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ABSTRACT

Long-Term Care (LTCs) facilities and nursing homes have been an essential part of the healthcare industry to meet the needs of older adults. However, Electronic Medical Records (EMRs/ EHR within LTC facilities and nursing homes have lagged more than in other healthcare sectors. This research analyzed the impact of implementing EMR/EHR and Computerized Decision Support Systems within LTC facilities and nursing homes. In nursing homes and LTC facilities where EMR/EHR has been implemented, patient outcomes improved by reduced pressure ulcers and increased identification of patients at risk for malnutrition and falls. Integration of CDSSs with EMR/EHR improved documentation and prescribing of medicines. Partnerships between large hospital networks and nursing homes/LTC facilities may increase the implementation of these technologies in the latter.

INTRODUCTION

Long-Term Care facilities (LTCs) and nursing homes have been an essential part of the healthcare industry to meet the needs of older adults. As the numbers in this population have continued to increase, it has been critical that LTC providers work effectively with hospitals and providers to deliver quality, coordinated care to these patients (MacTaggart & Thorpe, 2013). Incorporating Health Information Technology (HIT) in healthcare settings has facilitated care coordination between providers and improved patient care quality (Hsiao, King, Hing, & Simon, 2015). However, a significant gap has persisted regarding LTC providers, as many have yet to implement HIT (Ko, Wagner, & Spez, 2018) fully.

The use of HIT and the management of Electronic Medical Records (EMRs) or Electronic Health Records (EHRs) within LTCs and nursing homes has lagged more than in other sectors, mainly because LTCs have not been eligible for incentives under the Meaningful Use program (Kruse et al., 2017). Although LTC providers have not been excluded from eligibility, there has been no funding for implementing HIT in those sectors (MacTaggart & Thorpe, 2013). Other factors contributing to the delay of implementation have included the need for more skilled workers, hurdles surrounding the training of staff, institutional culture, and uncertainty surrounding whether HIT adds value to patient care (Ko et al., 2018).

Despite the benefits to patients and providers, barriers to the widespread use of health information technologies in LTCs have persisted (Kruse, Mileski, Alaytsev, Carol, & Williams, 2015). The most common reason for the lack of implementation has been cost, lack of skilled, computer-literate personnel, resistance to change, and lack of understanding of the benefits (Kruse et al., 2015). Because of the lack of evidence that patient care would be improved with HIT, many facilities have resisted investing in the necessary technical requirements and staff training (Cherry, 2011).

The elderly population has been rapidly increasing, leading to greater demands on the healthcare system (Garza, 2015). Many older adults in LTC have chronic conditions, the management of which could benefit from the use of EMR/EHR and HIT to manage health data (Alexander et al., 2020). LTC residents have been at higher risk for medication prescribing errors and adverse drug reactions, 0.60/100 resident months reported in 1997, which may be improved by technologies such as e-prescribing and EMR/EHR (Wilson, March, & Sambrook, 2010). There has

been an urgent need for increased incorporation of HIT in LTCs and services to address these challenges (Alexander et al., 2020).

In LTCs that have implemented HIT over the past years, nurses using an electronic documenting system for patient records reported that the information was complete, less repetitious, and more legible than conventional documentation (Cherry, Ford, & Peterson, 2011; Munyisia, Yu, & Hailey, 2011). The staff has accessed patients' information more readily, which has generally been more accurate (Cherry et al., 2011). EMR/EHRs systems have helped manage patients in LTC with chronic conditions where multiple caregivers have been involved, and transferability of information has been critical for Care (Shiells, Holmerova, Steffl, & Stepankova, 2019).

Patient care was further enhanced when EMR/EHR was integrated into Computerized Decision Support Systems (CDSSs) (Bail et al., 2022). CDSSs have combined a clinical knowledge base with an individual patient's information to obtain computer-generated suggestions that the provider uses in deciding on that patient's Care or treatment plan (Sutton, Pincock, Baumgart, Sadowski, Fedorak, et al., 2020). CDSSs that have integrated EMR/EHR and computerized provider order entry systems have provided alerts for drug-drug interactions, adverse drug interactions, patient safety, and clinical decision-making (Sutton et al., 2020). The most common cause of adverse drug events in nursing homes has been due to errors in prescribing, 33-40% higher compared to elderly living in the community, and CDSSs in nursing homes have the potential to positively impact patient safety related to prescription drugs (Marasinghe, 2015).

