

RESEARCH ARTICLE

Patient safety. Factors for and perceived consequences of nursing errors by nursing staff in home care services

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Funding information

This study was supported by Stiftung Zentrum für Qualität in der Pflege/Centre for Quality of Care (ZQP).

Abstract

Aim: To identify factors for and perceived consequences of nursing errors by nursing staff in home care services in correlation with qualification, work experience, working hours and trainings.

Background: Patient safety has increasingly been brought into focus of politics and care practices over the past few years. However, little evidence has been provided yet on nursing errors in out-of-hospital settings.

Design: A cross-sectional study.

Methods: Randomized sample of 107 home care services and 656 nurses and nursing assistants recruited from all 16 federal states in Germany.

Results: Missing trainings on error management within the past 2 years were identified to be an important factor for mistakes regarding hygienic measures and medication administration. However, most errors arose in documentation without any significant differences in qualification, work experience, training and working hours.

Conclusion: Findings indicate that insufficient hygiene and medication administration might be reduced by implementing error management trainings on a regular basis in home care services.

KEYWORDS

error management, home care services, multilevel analysis, nursing errors, patient safety, qualification, risk management, training, work experience and working hours

1 | INTRODUCTION

The complexity of the healthcare environment becomes particularly evident when it comes to patient safety. Various factors from different stakeholders and parties involved in healthcare interlock to be measured against one goal: patient outcome. Although the 1999 Institute of Medicine (IOM) report *To Err Is Human* (Kohn et al., 1999) has significantly accelerated the safety measure development, the systematic review on patient safety by Hatoun and colleagues (Hatoun et al., 2016) revealed that research has yet primarily focused

on inpatient care. Nonetheless, ambulatory setting is actually where most medical care is administered and hence should play an increasingly important role regarding patient safety (Montano et al., 2016; Sockolow et al., 2017; Zonana et al., 2018). In Germany, the expected increase in the number of people in need of care from 2.5 million in 2013 to up to 3.5 million in 2030 (Statistische Ämter des Bundes und der Länder, 2010) is also expected to result in a growing proportion of old and very old people living in their own homes and/or receiving care there. Currently, about three quarters of all care recipients in Germany are cared for at home (Statistisches Bundesamt, 2017).

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This corresponds to the desire of most people in need of care to be cared for in their own homes (Mestheneos, 2011). In addition to care given by family caregivers, home care in Germany is to a large extent covered by home care services. The nursing staff of these home care services serve clients in their homes on a regular basis, between several times a week up to several times a day, depending on the clients' need for care. Several Studies have pointed out a link between the qualifications of nursing staff and improved patient outcomes such as mortality (Aiken et al., 2014, 2017; Cho et al., 2015; Needleman, 2017; Needleman et al., 2002). Other studies have focused on nurses' working hours associated with patient safety (Olds & Clarke, 2010; Rogers et al., 2004; Stimpfel et al., 2019). As shown in a systematic review on safety risks in home care settings (Hignett et al., 2016), the main risk factors identified in the 42 papers included in qualitative synthesis were permanent and temporary building design and access, communication and lone working, provision of equipment and consumables and clinical tasks. However, though highly relevant and interesting, the findings in many of these papers remain solely on safety risks associated with physical location and social environment. Yet, few studies in home health care have been conducted on the association between the two concepts (a) nurse staffing level, qualification, working hours and/or workload and (b) patient outcomes or patient safety—in contrast to studies performed at the acute healthcare settings (as cited above), which focus on nursing staff's qualification directly associated with patient outcomes such as mortality. Nevertheless, as home care increases, there is a need to ensure patient safety through a high-quality standard in nursing care. A possibility to optimize nursing care in home health care is to identify risk factors linked to patient outcomes and to implement or adapt qualification schedules and training topics accordingly, that is on error management. Therefore, this study aims at identifying factors for and perceived consequences of nursing errors by nursing staff in home care services in correlation with qualification, work experience, working hours and trainings of nurses and nursing assistants to achieve a high-quality standard in nursing care associated with patient safety.

1.1 | Background

Patient safety implies the absence of any adverse events. Patient adverse events are important indicators predictive of the quality of care (Kang et al., 2014). An unintentional act or unexpected outcome resulting from an intervention by healthcare staff may occur due to various factors such as staff workload, training, lack of information, access to equipment and resources, inexperience and limited qualification (Giles et al., 2015; de Vries et al., 2008). According to a recently published Health Working Paper by the Organisation for Economic Co-operation and Development (OECD), up to four out of 10 patients are harmed in ambulatory care settings (Auraaen et al., 2018) due to adverse events.

