

Global systematic review of homecare patient safety models: Implications for resource-limited settings

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Abstract. Homecare services have become an important component of modern healthcare systems, including in tropical and resource-limited settings. However, the shift from hospital-based care to home-based care presents significant challenges related to patient safety. This systematic review aims to provide evidence related to effective findings in improving patient safety in homecare services with a focus on the role of caregivers, medication management, and the prevention of adverse events. A comprehensive Scopus search covering the period 2015–2025 yielded 41 eligible articles published between 2015 and 2024, which were synthesized following the PRISMA guidelines. The review revealed three main themes: the central role of patients and caregivers in creating safety; key operational domains of patient safety in home and outpatient settings; and innovative models and technologies to improve patient safety. Another key finding was the dominance of custom digital applications over standard analysis software indicating a shift toward practical user-centered solutions. Theoretical frameworks such as the Chronic Care Model, Complex Adaptive Systems, and Patient and Family Engagement Theory provided conceptual foundations for the reviewed interventions. The findings of this study underscore the importance of collaborative, adaptive, and contextual approaches in improving patient safety in homecare services, particularly in tropical regions.

Keywords: patient safety, homecare, tropical regions

Introduction

Home healthcare has become increasingly popular in recent years and is one of the directions of modern healthcare systems. However, this trend has brought significant challenges in the context of patient safety. Studies show that 71.6% of unexpected events in home healthcare can be prevented with the most common incidents being infections, falls, and pressure ulcers (Schildmeijer et al., 2018). The complexity of the issue is not only due to systemic factors but is also greatly influenced by human factors. Incident reports in outpatient services reveal that patient and caregiver factors such as the patient's disability status, compliance behavior, and limited health literacy are the primary contributors to adverse events (Sharma et al., 2021). It is important to emphasize that patients and caregivers play an active role in determining patient safety dynamics.

One of the most critical domains in patient safety at home is medication management especially for vulnerable populations such as the elderly. Medication safety is not solely the responsibility of individuals but involves families and healthcare professionals such as community pharmacists who play a key role in building relationships and mediating the necessary interactions to ensure safe medication use at home, highlighting the importance of a collaborative approach to reduce medication-related risks (Collier et al., 2023).

Patient safety in home healthcare is considerably more complex when examined across the distinct yet interrelated dimensions of resource-limited and tropical settings. In this context, resource-limited settings refer to structural constraints within the health system, including shortages of visiting healthcare professionals, fragile primary care referral mechanisms, and limited availability of essential clinical supplies. Under such circumstances, simplified and decentralized models of healthcare delivery, such as the SPEEDI initiative in Tanzania, have demonstrated that task-shifting and the implementation of standardized care protocols can help maintain clinical outcomes despite substantial resource constraints (Bacha et al., 2018). By contrast, tropical settings are characterized by specific bioclimatic and epidemiological conditions that pose additional challenges to the safety of home-based care. Elevated ambient temperatures and high humidity may compromise the physical and chemical stability of pharmaceuticals stored in households, particularly heat-sensitive medications and biologic products, especially where domestic refrigeration capacity and cold-chain reliability are inadequate. Moreover, the high prevalence of endemic infectious diseases, together with increased environmental exposure, may further elevate the risk of secondary infections and other complications during home-based clinical procedures, including catheter management and wound care. When structural resource limitations intersect with the environmental and epidemiological challenges of tropical settings, informal family caregivers may be disproportionately required to undertake complex clinical tasks with limited professional supervision, thereby substantially increasing the risk of preventable adverse events.

Although the existing literature has extensively examined patient safety frameworks in acute hospital settings and well-resourced home healthcare systems in high-income countries, a substantial evidence gap remains concerning the applicability and transferability of these frameworks to resource-constrained and tropical environments. Many established home healthcare models implicitly assume the availability of regular home-visiting healthcare professionals, interoperable electronic health records, and reliable household infrastructure—conditions that are frequently unavailable or inconsistently maintained in low-resource and tropical settings. Consequently, the extent to which fundamental components of homecare patient safety, including caregiver capacity-building and clinical empowerment, interprofessional communication, and systematic adverse event surveillance, can be effectively and sustainably implemented under such constraints remains poorly understood. Addressing this gap requires greater attention to the contextual, organizational, and environmental factors that shape the implementation of patient safety practices beyond conventional healthcare infrastructures. Therefore, this systematic literature review aims to synthesize the global evidence on patient safety models in home healthcare, critically examine their underlying mechanisms and theoretical foundations, and identify key gaps in the existing literature. The findings are expected to provide an evidence base for the development of contextually appropriate and sustainable patient safety interventions tailored to the specific challenges of tropical and resource-limited settings.

Methods

Study Design and Search Protocol

This systematic literature review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines using Watase Uake Tools, a semi-automated systematic literature review mining and extraction tool. The software executes direct API queries to the **Scopus** database to retrieve, filter, and structure bibliometric

and thematic data. Scopus was selected as the sole database for this review because of its multidisciplinary coverage across nursing, patient safety, and healthcare systems, as well as its complete indexing of MEDLINE records.

Search Strategy and Automation Parameters

The literature search within the *Watase Uake* system was executed using three primary targeted keyword clusters:

1. "Homecare Patient Safety Caregiver"
2. "Home Nursing Medication Safety Caregiver"
3. "Outpatient care Patient Safety Caregiver"

The software automatically queried these terms across the Title, Abstract, and Keywords (TITLE-ABS-KEY) fields. Pre-screening filter parameters built into the tool were configured as follows:

1. Publication timeframe: Articles published between 2015 and 2025 (with all eligible synthesized articles identified between 2015 and 2024).
2. Quality Benchmark: Scopus-indexed original research articles across Quartiles 1 to 4 (Q1–Q4).
3. Document Format: Peer-reviewed original empirical studies with complete abstracts.