This research analyzed the impact of implementing EMR/EHR and CDSSs within LTCs and nursing homes on patient outcomes.

METHODOLOGY

The hypothesis was that the implementation of CDSSs integrated with EMR/EHR in LTCs and nursing homes has improved patient outcomes as measured by reducing adverse outcomes, including pressure ulcers, falls, and medication errors, and improvements in record keeping and documentation.

The conceptual framework for this research followed the process utilized by Yao, Chu, Li, Yao, et al. (2010). The methodology was a qualitative review of academic literature, followed by analysis and evaluation of relevant literature. Research articles and peer-reviewed literature were identified using Marshall University's PubMed, MEDLINE (EBSCO), Access Medicine, ProQuest research databases, and Google scholar. Keywords used in the search included 'Long Term Care' OR 'nursing home' AND 'computer decision support system' OR 'CDSS' OR 'computerized decision support' OR 'EMR' OR 'EHR' OR 'HIT AND pressure ulcers' OR 'falls' OR 'medication errors' OR 'financial benefit.'The literature search used the PRISMA method (Moher, Liberati, Tetzlaff, Altman, et al., 2009). The search found 385 articles and citations, of which 353 were excluded for not meeting inclusion criteria. Articles included were related to HIT, EMR/EHR, and computer decision support systems in long-term care settings. Articles from other sources were included in the total. Thirty-two articles were reviewed, were limited to English, and were published from 2010 through 2022. Only 18 articles were included in the results section. This search was completed by W.T. and validated by A.C., who acted as the second reviewer and determined if the references met the inclusion criteria.

RESULTS

EMR/EHR Benefits in LTC and nursing homes

Implementation of EHR in LTCs has been associated with increased performance for several quality indicators (Bjarnadottir, Herzig, Travers, Castle, & Stone, 2017). Data from 383 nursing homes were analyzed before and after the implementation of EHRs over a year (Bjarnadottir et al., 2017). In the EHR implementation group, there had been a significantly more significant reduction in patients that had lost weight due to malnutrition (decrease of 1.5% vs. 0.6% in the no HER group), a decrease in patients with UTIs and indwelling catheters (decrease of 2.1% vs. 1.6% in the no HER group). Also, there was a reduction of depressive symptoms in patients (a decrease of 2.4% vs. 1.8% in the no-EHR group) (Bjarnadottir et al., 2017). Nine residential aged-care facilities in Australia cited EMR/EHR implementation as the primary reason for improvements in the quality of patients' records (Zhang, Yu, & Shen, 2012). EHR use was accepted by 87% of staff participants, with 81% reporting increased efficiency in patient documentation, a better understanding of patient's needs, easier identification of patients by staff, and greater awareness of each patient's care plan compared to before implementation (Zhang et al., 2012). Up to date EHRs and having more and higher quality information displayed simultaneously on the screen allowed better and faster

communication both internally and with providers from other facilities (Zhang et al., 2012). Furthermore, 52.7% of staff participants in the study had cited quicker access to data as one of the top benefits of EHR implementation, followed by easier data entry (39.1%), easy access to patient HER (35.4%), and improved record format (26.4%) (Zhang et al., 2012).

Thirteen nursing homes in California with centralized EMR/EHR assessed the effectiveness of using the data to predict fall risk for nursing home residents (Marier, Olsho, Rhodes, & Spector, 2016). There had been a 13% improvement in projected fall risk compared to predictions made using the Minimum Data Set (MDS), an assessment tool commonly used for Medicare residents of U.S. nursing homes, likely due to more rapid updating of data in the EMR (Marier et al., 2016).

Computerized decision support systems (CDSSs) in LTC and nursing homes

A CDSS module designed to prevent and treat pressure ulcers and malnutrition has been integrated into the EHRs of 15 nursing homes in Norway (Fossum, Ehnfors, Fruhling, & Ehrenberg, 2011). In that study, nursing personnel using the CDSS system found that patient documentation was complete compared to the perceptions of personnel not using the system (Fossum et al., 2011). Nursing personnel that had used the system to plan the care for patients at risk for pressure ulcers and malnutrition had reported an increase in their awareness of patients requiring nutritional interventions. It was also felt that they were more focused on patient documentation than those who had used standard, non-computerized protocols (Fossum et al., 2011). When CDSS implementation was combined with education and training for nurses, there was an even more significant improvement in the documentation of pressure ulcer assessment, an increase from 25% to 88% (Fossum, Ehnfors, Svensson, Hansen, & Ehrenbe, 2013).