To achieve a high level of quality of care and to improve patient safety, it is necessary to identify avoidable nursing errors, which may

cause adverse events in the treatment of patients, and the factors they are based on to avoid such incidents. In this context, particular importance is attached to hygiene and medication management as well as the expansion of complaint and error management systems in home care services. Lack of hygiene measures, incorrectly administered medication and omitted error reports can be causes for a potentially increased risk to the patient and, for example, considerably impair the fight against multi-resistant pathogens (Strube-Lahmann et al., 2018).

Therefore, we conducted a cross-sectional study in home care services in all federal states of Germany to better understand factors for nursing errors in correlation with qualification, work experience, working hours and trainings and their perceived consequences by nursing staff on patient safety.

2 | THE STUDY

2.1 | Aim

The aim of the study was to identify factors for and perceived consequences of nursing errors by nursing staff in home care services in correlation with qualification, work experience, working hours and trainings on error management for nurses and nursing assistants to increase and ensure patient safety.

The following research questions were addressed in the investigation:

1. What are the most common factors for errors in home care services from the nurses' and nursing assistants' perspective?
2. Which perceived consequences may result from different types of nursing errors?
3. How do employees' qualification, work experience, training on failure management and working hours influence the occurrence of errors?

2.2 | Design

The study had a cross-sectional design and questionnaires were paper-pencil based.

2.3 | Participants, settings and sample

A total of 160 home care services and 1,600 nursing employees were randomly selected and invited to participate in the study. Participating employees were nurses with a degree as nurse, geriatric nurse, paediatric nurse or a bachelor's degree as well as nursing assistants and trainees. The aim was to survey 10 employees of 10 services in each federal state of Germany. A computer-controlled random selection of 30 home care services per federal state was carried out, 10 of which were to be included in the study, followed by

contact with the randomly selected facilities via e-mail or telephone. The selected home care services received a written summary of the study objectives and procedure. The confirmation of the study was given by the home care services in the form of a binding written registration. If a home care service refused to participate, the next home care service was contacted from the randomly selected list. In cases where all 30 facilities were contacted but the target number of home care services could not be reached, a new randomly selected list was drawn up. This procedure was to be repeated until the target number of 10 nursing services per federal state was reached.

No concrete sample size was determined. For a sufficient precision of the determined point estimators, a targeted sample size of approximately 800 questionnaires was considered sufficient. This assumption was based on the calculation that 10 home care services per federal state would participate in the study. In each home care service, 10 employees were to fill in the questionnaire. Each home care service received 10 questionnaires with all necessary information and stamped envelopes for return. The questionnaires were handed out to randomly selected employees by each individual home care service. Since the challenges of such surveys are known, a response rate of about 50% was assumed. Despite an extension of the recruitment phase, this target number of participating nursing services could not be achieved. In total, 107 home care services and 656 employees agreed to participate. The private sector accounted for 51.6% of the participating home care services, followed by the non-profit sector with 45.1% and the public sector with 3.3%. The number of questionnaires returned by the individual nursing services varied greatly. Eleven nursing services returned one questionnaire each and twelve nursing services returned two questionnaires each. In 27 nursing services, more than eight questionnaires were returned. 73.2% of the 656 participating employees were fully qualified nurses. A total of 3,152 employees were working in the participating home care services at the time of the survey. 57.7% of these were employed part-time, and 30.6% were employed on a full-time basis. Informed consent was provided by all participating employees and home care services.

2.4 | Data collection

Research was conducted in winter 2016–2017. The questionnaires were sent to the participating home care services. A guide with instructions on how to complete the questionnaires was attached. In addition, a telephone contact was provided for queries. To ensure that data would be treated confidentially, a stamped envelope was enclosed with each questionnaire, so that the employees had the opportunity to answer the questionnaires at home.

2.5 | Variables

To characterize the home care service employees, the characteristics "work experience in years" and "assisted clients per shift" were

collected as continuous variables and "professional qualification" and "working hours" as categorical variables. With regard to working hours, the terms "minor employment" and "minijob" (a common term in Germany used to describe a minor employment with a monthly salary of 450 euros) were used synonymously, summarizing the group of nurses and nursing assistants who do not earn more than 450 euros per month in this employment.