Eligibility and Screening Process

Non-research documents (e.g., editorial commentaries, letters, conference proceedings, narrative reviews, and systematic reviews) and records lacking full abstracts were automatically excluded during the initial software pipeline. The remaining articles underwent full-text retrieval and qualitative eligibility assessment according to the study's thematic scope on patient safety models, caregiver participation, and medication management in homecare settings.

Data Extraction and Thematic Synthesis

Qualitative thematic synthesis was conducted to categorize findings from the 41 included studies into coherent domains. Two reviewers independently coded the extracted study findings using inductive and deductive content analysis. Studies could be assigned multiple codes across different domains if they reported multi-component interventions. The identified codes were clustered into three overarching thematic areas and subsequent sub-themes. Percentages presented for each sub-theme represent the relative proportion of thematic coding occurrences within that specific overarching theme (where the denominator equals the total number of coded units mapped within that theme domain), providing a standardized metric of relative literature weight. Any coding discrepancies between reviewers were discussed and resolved through consensus.

Results and Discussion

The selection and screening workflow for this systematic review was conducted following the PRISMA guidelines and executed through Watase Uake Tools. The initial database search identified 285 records from Scopus. Prior to formal screening, 95 records were removed using automated system filters: 70 records were published outside the specified timeframe (2015–2025), 8 records were unranked or non-quartile indexed sources (failing to meet the Scopus Q1–Q4 peer-reviewed indexing benchmark), and 17 records lacked complete



abstracts. Consequently, a total of 190 records underwent title and abstract screening. Of these, 46 records were excluded due to topical irrelevance, leaving 144 reports sought for full-text retrieval. Access limitations prevented the retrieval of 80 reports, resulting in 64 articles assessed for full-text eligibility. Following full-text evaluation against the methodological and contextual inclusion/exclusion criteria, 23 articles were further excluded (primarily for focusing solely on hospital inpatient settings without outpatient/homecare components or being secondary literature). Ultimately, 41 empirical studies met all eligibility criteria and were included in the final qualitative synthesis. The detailed study selection process is illustrated in Figure 1.

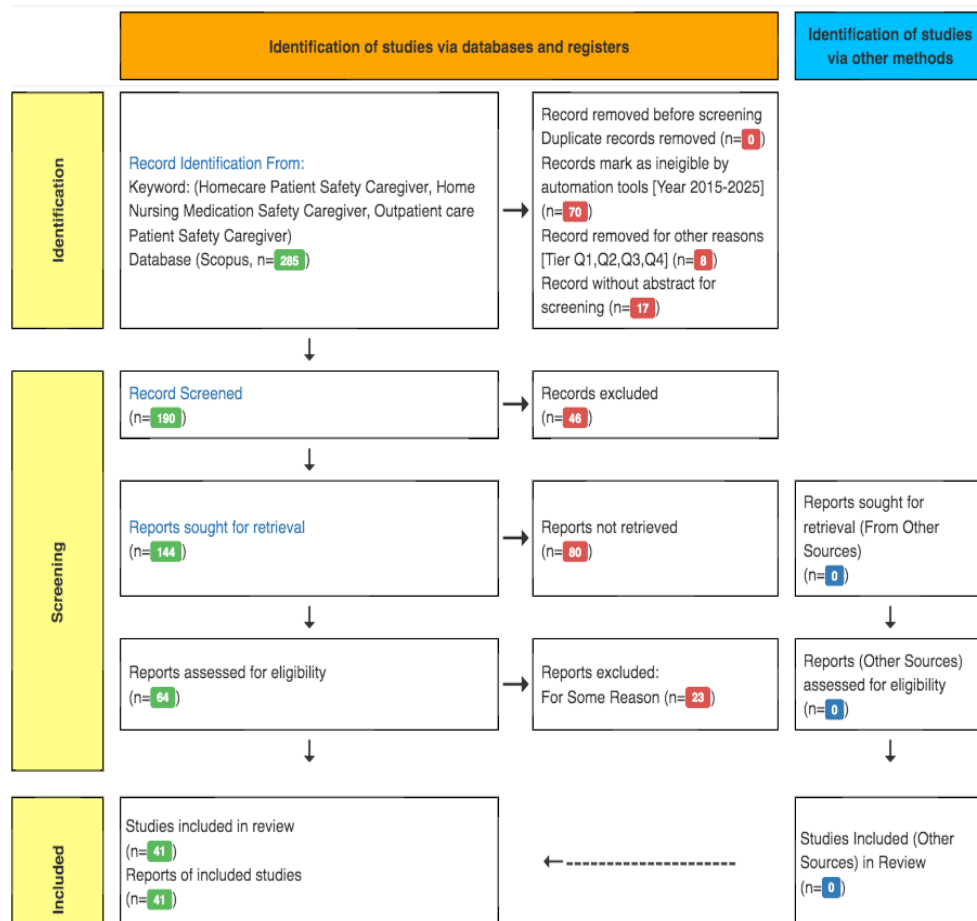


Figure 1. Prisma Diagram

The database search covered publications from 2015 up to early 2025. However, all eligible articles included in the final synthesis were published between 2015 and 2024 ($n = 41$), as no studies published in 2025 met the inclusion criteria ($n = 0$).