A nursing home and senior living facility implementing a Pressure Ulcer Prevention Program (PUPP) had a 67% reduction in the development of pressure ulcers among residents and cost savings of $798 per resident at risk (Shannon, Brown, & Chakravarthy, 2012). PUPP is a strategic product bundle with decision algorithms developed from the MDS 2.0 Resident Assessment Scores. It provides decision-making capabilities for preventing or reducing pressure ulcers and incontinence-associated skin conditions (Shannon et al., 2012). A similar CDSS program called Pre-vPlan had been used in a nursing home in Belgium to prepare pressure ulcer prevention protocols specifically tailored to individual patients (Beeckman et al., 2013). There had been a somewhat lower prevalence of pressure ulcers in the intervention group of patients compared to those patients cared for by staff using the paper-based standard pressure ulcer prevention protocols (Beeckman et al., 2013). Implementing the CDSS system in that nursing home had only modestly improved how well staff adhered to prevention protocols and had not significantly increased the staff's knowledge levels (Beeckman et al., 2013). The addition of a patient monitoring system in a 120-bed nursing home in the form of a sensor worn on the residents that transmitted data to the nurse's station coupled with a computerized repositioning standard protocol had resulted in higher rates of compliance to established prevention protocols (Yap, Kennerly, & Ly, 2019).

Twelve nursing homes in New York had implemented a CDSS called On-Time Quality Improvement, which included a module for pressure ulcer management that had previously been demonstrated to reduce pressure ulcers (Olsho et al., 2014). The On-Time CDS intervention had been integrated with EHRs and included risk reports with modules to reduce pressure ulcers, falls, and hospitalizations (Oshlo et al., 2014). After one month of using the On-Time system, the incidence of pressure ulcers had decreased by 59% (Oshlo et al., 2014). All twelve nursing homes have used EHRs for patients since 2009 (Oshlo et al., 2014). Fourteen nursing homes in Washington D.C. that had implemented the On-Time Quality Improvement program for pressure ulcer prevention had also determined that in addition to the integration with EHRs, other factors that were important for success included the presence of in-house dietitians, high-level participation by top administrators, and the facility is open to change (Sharkey et al., 2013). However, in another study, in nursing homes that had implemented the On-time CDS program for pressure ulcer prevention, only a 0.09% average decrease in pressure ulcers was observed compared to the control groups (Davidson et al., 2019). A subset of 13 nursing homes had averaged a 3.2 % reduction in pressure ulcers. However, the reduction was not attributable to participation in the On-time CDS program but to other quality initiatives (Davidson et al., 2019).

Medication management in LTC

In a study comparing the reporting of Drug Related Problems (DRP) for patients in nursing homes in Sweden, the CDSS system identified significantly more potential DRPs than did nurses. For 54 patients, CDSSs reported 205 DRPs compared to 86 reported by nurses (Johansson-Pajala, Martin, & Jorsäter, 2018). These included

Adverse Drug Reactions (ADRs) (57 reported by nurses vs. 142 by CDSS), drug-drug interactions (11 reported by nurses vs. 42 by CDSS), inappropriate drugs (11 reported by nurses vs. 9 by CDSS), and drug duplication (7 reported by nurses vs. 12 by CDSS) (Johansson-pajama et al., 2018). A pilot program to implement CDSS to generate physician alerts for prescribing has been tested in nursing homes in Canada (Kennedy, Campbell, Garg, Dolovich, Stroud, et al., 2011). The program involved a partnership with a consultant pharmacist using CDSS to generate physician alerts for prescribing drugs to patients with renal impairment. In addition, physicians had a high acceptance rate, and 70% of physicians responded, resulting in the discontinuation of medicines or dose changes (Kennedy et al., 2011).

In a nursing home in Australia, the implementation of an electronic prescribing and medication management system (ePMMS) resulted in 25.9% of medications ordered by general practitioners and 74.1% of medicines ordered by pharmacists utilizing the system and a reduction in paper-based ordering/administration of medications (Elliott, Lee, & Hussainy, 2016). This ePMMS has improved patient safety and allowed providers to modify patient medication information remotely (Elliott et al., 2016). Users had reported that CDSS was helpful when data processing was required, especially for changing patients' medications (Zhu et al., 2017).

