appropriate for exploratory qualitative approach and grounded theory methodology • Setting for data collection was justified • Described planning of single-role focus groups to minimize power differentials in first groups, then planned multirole groups • Described iterative modification of interview guide	• Individual interviews may have elicited more reflective and personal accounts • Observations of nursing staff during transfers not included	• Collecting data at staff meeting with semistructured interview allowed exploration of staff perspectives • Describes how the second interview session was modified to include a questionnaire based on results from first interview sessions	• Did not describe which staff roles were selected for the interview or why • Data saturation not described
Has the relationship between researcher and participants been adequately considered?	• Self-reflexivity noted in data analysis • Researchers critically examined own role and potential bias during analysis phase • Many direct quotes promote authenticity and credibility	• Researcher role and influence not described in creation of research questions and interview guide • Group dynamics between interviewer and participants during the focus group sessions not described	• States that labeling of statements by social science researchers were clearly positioned and had agreement with participants	• Researcher role and influence not described in creation of research questions and interview guide • Group dynamics between interviewer and participants during the group sessions not described
Have ethical issues been taken into consideration?	• Procedural ethics reported such as IRB approval • Informed consent and confidentiality described	• No ethical issues evident	• Received ethical approval • Informed consent described	• No ethical issues evident

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Supplementary Table 2 (*continued*)

CASP Checklist Item	Stephens et al, 2020[34]		Piau et al, 2020[31]	
	Strengths	Weaknesses	Strengths	Weaknesses
Was the data analysis sufficiently rigorous?	• Reflexivity used to address preconceptions and biases • Transparent discussion of limitations and potential for bias from self-selecting to participate due to interest in technology • Constant comparative analysis, line-by-line coding, memo writing, and integrative diagramming techniques described	• Composition of multirole focus groups not reported. Article alluded to complexity of these groups' interactions but were not specifically described. • Potential contradictory responses not reported	• Provides example codes that went into the key themes	• Composition of group interviews not reported • Does not describe whether researcher critically examined their own role or potential bias
Is there a clear statement of findings?	• Theoretical constructs effectively demonstrate findings such as trust, validation, role misunderstanding, remote presence, and "the power of the visual" • Described research team members' regular meetings to reach consensus on codes • Findings thoroughly discussed in relation to original research question	• Respondent validation and member checking not described	• Visualization using SWOT analysis nicely summarizes and presents the data • States that labeling of statements by social science researchers were clearly positioned and had agreement with participants	• States positive impact on NPS but clinical assessments or measurements not explicitly reported
How valuable is the research?	• Timely and significant topic • Paucity of research in nursing home perspectives, especially in regard to telehealth • Transferable findings • Identified new areas for further research	• Authors note limitation of generalizability due to small sample and limited geographic area • Focuses on benefits of technology but concerns and barriers not explored in results	• Provides helpful discussion of the study results in context of previous research • 2 years of field experience produces valuable results	• As described in limitations, only 1 researcher carried out interviews, limits generalizability

CASP, Critical Appraisal Skills Program; IRB, institutional review board; NH, nursing home; NPS, neuropsychiatric symptoms; PLWD, person living with dementia; SWOT, strengths, weaknesses, opportunities, and threats.