Year Article

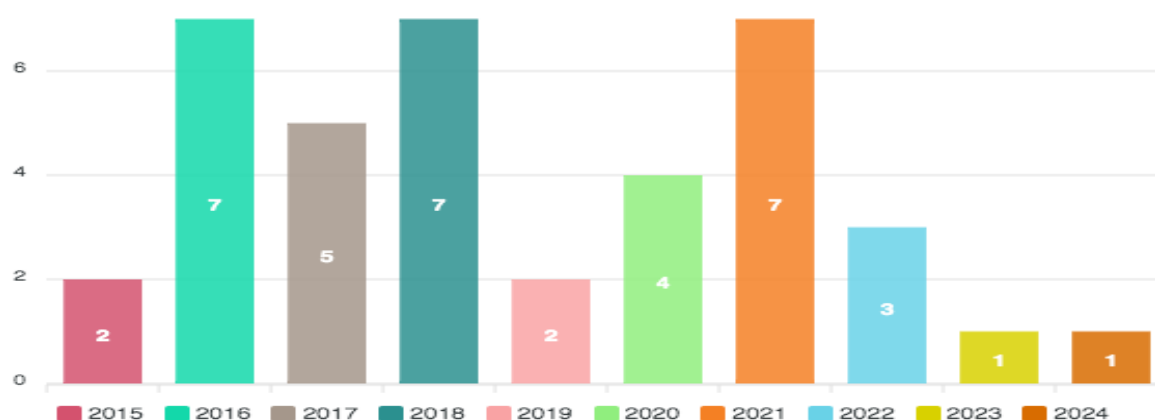


Figure 2. Year Article Classification

The articles identified and analyzed in this study were published between 2015 and 2024. The peak of publications occurred in 2016, 2018 and 2021. The surge in 2021 was due to the COVID-19 pandemic response which caused patient safety issues in homecare services to receive significant attention (Chew et al., 2021; Harrison et al., 2021; Hertzum, 2021; DRKS., 2020; Licchetta et al., 2021; Nasrallah et al., 2021). However, spikes also occurred in 2016 and 2018. The year 2016 marked the beginning of a paradigm shift from a centralized system (hospitals) to a more decentralized system (homecare) and the consolidation of theoretical models in home-based patient management such as *the chronic care model* and *lean management* (Abuhejleh et al., 2016; Clemmons and Anderegg., 2017; Mazzo et al., 2016; Mujal et al., 2016; Park et al 2016; Rasschaert et al., 2016; Van et al., 2016). Meanwhile, 2018 was a period when various homecare interventions began to be implemented and empirically tested thereby impacting caregiver education, integrated home visits, and home-based patient safety program evaluations which are highly relevant for tropical regions facing resource and infrastructure constraints (Berrevoets et al., 2018; Boustani et al., 2018; Fleisher et al., 2018; Hari et al., 2018; Sanroma et al., 2018; Wysocki et al., 2018).

Country

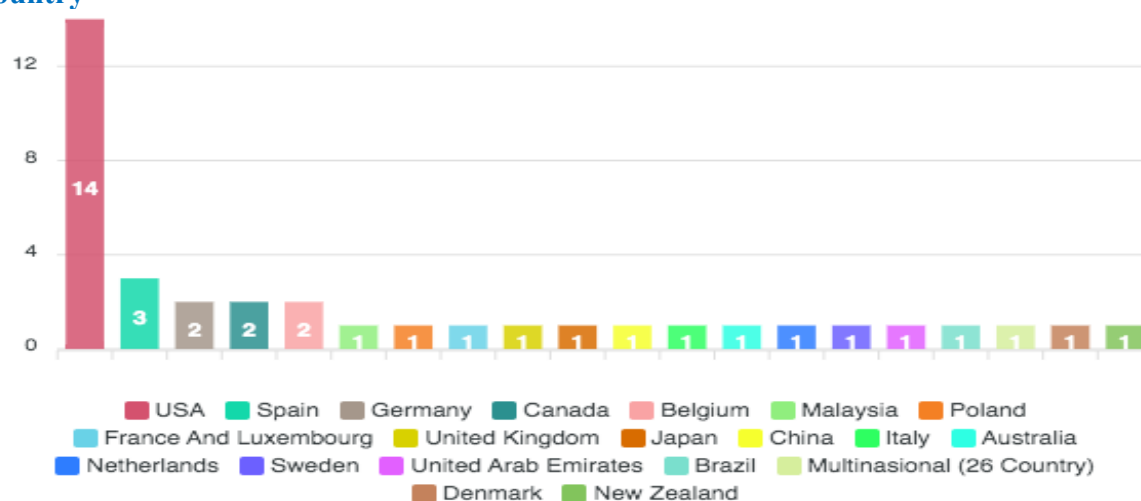


Figure 3. Country Classification

The reviewed articles originated from various countries with the largest contributions coming from the United States followed by countries such as Spain, Germany, Canada, and Belgium. However, there is a publication gap from tropical countries particularly in Asia and Africa (Chew et al., 2021; Abuhejleh et al., 2016; Feng et al., 2024). This indicates a research gap and the importance of developing research directions toward tropical regions as environmental challenges such as climate, endemic infections, and limited access to healthcare facilities influence patient safety dynamics in homecare services.