Financial Benefits of CDSS in LTC

Financial benefits have also been realized by nursing homes that have implemented CDSSs. Canadian nursing homes using EMRs integrated with CDSSs to monitor the care of patients with renal insufficiency had experienced a 7.6% annual cost savings for prescription drugs (Subramanian et al., 2012). Although cost savings were minimal, they may have been greater if prevention of adverse drug events had been factored into the results (Subramanian et al., 2012). Implementing PUPP for pressure ulcer prevention resulted in a $798 cost savings per at-risk resident over six months (Shannon et al., 2012).

CMS Quality Reporting for LTC

The Long-Term Care Hospital (LTCH) Quality Reporting Program (QRP) creates LTCH quality reporting requirements, as mandated by Section 3004(a) of the Patient Protection and Affordable Care Act (ACA) of 2010. By October 1, CMS has published the quality measures LTCHs must report every year. (CMS, 2022.)

The Improving Medicare Post-Acute Care Transformation Act of 2014 (IMPACT Act) added section 1899B to the Social Security Act (SSA). It required reporting standardized patient assessment data about quality measures and standardized patient assessment data elements. The Act required submitting data about quality measures, resource use, and other domains. In addition, the IMPACT Act required assessment data to be standardized and interoperable to allow for data exchange among post-acute providers and other providers. The IMPACT Act was intended for standardized post-acute care data to improve Medicare beneficiary outcomes through shared decision-making, care coordination, and enhanced discharge planning. (CMS, 2021) Starting in 2014 and each subsequent year after, any LTCH not submitting quality data has been subject to a 2%-point reduction in the yearly Annual Payment Update (CMS, 2021).

The Quality Measure Domains as part of the IMPACT Act of 2014 included Skin integrity and changes in skin integrity (pressure ulcers), Medication reconciliation, Incidence of major falls, and Transfer of health information and care preferences when an individual transitions. (CMS, 2021).

DISCUSSION

The purpose of this research has been to determine the impact the implementation of EMR/EHR and CDSSs had on patient outcomes in LTCs and nursing homes. The hypothesis was that implementing these health information technologies in LTCs, and nursing homes has patient outcomes patients as determined by a reduction of pressure ulcers, falls, and adverse drug events. The findings have supported this hypothesis, showing improved patient outcomes where these technologies have been implemented.

Findings

Implementation of EHRs in nursing homes resulted in a 1.5% decrease in patients that had lost weight, a 2.1% decrease in patients with UTIs and indwelling catheters, and a 2.4% reduction in patients with depressive symptoms (Bjarnadottir et al., 2017). The use of EMRs to predict patients in nursing homes at risk for falls showed a 13%

improvement (Marier et al., 2016). EMR/EHRs used with CDSSs improved pressure ulcer assessment from 25% to 88% (Fossum et al., 2013). Nursing homes using the Pressure Ulcer Prevention Program (PUPP) realized a 67% reduction in the development of pressure ulcers among patients and a cost savings of $798 per resident (Shannon et al., 2012). Implementing the On-time quality improvement program resulted in a 59% decrease in pressure ulcers (Olsho et al., 2014).

CDSSs used in nursing homes to monitor and alter patients' medications resulted in more effective reporting of DRPs, with 205 reported by CDSSs compared to 86 reported by nurses (Johansson-Pajala et al., 2018). In a nursing home utilizing ePMMS, 74.1% of medications for patients were ordered by pharmacists and 25.9% by general practitioners (Elliott et al., 2016).

Implications for improved patient outcomes

Information sharing contributes to the effective coordination of care between different healthcare entities across a patient's care continuum and improves the quality of care. Nursing homes and LTCs that have implemented EMR/EHR and CDSSs have shown improvements in patient outcomes, although usage of these technologies has yet to be widespread throughout long-term care.