In addition, the employees were asked how long ago their last training on error management took place. The respondents could distinguish between "less than 1 year", "1–2 years", "longer than 2 years" and "no training".

The first research question on the three most common factors for nursing errors was addressed via possible multiple answers and an extra blank box for listing additional factors by the employees.

For the second research question on perceived error consequences, the nurses and nursing assistants were asked to fill in the frequency ("daily", "weekly", "monthly", "annually", "never", "never in the past 12 months, but at least once before") and severity ("no damage", "little damage", "moderate damage", "severe damage", "death", "don't know") of perceived error consequences on 16 possible events in their home care service in the field of medication, hygiene and nursing interventions. Respondents were given guidance on interpretation of the severity categories according to definitions of the Stiftung für Patientensicherheit Schweiz (Swiss Foundation for the Security of Patients) (Gehring & Schwappach, 2012, 2014; Gehring et al., 2012; Schwappach et al., 2012).

For the third research question on how qualification, work experience, training on failure management and working hours influence the occurrence of errors, the employees were asked to indicate if they had made an error themselves in the categories *direct care*, *documentation*, *healthcare instructions*, *organization*, *hygiene and medication administration*. The six possible answers ("never", "yes, maximum a month ago", "yes, more than a month ago but maximum ½ year ago", "yes, longer than ½ year ago but maximum 1 year ago", "yes, longer than 1 year ago", "no information") were combined into two variables (1 = 1 month – 12 months), (2 = >12 months – never).

In the available data set, the structural characteristics state and code are available in addition to the "content active" ones, both of which can in principle generate intraclass correlations with the known consequences (Crawley, 2013; Faraway, 2010; Gelman & Hill, 2007; R-Package MASS). The application of "Mixed Effect Models for non-normal responses" did not result in a significant change of the results, neither with respect to the federal state nor with respect to the group characteristic code. Calculations have been conducted with R-Routine `glmmPQL[MASS]`.

All answers indicating "no information" were treated as missing values. The explanatory variables were dichotomized. The arithmetic mean value served as the cut-off for the respective metric variables "work experience in years" and "assisted clients per shift". Employees who stated a degree as nurse, geriatric nurse, paediatric nurse or a bachelor's degree were coded as "fully

qualified". Trainees, nursing assistants or other employees were recorded as "not fully qualified".

2.6 | Data analysis

The collected data were recorded by means of high-performance scanners and then transferred for analysis to the statistics program SPSS® for Windows version 25. In addition to the descriptive representation of the three response variables "most common factors for errors", "error consequences" and "errors made during the past 12 months" and the explanatory variables ("work experience in years", "professional qualification", "training on error management", "working hours", "assisted clients per shift"), corresponding correlations were analysed bivariately and checked for statistical significance by means of a chi-squared test. Subsequently, all explanatory variables were included in a respective multivariate logistic regression model. A p -value < .05 (two-sided) was assumed as statistically significant.

2.7 | Validity, reliability and rigour

The questionnaire was machine-readable based on existing standardized questionnaires. Some questions or sections of questions, particularly on safety culture and error management, were taken from existing questionnaires that were standardized according to the literature and adapted to the setting in home care services and the main topics of the study. The following questionnaires (excerpts or single questions) were used in a modified form: Fragebogen zur Patientensicherheit und Sicherheitskultur in der Grundversorgung (© Stiftung für Patientensicherheit) (Gehring & Schwappach, 2012, 2014; Gehring et al., 2012; Schwappach et al., 2012); FraSiK (Fragebogen zum Sicherheitsklima in Hausarztpraxen) based on the questionnaire Safety Attitude Questionnaire, ambulatory version (SAQ-A) (Hoffmann et al., 2009, 2011); Erhebung der Pflegefehler in stationären Versorgungseinrichtungen (Cramer, Foraita, & Habermann, 2012, 2014; Habermann et al., 2013).

To adapt the questionnaire to the target group, it was tested for comprehensibility, legibility and applicability by employees of three home care services as part of a pretest. Subsequently, the questionnaire was modified accordingly. The data set of the scanned questionnaires was checked for implausible values and errors in terms of structure and content.