The geographic distribution of the 41 synthesized studies demonstrates a pronounced concentration of evidence on home healthcare patient safety in high-income Western countries, with the United States contributing the largest proportion of studies ($n = 14$), followed by Spain ($n = 3$), Germany ($n = 2$), Canada ($n = 2$), and Belgium ($n = 2$). In contrast, representation from low- and middle-income countries in Asia and Africa remains markedly limited within the retrieved body of literature, with countries such as Malaysia, Brazil, China, and the United Arab Emirates represented by only isolated studies. Although this geographic imbalance may partly reflect the search strategy and indexing characteristics of the Scopus database, it nevertheless underscores a substantial contextual evidence gap: existing home healthcare patient safety models have predominantly been conceptualized, implemented, and evaluated within well-resourced and highly institutionalized healthcare systems. As a result, the direct applicability and transferability of these models to tropical and resource-constrained settings remain highly uncertain. Many interventions developed in high-income contexts implicitly assume the availability of stable digital telemonitoring infrastructure, integrated multidisciplinary home-visiting teams, and controlled indoor environmental conditions. Such assumptions are often difficult to sustain in tropical and resource-limited settings, where patient safety challenges are further intensified by high ambient temperatures and humidity, a substantial burden of endemic infectious diseases, limited healthcare infrastructure, and considerable reliance on informal family caregivers who may have limited clinical training. These contextual disparities highlight the need for patient safety frameworks that are not merely transplanted from high-income settings but are systematically adapted to the environmental, structural, and sociocultural realities of tropical and resource-constrained home healthcare environments.

Software

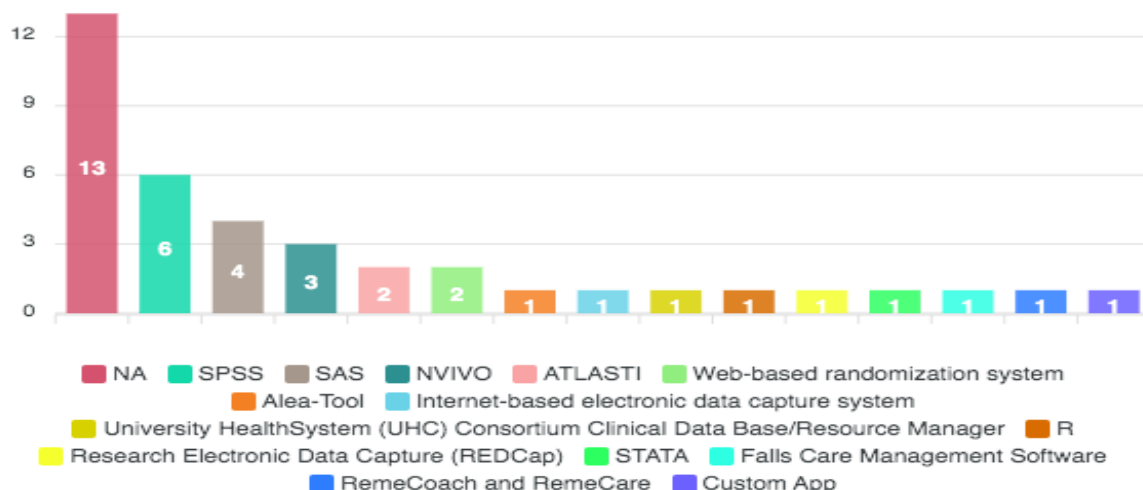


Figure 4. Software Classification

The distribution of software reported across the reviewed studies reflects both analytical approaches and the adoption of digital health tools in homecare patient safety research (Figure

4). For data processing and empirical evaluation, studies utilized standard quantitative statistical packages such as SPSS (n = 6), SAS (n = 4), STATA (n = 1), and R (n = 1) to analyze incident rates and clinical outcomes, alongside qualitative analysis software such as NVivo (n = 3) and ATLAS.ti (n = 2) to examine caregiver experiences and communication barriers. In parallel, several studies deployed specialized digital platforms, electronic data capture systems (e.g., REDCap, Alea-Tool), and direct patient/caregiver intervention software (such as RemeCoach/RemeCare, Falls Care Management Software, and tailored Custom Apps) to facilitate remote monitoring, medication reconciliation, and adverse event reporting in home environments. Importantly, the "NA" (Not Available) category comprised the largest single group (n = 13). Rather than representing technological innovation, this category reflects studies that relied on manual data analysis methods (e.g., conventional paper-based qualitative content analysis or clinical chart reviews) or those that did not explicitly disclose specific software tools within their published methodologies (Collier et al., 2023; Hertzum, 2021; Massar et al., 2022). Nonetheless, the explicit emergence of custom and mobile applications across the subset of intervention-focused studies highlights a valuable pathway for resource-limited and tropical contexts: adopting lightweight, low-bandwidth, and user-centered digital solutions that empower family caregivers without requiring expensive, high-maintenance institutional software infrastructure.

Top Author

Table 1. Top Five Most-Cited Studies

No	Author	Year	Title	Journal	Citation
1	de la Cruz, Maxine; Reddy, Akhila; Balankari, Vishidha; Epner, Margeaux; Frisbee-Hume, Susan; Wu, Jimin; Liu, Diane; Yennuraialingam, Sriram; Cantu, Hilda; Williams, Janet; Bruera, Eduardo	2017	The impact of an educational program on patient practices for safe use, storage, and disposal of opioids at a comprehensive cancer center,	<i>Oncologist</i>	92
2	Boustani, Malaz; Alder, Catherine A.; Solid, Craig A.	2018	Agile Implementation: A Blueprint for Implementing Evidence-Based Healthcare Solutions,	<i>Journal of the American Geriatrics Society</i>	58
3	Fleisher, Jori; Barbosa, William; Sweeney, Meghan M.; Oyler, Sarah E.; Lemen, Amy C.; Fazl, Arash; Ko, Mia; Meisel, Talia; Friede, Naomi; Dacpano, Geraldine; Gilbert, Rebecca M.; Di Rocco, Alessandro; Chodosh, Joshua	2018	Interdisciplinary Home Visits for Individuals with Advanced Parkinson's Disease and Related Disorders,	<i>Journal of the American Geriatrics Society</i>	50
4	Reuben, David B.; Gazarian, Priscilla; Alexander, Neil; Araujo, Katy; Baker, Dorothy; Bean, Jonathan F.; Boulton, Chad; Charpentier, Peter; Duncan, Pamela; Latham, Nancy; Leipzig, Rosanne M.; Quintiliani, Lisa M.; Storer, Thomas; McMahon, Siobhan	2017	The Strategies to Reduce Injuries and Develop Confidence in Elders Intervention: Falls Risk Factor Assessment and Management, Patient Engagement, and Nurse Co-management,	<i>Journal of the American Geriatrics Society</i>	49