Nursing homes and LTCs that are hospital-associated or part of a more extensive network of healthcare organizations would have greater access to the electronic resources of those facilities. A report from the Regenstrief Institute and Indiana University outlined how meaningful partnerships between nursing homes and hospitals lead to better care for residents of LTCs. Data sharing was a significant benefit (*Partnerships with health systems can support nursing homes during a pandemic,* 2020). For example, The University of Washington medical center, which has a meaningful partnership between acute care hospitals and nursing homes, provided improved care for patients in LTC during the COVID-19 pandemic. Also, the success of these partnerships relies on nursing facilities being willing to adopt software and other tools to report data and track patient metrics (Unroe & Vest, 2020). The COVID-19 pandemic highlighted the importance of nursing homes utilizing electronic health records and linking these data with health information exchange networks (Unroe, 2021). This close collaboration and established relationship between acute care hospitals and nursing homes facilitated information exchange, leading to better patient outcomes.

Limitations of the study

As the research was limited to publications within the last ten years, the number of references needed to be increased. The narrow research topic further limited the available studies. Other limitations included the search strategy, number of databases, keywords, and the English language. The background and prior knowledge of the researcher could also introduce bias. Further research is needed in this area to expand the pool of studies.

Practical Applications/Future directions

The research demonstrates the need for more widespread adoption and implementation of EMR/EHR and CDSSs in LTCs and nursing homes to improve the quality of patient care. Incentives may lead to more widespread use of HIT in these sectors. Establishing formal partnerships with hospitals may also lead to the increased usage of health information technologies in nursing homes and increased interoperability ((hcomiskey@himss.org, 2021).

CONCLUSION

LTCs and nursing homes that have implemented EMR/EHR integrated into CDSSs have experienced improved patient outcomes, including decreased pressure ulcers, identification of fall risk, and reduction in adverse drug events. These results highlight the benefits of implementing these health information technologies to improve patient outcomes in long-term care settings.

REFERENCES

1. Alexander, G. L., Georgiou, A., Doughty, K., Hornblow, A., Livingstone, A., Dougherty, M., Jacobs, S., & Fisk, M. J. (2020). Advancing health information technology roadmaps in long-term care. International journal of medical informatics, p. 136, 104088. https://doi.org/10.1016/j.ijmedinf.2020.104088
2. Bail, K., Gibson, D., Acharya, P., Blackburn, J., Kaak, V., Kozlovski, M., Turner, M., & Redley, B. (2022). Using health information technology in residential aged care homes: An integrative review to identify service and quality outcomes. International journal of medical informatics, p. 165, 104824. https://doi.org/10.1016/j.ijmedinf.2022.104824
3. Beeckman, D., Clays, E., Van Hecke, A., Vanderwee, K., Schoonhoven, L., & Verhaeghe, S. (2013). A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial. *International journal of nursing studies*, *50*(4), 475–486. https://doi.org/10.1016/j.ijnurstu.2012.09.007
4. Bjarnadottir, R. I., Herzig, C., Travers, J. L., Castle, N. G., & Stone, P. W. (2017). Implementation of Electronic Health Records in U.S. Nursing Homes. Computers, informatics, nursing: CIN, 35(8), 417–424. https://doi.org/10.1097/CIN.0000000000000344
5. Centers for Medicare & Medicaid Services *(CMS)*. (December 1, 2021). *IMPACT Act of 2014 Data Standardization & Cross Setting Measures* Centers for Medicare & Medicaid Services. Retrieved January 23, 2023, from https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Post-Acute-Care-Quality-Initiatives/IMPACT-Act-of-2014/IMPACT-Act-of-2014-Data-Standardization-and-Cross-Setting-Measures.
6. Centers for Medicare & Medicaid Services. (*CMS)*. (2022). Centers for Medicare & Medicaid Services. Retrieved January 23, 2023, from https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments/ltch-quality-reporting.
7. Cherry B. (2011). Assessing organizational readiness for electronic health record adoption in long-term care facilities. *Journal of gerontological nursing*, *37*(10), 14–19. https://doi.org/10.3928/00989134-20110831-06
8. Cherry, B. J., Ford, E. W., & Peterson, L. T. (2011). Experiences with electronic health records: early adopters in long-term care facilities. Health care management review, 36(3), 265–274. https://doi.org/10.1097/HMR.0b013e31820e110f
9. Davidson, C., Loganathan, S., Bishop, L., Imhoff, L., Gerzofsky, L., Spector, W., & Konetzka, R. T. (2019). Scalability of an I.T. Intervention to Prevent Pressure Ulcers in Nursing Homes. Journal of the American Medical Directors Association, 20(7), 816–821.e2. https://doi.org/10.1016/j.jamda.2019.02.008
10. Elliott, R. A., Lee, C. Y., & Hussainy, S. Y. (2016). Electronic Prescribing and Medication Management at a Residential Aged Care Facility: Uptake by General Practitioners and Qualitative Evaluation of the Benefits and Barriers. Applied clinical informatics, 7(1), 116–127. https://doi.org/10.4338/ACI-2015-08-RA-0098
11. Fossum, M., Ehnfors, M., Fruhling, A., & Ehrenberg, A. (2011). An evaluation of the usability of a computerized decision support system for nursing homes. Applied clinical informatics, 2(4), 420–436. https://doi.org/10.4338/ACI-2011-07-RA-0043
12. Fossum, M., Ehnfors, M., Svensson, E., Hansen, L. M., & Ehrenberg, A. (2013). Effects of a computerized decision support system on care planning for pressure ulcers and malnutrition in nursing homes: an intervention study. International journal of medical informatics, 82(10), 911–921. https://doi.org/10.1016/j.ijmedinf.2013.05.009
13. Garza, A. (2015). The Aging Population: The Increasing Effects on Health Care. Pharmacy times. https://www.pharmacytimes.com/view/the-aging-population-the-increasing-effects-on-health-care
14. hcomiskey@himss.org. (2021, March 30). *Sharing Data Across the Care Continuum: Perspectives from Long-Term and Post-Acute Care Case Studies*. HIMSS. Retrieved November 11, 2022, from https://www.himss.org/resources/sharing-data-across-care-continuum-perspectives-long-term-and-post-acute-care
15. Hsiao, C. J., King, J., Hing, E., & Simon, A. E. (2015). The role of health information technology in Care coordination in the United States. Medical Care, 53(2), 184–190. https://doi.org/10.1097/MLR.0000000000000276

16. Johansson-Pajala, R. M., Martin, L., & Jorsäter Blomgren, K. (2018). Registered nurses' use of computerized decision support in medication reviews. International journal of health care quality assurance, 31(6), 531–544. https://doi.org/10.1108/IJHCQA-01-2017-0009
17. Kennedy, C. C., Campbell, G., Garg, A. X., Dolovich, L., Stroud, J. B., McCallum, R. E., & Papaioannou, A. (2011). Piloting a renal drug alert system for prescribing to residents in long-term care. Journal of the American Geriatrics Society, 59(9), 1757–1759. https://doi.org/10.1111/j.1532-5415.2011.03565.x
18. Ko, M., Wagner, L., & Spetz, J. (2018). Nursing Home Implementation of Health Information Technology: Review of the Literature Finds Inadequate Investment in Preparation, Infrastructure, and Training. Inquiry, 55, 46958018778902. https://doi.org/10.1177/0046958018778902
19. Kruse, C. S., Mileski, M., Alaytsev, V., Carol, E., & Williams, A. (2015). Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ open*, *5*(1), e006615. https://doi.org/10.1136/bmjopen-2014-006615
20. Kruse, C. S., Mileski, M., Vijaykumar, A. G., Viswanathan, S. V., Suskandla, U., & Chidambaram, Y. (2017). Impact of Electronic Health Records on Long-Term Care Facilities: Systematic Review. JMIR medical informatics, 5(3), e35. https://doi.org/10.2196/medinform.7958
21. MacTaggart, P., & Thorpe, J. H. (2013). Long-term care and health information technology: opportunities and responsibilities for long-term and post-acute care providers. *Perspectives in health information management*, *10*(Fall), 1e.
22. Marasinghe K. M. (2015). Computerized clinical decision support systems to improve medication safety in long-term care homes: a systematic review. BMJ open, 5(5), e006539. https://doi.org/10.1136/bmjope2015)n-2014-006539
23. Marier, A., Olsho, L. E., Rhodes, W., & Spector, W. D. (2016). Improving prediction of fall risk among nursing home residents using electronic medical records. Journal of the American Medical Informatics Association: JAMIA, 23(2), 276–282. https://doi.org/10.1093/jamia/ocv061
24. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and meta-analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal. pmed1000097
25. Munyisia, E. N., Yu, P., & Hailey, D. (2011). The changes in caregivers' perceptions about the quality of information and benefits of nursing documentation associated with the introduction of an electronic documentation system in a nursing home. International journal of medical informatics, 80(2), 116–126. https://doi.org/10.1016/j.ijmedinf.2010.10.011
26. Olsho, L. E., Spector, W. D., Williams, C. S., Rhodes, W., Fink, R. V., Limcangco, R., & Hurd, D. (2014). Evaluation of AHRQ's on-time pressure ulcer prevention program: a facilitator-assisted clinical decision support intervention for nursing homes. *Medical Care*, *52*(3), 258–266. https://doi.org/10.1097/MLR.0000000000000080
27. *Partnerships with health systems can provide support to nursing homes during a pandemic*. (2020, July 13) Regenstrief Institute. Retrieved November 11, 2022, from https://www.regenstrief.org/article/health-systems-partnerships-support-nursing-homes/
28. Shannon, R. J., Brown, L., & Chakravarthy, D. (2012). Pressure Ulcer Prevention Program Study: a randomized, controlled prospective comparative value evaluation of 2 pressure ulcer prevention strategies in nursing and rehabilitation centers. *Advances in skin & wound care*, *25*(10), 450–464. https://doi.org/10.1097/01.ASW.0000421461.21773.32
29. Sharkey, S., Hudak, S., Horn, S. D., Barrett, R., Spector, W., & Limcangco, R. (2013). Exploratory study of nursing home factors associated with successful implementation of clinical decision support tools for pressure ulcer prevention. Advances in skin & wound care, 26(2), 83–p.94. https://doi.org/10.1097/01.ASW.0000426718.59326.bb
30. Shiells, K., Holmerova, I., Steffl, M., & Stepankova, O. (2019). Electronic patient records as a tool to facilitate care provision in nursing homes: an integrative review. Informatics for health & social care, 44(3), 262–277. https://doi.org/10.1080/17538157.2018.1496091
31. Subramanian, S., Hoover, S., Wagner, J. L., Donovan, J. L., Kanaan, A. O., Rochon, P. A., Gurwitz, J. H., & Field, T. S. (2012). Immediate financial impact of computerized clinical decision support for long-term care residents with renal insufficiency: a case study. Journal of the American Medical Informatics Association: JAMIA, 19(3), 439–442. https://doi.org/10.1136/amiajnl-2011-000179
32. Sutton, R.T., Pincock, D., Baumgart, D.C., Sadowski, D.C., Fedorak, R.N., Kroeker, K.I. (2020). An overview of clinical decision support systems: benefits, risks, and strategies for success. 3, 17. https://doi.org/10.1038/s41746-020-0221-y