5	Abuhejleh, A. A., Dulaimi, M., Ellahham, S.	2016	Using lean management to leverage innovation in healthcare projects: Case study of a public hospital in the UAE	<i>BMJ Innovations</i>	36
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The top five most frequently cited studies in this review demonstrate a coherent thematic focus on establishing educational, structural, and interdisciplinary frameworks for patient safety outside conventional hospital wards (Table 1). The most cited study, by de la Cruz et al. (2017) (92 citations), demonstrated how structured caregiver and patient educational interventions dramatically improve medication safety, storage, and disposal at home. Boustani et al. (2018) (58 citations) established the Agile Implementation model, underscoring the necessity of adaptive, rapid-cycle execution frameworks when embedding safety processes into community-based healthcare. In parallel, Fleisher et al. (2018) (50 citations) and Reuben et al. (2017) (49 citations) validated proactive clinical safety mechanisms specifically interdisciplinary home-visiting models and nurse-led fall risk co-management which significantly mitigate domestic injury risks among frail elderly populations. Finally, Abuhejleh et al. (2016) (36 citations) highlighted the application of Lean management to eliminate process errors and streamline care pathways. Collectively, these top-cited studies emphasize that sustaining homecare safety requires a tripartite foundation: targeted patient-caregiver education, structured interdisciplinary coordination, and adaptive operational frameworks.

Theory

Table 2. Theoretical Frameworks Utilized in the Reviewed Studies

No	Theoretical Frameworks	Study Citation Count (Scopus)	Included Articles (n)	Primary Reference
1	Chronic Care Model	10	1	Rasschaert et al., 2016
2	Complex Adaptive Systems (CAS) and Social Cognitive Theories.	58	1	Boustani et al., 2018
3	Eight Picker Principles of Patient-centeredness.	27	1	Berrevoets et al., 2018
4	Lean Management Philosophy	36	1	Abuhejleh, 2016
5	Patient and Family Engagement Theory	12	1	Harrison et al., 2021
6	Social-Ecological Model (SEM) and The Dyadic Stress Model.	18	1	LeBaron et al., 2019

During full-text data extraction, theoretical and conceptual frameworks explicitly utilized to ground the study designs and safety interventions were mapped (Table 2). Across the 41 synthesized studies, only a small subset of articles ($n = 6$) explicitly defined formal theoretical foundations, with each framework represented in a single primary study ($n = 1$). These frameworks reflect complementary perspectives for structuring homecare safety systems:

1. *System and Adaptive Change Models*: Boustani et al. (2018) integrated Complex Adaptive Systems (CAS) and Social Cognitive Theory to structure rapid-cycle implementation of evidence-based safety solutions in volatile care environments, while Abuhejleh et al.

- (2016) applied Lean Management principles to minimize workflow variation, eliminate waste, and prevent clinical errors during decentralized care delivery.
2. *Patient and Family-Centered Frameworks*: Harrison et al. (2021) utilized Patient and Family Engagement Theory to co-design consumer safety interventions, whereas Berrevoets et al. (2018) operationalized the Eight Picker Principles of Patient-Centeredness to improve communication and care coordination in home-based antimicrobial therapy.
 3. *Behavioral and Chronic Care Models*: LeBaron et al. (2019) combined the Social-Ecological Model (SEM) with the Dyadic Stress Model to understand patient-caregiver behavioral interactions in home pain management, while Rasschaert et al. (2016) utilized the Chronic Care Model to empower patients through digital symptom monitoring.

The fact that only six studies explicitly reported theoretical foundations highlights an important conceptual gap in homecare safety research. Integrating adaptive models (such as CAS and Lean) with dyadic patient-caregiver engagement theories provides a crucial framework for designing resilient, low-resource safety interventions in tropical settings, where formal supervision is limited and workflows must dynamically adapt to domestic constraints.

Based on the qualitative synthesis of the 41 included studies, the evidence on homecare patient safety was categorized into three overarching thematic domains:

Theme 1: The Central Role of Patients and Caregivers in Creating Safety

The first major theme synthesizes how patient and family involvement operates as a core protective mechanism across homecare and outpatient environments, divided into two key sub-themes:

Patient and Caregiver Involvement and Participation (53.8%): The synthesis confirms that active involvement of patients and family caregivers is a core mechanism for preventing harm in homecare. Across domestic environments with minimal direct clinical supervision, caregivers actively monitor fluctuating symptoms, manage complex therapies, and detect acute deterioration early (Chew et al., 2021). In resource-limited and tropical environments, family caregiver participation serves as an adaptive operational strategy to sustain continuity and care safety amidst health workforce shortages (Bacha et al., 2018). However, structured engagement and empowerment frameworks must be formally embedded into care models to prevent an excessive cognitive and physical burden on informal caregivers.

Communication and Shared Decision-Making (46.2%): The synthesis indicates that two-way, structured communication such as family conferences, interprofessional consultations, and pharmacist liaisons is essential for mitigating polypharmacy, optimizing medication adherence, and preventing adverse drug reactions (Feng et al., 2024; Mortsiefer et al., 2023). Shared decision-making aligns complex therapeutic regimens with patient functional capacities and domestic living conditions, directly resolving safety hazards associated with low health literacy and traditional paternalistic communication barriers (Feng et al., 2024; Harrison et al., 2021).

Theme 2: Key Operational Domains of Patient Safety in Home and Outpatient Settings

The existing literature identifies three critical operational domains that require targeted safety interventions outside hospital facilities:

Drug Management and Safety (46.2%): Medication management represents the most prevalent risk area due to complex regimens, narrow therapeutic margins, and limited ongoing clinical supervision in home environments (Abuhejleh et al., 2016; Duvignaud et al., 2020; Licchetta et al., 2021). The TELE-EPIC trial demonstrated that telemedicine-supported medication reconciliation and continuous remote side-effect monitoring maintained therapeutic



safety without compromising clinical outcomes, enabling the early detection of adverse drug events (Licchetta et al., 2021). Furthermore, clinical protocols for home-based pharmacotherapy such as those evaluated in the COVERAGE trial for older adults demonstrate that strict drug selection, interaction screening, and safety criteria are vital to prevent medication errors that could precipitate emergency hospitalization (Duvignaud et al., 2020). Applying Lean management principles also streamlines decentralized drug administration processes, minimizing workflow variability and empowering frontline caregivers to maintain compliance (Abuhejleh et al., 2016).

Care Coordination and Interdisciplinary Collaboration (28.2%): Patient safety in homecare depends heavily on interprofessional integration and continuous communication across care transitions (Berrevoets et al., 2018; Collier et al., 2023; Olayiwola et al., 2018). Longitudinal ethnographic research demonstrates that collaborative partnerships between physicians, home nurses, and community pharmacists serve as a vital safety barrier for multimorbid patients, with pharmacists functioning as key information liaisons who mitigate service fragmentation (Collier et al., 2023). Asynchronous electronic consultation and referral systems further clarify clinical roles and expedite shared decision-making (Olayiwola et al., 2018). Similarly, in Outpatient Parenteral Antimicrobial Therapy (OPAT) models, structured cross-setting coordination between hospitals, outpatient clinics, and community pharmacies is consistently identified by patients as an essential prerequisite for preventing therapy failure and procedural complications (Berrevoets et al., 2018).

Prevention and Management of Adverse Events (25.6% of Theme 2 coded units): Preventing domestic adverse events (AEs) particularly falls, hospital readmissions, and catheter- or wound-related infections requires proactive surveillance and structured transition mechanisms (Goldberg et al., 2020; LeBaron et al., 2019; Nasrallah et al., 2021; Schildmeijer et al., 2018). Retrospective record reviews using trigger tools highlight that over 70% of homecare incidents are preventable through structured risk assessment and patient-caregiver vigilance (Schildmeijer et al., 2018). The ALPINE study demonstrated that structured post-discharge monitoring and continuous caregiver engagement significantly minimize the risk of clinical relapse and complications during transitional care (Nasrallah et al., 2021). Additionally, smart health technologies such as multi-sensor environmental and physiological monitoring frameworks (e.g., the BESI-C platform) enable real-time early detection of acute symptom escalation, enabling prompt clinical intervention before adverse events result in emergency admission (LeBaron et al., 2019).

Theme 3: Innovative Models and Technologies to Improve Patient Safety

In response to decentralized safety challenges, the literature highlights emerging delivery models and technological innovations, categorized into four sub-themes:

Care Adjustments for Vulnerable Populations (38.5%): Tailoring safety practices to vulnerable groups such as frail older adults, individuals with cognitive impairment, and patients with physical disabilities requires contextualized, collaborative adaptations (Mazzo et al., 2016; Mortsiefer et al., 2023; Van Vracem et al., 2016). The COFRAIL study established that structured family conferences and shared therapy prioritization reduce inappropriate polypharmacy and align medication regimens with patients' functional capacities (Mortsiefer et al., 2023). For patients with dementia, mitigating environmental risks such as nocturnal overstimulation from noise and light serves as an essential non-pharmacological safety barrier against agitation and falls (Van Vracem et al., 2016). In procedural care at home, utilizing standardized clinical devices and technique adaptations (e.g., in intermittent urethral

catheterization) prevents traumatic tissue complications and secondary infections (Mazzo et al., 2016).

Outpatient and Differentiated Care Models (33.3%): Differentiated care frameworks improve patient safety and system efficiency across high-risk clinical pathways (Clemmons & Anderegg, 2017; Nasrallah et al., 2021; Park et al., 2016). The ALPINE trial demonstrated that structured inpatient-to-outpatient transitional regimens maintain therapeutic stability and reduce family caregiver strain during community reintegration (Nasrallah et al., 2021). Similarly, mixed outpatient–inpatient delivery models for complex oncological therapies (such as autologous stem cell transplantation) have proven safe and cost-effective, avoiding excess adverse events while optimizing limited institutional resources (Clemmons & Anderegg, 2017). Furthermore, tailoring medication administration workflows in community facilities based on staff skill levels and interprofessional protocols ensures safe daily drug distribution (Park et al., 2016).

Technology-Based Care and Monitoring (15.4%): Digital health platforms and remote surveillance systems facilitate timely risk identification, though their efficacy depends on system usability and documentation governance (Boustani et al., 2018; Hertzum, 2021; LeBaron et al., 2019). Nationwide evaluations indicate that while electronic health records (EHRs) enhance inter-provider communication, documentation omissions in homecare still pose medication safety risks, highlighting the necessity of structured user governance (Hertzum, 2021). Conversely, multi-sensor systems such as the Behavioral and Environmental Sensing and Intervention for Cancer (BESI-C) platform demonstrate the feasibility of real-time environmental and physiological monitoring for early symptom escalation detection (LeBaron et al., 2019). The adoption of these digital tools is strongly reinforced by frameworks like Agile Implementation, which prioritize rapid localized adaptation and clinical feedback (Boustani et al., 2018).