33. Unroe, K.T. (2021). The Pandemic Creates Urgency Around Designing Health System Support Structures for Nursing Homes. J Am Geriatric Soc, 69: 18-19. https://doi.org/10.1111/jgs.16916
34. Unroe, K.T., & Vest, J. (2020). Time to Leverage Health System Collaborations: Supporting Nursing Facilities Through the COVID-19 Pandemic. J Am Geriatric Soc, 68: 1129-1130. https://doi.org/10.1111/jgs.16540
35. Wilson, N. M., March, L. M., Sambrook, P. N., & Hilmer, S. N. (2010). Medication safety in residential aged-care facilities: a perspective. *Therapeutic advances in drug safety*, *1*(1), 11–20. https://doi.org/10.1177/2042098610381418
36. Yao W., Chu C. H., Li Z. "The Use of RFID in Healthcare: Benefits and Barriers." In Proceedings of 2010 IEEE International Conference on RFID-Technology and Applications (RFID-TA). IEEE, 2010, 128–34.
37. Yap, T. L., Kennerly, S. M., & Ly, K. (2019). Pressure Injury Prevention: Outcomes and Challenges to Use of Resident Monitoring Technology in a Nursing Home. Journal of wound, ostomy, and continence nursing, 46(3), 207–213. https://doi.org/10.1097/WON.0000000000000523
38. Zhang, Y., Yu, P., & Shen, J. (2012). The benefits of introducing electronic health records in residential aged care facilities: a multiple case study. *International journal of medical informatics*, *81*(10), 690–704. https://doi.org/10.1016/j.ijmedinf.2012.05.013
39. Zhu, W., Luo, L., Jain, T., Boxer, R. S., Cui, L., & Zhang, G. Q. (2017). DCDS: A Real-time Data Capture and Personalized Decision Support System for Heart Failure Patients in Skilled Nursing Facilities. AMIA ... Annual Symposium proceedings. AMIA Symposium, 2016, pp. 2100–2109.