Caregiver Training and Empowerment (12.8%): Empowering informal caregivers through structured skill-building represents a vital yet under-researched safety strategy (Acharya et al., 2015; Poolman et al., 2019; Sanroma et al., 2018). The CARiAD study protocol established a structured framework designed to train lay caregivers to safely administer as-needed subcutaneous medications for breakthrough symptoms in end-of-life homecare, addressing procedural safety protocols and caregiver preparedness within home environments (Poolman et al., 2019). Empirical data from the OPAT registry in Spain further confirm that structured caregiver training enables safe self-administration of parenteral therapies at home, achieving high clinical success rates with minimal complications when supported by regular clinical oversight (Sanroma et al., 2018). Equipping informal caregivers with formal clinical competency and behavioral management skills mitigates domestic errors, reduces emergency hospitalizations, and establishes family members as capable safety partners (Acharya et al., 2015; Poolman et al., 2019; Sanroma et al., 2018).

Conclusion

This systematic review demonstrates that patient safety in homecare relies fundamentally on informal caregivers and patients functioning as proactive safety partners rather than passive care recipients. The synthesized global literature highlights three primary operational domains: medication safety as the predominant clinical risk area, structured care coordination across multidisciplinary teams, and proactive surveillance to prevent domestic adverse events (such as falls and secondary infections). Current innovation models emphasize differentiated care



pathways and digital monitoring tools tailored for vulnerable populations, while structured clinical training and task empowerment for informal caregivers represent an emerging yet under-investigated area (accounting for only 12.8% of innovation-focused coding).

Importantly, the existing evidence base is geographically skewed toward high-income healthcare systems with robust visiting nurse infrastructures, leaving the applicability, cost-efficiency, and safety outcomes of these models in tropical and resource-constrained environments largely uncharacterized. Therefore, future research must move beyond theoretical extrapolation and prioritize primary empirical investigations to co-design, adapt, and validate caregiver-centered safety interventions that account for the unique bio-climatic hazards, infrastructure constraints, and workforce shortages inherent to tropical and resource-limited settings.

References

- Acharya, D., Harper, D. G., Achtyes, E. D., Seiner, S. J., Mahdasian, J. A., Nykamp, L. J., Adkison, L., Van der Schuur White, L., McClintock, S. M., Ujkaj, M., Davidoff, D. A., & Forester, B. P. (2015). Safety and utility of acute electroconvulsive therapy for agitation and aggression in dementia. *International Journal of Geriatric Psychiatry*, 30(3), 265–273. <https://doi.org/10.1002/gps.4137>
- Bacha, J. M., Aririguzo, L. C., Mng'ong'o, V., Malingoti, B., Wanless, R. S., Ngo, K., Campbell, L. R., & Schutze, G. E. (2018). The Standardized Pediatric Expedited Encounters for ART Drugs Initiative (SPEEDI): Description and evaluation of an innovative pediatric, adolescent, and young adult antiretroviral service delivery model in Tanzania. *BMC Infectious Diseases*, 18, 448. <https://doi.org/10.1186/s12879-018-3331-2>
- de la Cruz, M., Reddy, A., Balankari, V., Epner, M., Frisbee-Hume, S., Wu, J., Liu, D., Yennuraialingam, S., Cantu, H., Williams, J., & Bruera, E. (2017). The impact of an educational program on patient practices for safe use, storage, and disposal of opioids at a comprehensive cancer center. *The Oncologist*, 22(1), 115–121. <https://doi.org/10.1634/theoncologist.2016-0266>
- Duvignaud, A., Lhomme, E., Pistone, T., Onaisi, R., Sitta, R., Journot, V., Nguyen, D., Peiffer-Smadja, N., Crémer, A., Bouchet, S., Darnaud, T., Poitrenaud, D., Piroth, L., Binquet, C., Michel, J.-F., Lefèvre, B., Lebeaux, D., Lebel, J., Dupouy, J., ... COVERAGE Study Group. (2020). Home treatment of older people with symptomatic SARS-CoV-2 infection (COVID-19): A structured summary of a study protocol for a multi-arm multi-stage (MAMS) randomized trial to evaluate the efficacy and tolerability of several experimental treatments to reduce the risk of hospitalisation or death in outpatients aged 65 years or older (COVERAGE trial). *Trials*, 21(1), 846. <https://doi.org/10.1186/s13063-020-04619-1>
- Fleisher, J., Barbosa, W., Sweeney, M. M., Oyler, S. E., Lemen, A. C., Fazl, A., Ko, M., Meisel, T., Friede, N., Dacpano, G., Gilbert, R. M., Di Rocco, A., & Chodosh, J. (2018). Interdisciplinary home visits for individuals with advanced Parkinson's disease and related disorders. *Journal of the American Geriatrics Society*, 66(6), 1226–1232. <https://doi.org/10.1111/jgs.15337>

- Galvan, N. T. N., Moreno, N. F., Garza, J. E., Bourgeois, S., Hemmersbach-Miller, M., Murthy, B., Timmins, K., O'Mahony, C. A., Anton, J., Civitello, A., Garcha, P., Loor, G., Liao, K., Shaffi, A., Vierling, J., Stribling, R., Rana, A., & Goss, J. A. (2020). Donor and transplant candidate selection for solid organ transplantation during the COVID-19 pandemic. *American Journal of Transplantation*, 20(11), 3113–3122. <https://doi.org/10.1111/ajt.16138>
- Harrison, R., Walton, M., Manias, E., Wilson, C., Girgis, A., Chin, M., Leone, D., Seale, H., Smith, A. B., Chauhan, A., & CanEngage Project Group. (2021). Codesigning consumer engagement strategies with ethnic minority consumers in Australian cancer services: The CanEngage Project protocol. *BMJ Open*, 11(8), e048389. <https://doi.org/10.1136/bmjopen-2020-048389>
- LeBaron, V., Hayes, J., Gordon, K., Alam, R., Homdee, N., Martinez, Y., Ogunjirin, E., Thomas, T., Jones, R., Blackhall, L., & Lach, J. (2019). Leveraging smart health technology to empower patients and family caregivers in managing cancer pain: Protocol for a feasibility study. *JMIR Research Protocols*, 8(12), e16178. <https://doi.org/10.2196/16178>
- Licchetta, L., Trivisano, M., Baldin, E., Mohamed, S., Raschi, E., Mostacci, B., Zenesini, C., Contin, M., Vigeveno, F., Bisulli, F., Tinuper, P., & Vignatelli, L. (2021). TELEmedicine for EPilepsy Care (TELE-EPIC): Protocol of a randomised, open controlled non-inferiority clinical trial. *BMJ Open*, 11(12), e053980. <https://doi.org/10.1136/bmjopen-2021-053980>
- Mortsiefer, A., Wilm, S., Santos, S., Löscher, S., Wollny, A., Drewelow, E., Ritzke, M., Thürmann, P., Mann, N.-K., Meyer, G., Abraham, J., Icks, A., Montalbo, J., Wiese, B., & Altiner, A. (2020). Family conferences and shared prioritisation to improve patient safety in the frail elderly (COFRAIL): Study protocol of a cluster randomised intervention trial in primary care. *Trials*, 21(1), 285. <https://doi.org/10.1186/s13063-020-4182-x>
- Mortsiefer, A., Löscher, S., Pashutina, Y., Santos, S., Altiner, A., Drewelow, E., Ritzke, M., Wollny, A., Thürmann, P., Bencheva, V., Gogolin, M., Meyer, G., Abraham, J., Fleischer, S., Icks, A., Montalbo, J., Wiese, B., Wilm, S., & Feldmeier, G. (2023). Family conferences to facilitate deprescribing in older outpatients with frailty and with polypharmacy: The COFRAIL cluster randomized trial. *JAMA Network Open*, 6(3), e234723. <https://doi.org/10.1001/jamanetworkopen.2023.4723>
- Olayiwola, J. N., Knox, M., Dubé, K., Lu, E. C.-Y., Woldeyesus, T., James, I. E., Willard-Grace, R., & Tuot, D. (2018). Understanding the potential for patient engagement in electronic consultation and referral systems: Lessons from one safety net system. *Health Services Research*, 53(4), 2483–2502. <https://doi.org/10.1111/1475-6773.12776>
- Ponce González, M. A., Mirón Rubio, M., Muijal Martinez, A., Estrada Cuxart, O., Fiuza Perez, D., Salas Reinoso, L., Fernández Fabrellas, E., & Chiner Vives, E. (2017). Effectiveness and safety of outpatient parenteral antimicrobial therapy in acute exacerbation of chronic obstructive pulmonary disease. *International Journal of Clinical Practice*, 71(12), e13022. <https://doi.org/10.1111/ijcp.13022>
- Poolman, M., Roberts, J., Byrne, A., Perkins, P., Hoare, Z., Nelson, A., Hiscock, J., Hughes, D., Foster, B., O'Connor, J., Reymond, L., Healy, S., Roberts, R., Wee, B., Lewis, P., Johnstone, R., Roberts, S., Holmes, E., Wright, S., ... Wilkinson, C. (2019). CARer-ADministration of as-needed subcutaneous medication for breakthrough symptoms in



- homebased dying patients (CARiAD): Study protocol for a UK-based open randomised pilot trial. *Trials*, 20(1), 105. <https://doi.org/10.1186/s13063-019-3179-9>
- Reuben, D. B., Gazarian, P., Alexander, N., Araujo, K., Baker, D., Bean, J. F., Boulton, C., Charpentier, P., Duncan, P., Latham, N., Leipzig, R. M., Quintiliani, L. M., Storer, T., & McMahon, S. (2017). The Strategies to Reduce Injuries and Develop Confidence in Elders intervention: Falls risk factor assessment and management, patient engagement, and nurse co-management. *Journal of the American Geriatrics Society*, 65(12), 2733–2739. <https://doi.org/10.1111/jgs.15121>
- Sanroma, P., Muñoz, P., Mirón-Rubio, M., Aguilera, A., Estrada, O., García, D., González-Ramallo, V. J., Pajarón, M., Sgaramella, G. A., González, C. R., Muijal, A., Abad, A., Solé, A., González, S., Escalada, C., Vitoria, I., Gómez, M. J., Parra, J. J., Sampedro, I., & Pereda, I. (2018). Effectiveness and safety of ertapenem used in hospital-at-home units: Data from Spanish Outpatient Parenteral Antimicrobial Therapy Registry. *Future Microbiology*, 13(12), 1363–1373. <https://doi.org/10.2217/fmb-2018-0065>
- Sharma, A. E., Huang, B., Stakeholder Research Advisory Council, Del Rosario, J. B., Yang, J., Boscardin, W. J., & Sarkar, U. (2021). Patient and caregiver factors in ambulatory incident reports: A mixed-methods analysis. *BMJ Open Quality*, 10(3), e001421. <https://doi.org/10.1136/bmj-2021-001421>