3 | RESULTS

3.1 | Sample

In this study, $N = 656$ employees and 107 home care services throughout Germany participated. The median of participating employees per home care service was $N = 5$, the first quartile $N = 3$

and the third quartile $N = 7$. Data from 634 (96.6%) study participants were available on working hours. Of these, more than half (51.4%) were full-time employees, 45.3% part-time employees and a small proportion (3.3%) was working part-time on a minijob-basis. At 40.4%, the professional group of geriatric nurses accounted for the largest proportion of the employees surveyed. The second largest group were nurses (29.6%). Employees with a bachelor's degree were the least represented with 0.8%. On average, the study participants had 15.94 years of work experience as nursing staff in all settings (mean value; SD 10.34) and the surveyed employees provided 14.77 (mean value; SD 7.84) clients per shift on average. From the total of 656 questionnaires, 614 respondents provided information on attending error management training. 42.1% of the employees stated that their last training on how to deal with mistakes was less than a year ago. 14.2% had completed a training 1–2 years ago and 10.6% more than 2 years ago. 33.1% of the employees had not yet participated in any error management training.

3.2 | Most common factors for errors

Table 1 presents the results of the most common factors for errors in home care services stated from the nurses' and nursing assistants' perspective. The highest factor for errors named by the employees was *high workload* (48.3%). In second and third place were *lack of knowledge* (45.4%) and *lack of information* (39.9%). The respondents also felt that *staff shortage* (37.0%) and *work overload* (32.6%) posed an increased risk for errors. The factors *missing specifications, standards, guidelines, etc.* (3.8%), *reading and spelling difficulties* (4.0%) and *mistakes by superiors/management* (4.4%) were found to be the less important factors for causing errors as perceived by the nursing staff. Divided by qualification, the influence of the three most commonly indicated factors for errors *high workload*, *lack of knowledge* and *lack of information* was rated higher from the nurses' perspective (50.1%, 46.6%, 40.4%) compared with nursing assistants' perceptions (43.4%, 42.2%, 38.7%). In contrast, *staff shortage* was perceived as being a more important factor for errors by nursing assistants (42.2%) than by nurses (35.2%).

3.3 | Error frequencies and perceived consequences

Error frequencies and perceived consequences by the nursing staff on 16 items regarding medication, hygiene and nursing interventions are shown in Table 2. Out of a total of $N = 599$ events indicated by 656 participating nurses and nursing assistants, where a *wrong dosage/quantity of medication* was administered, 32.9% were indicated to appear once a year and 15.0% once a month causing minor damages in 13.2% and death in 0.2% (total $N = 521$). Incorrect or no hand disinfection or other hygienic measures due to *deficient discipline* occurred daily in 8.9%, weekly in 8.8%, once a month in 13.6% and once a year in 15.5% events (total $N = 594$) resulting in minor damages in 12.3%, medium damages in 2.7% and severe damages in 0.2% (total $N = 511$). Incorrect or no execution

TABLE 1 Most common factors for errors (N = 656)

Factors for errors	Total	Fully qualified (N = 483)	Not fully qualified (N = 173)	Chi ²
	%	%	%	p
- High workload	48.3	50.1	43.4	.13
- Lack of knowledge	45.4	46.6	42.2	.32
- Lack of information	39.9	40.4	38.7	.71
- Staff shortage	37.0	35.2	42.2	.10
- Work overload	32.6	32.5	32.9	.92
- Lack of motivation	17.8	18.0	17.3	.84
- Stay out of it when you actually need to get involved	16.6	15.9	18.5	.44
- Material or device (missing, faulty, unknown material or device, ...)	13.7	14.3	12.1	.48
- Poor professional attitude	12.7	14.1	8.7	.07
- Not qualified for the activity carried out	12.3	11.6	14.5	.33
- Interruptions	11.3	13.0	6.4	.02
- Shift length	8.4	8.7	7.5	.63
- Lack of language skills on the part of the carer	7.3	7.2	7.5	.91
- Time-consuming complex work	6.6	7.2	4.6	.23
- Too little support from superiors	5.9	5.8	6.4	.79
- Too little control by management	5.5	5.8	4.6	.56
- Mistakes by superiors/management	4.4	5.0	2.9	.25
- Other factors, namely:	4.4	4.8	3.5	.48
- Reading and spelling difficulties	4.0	3.3	5.8	.15
- Missing specifications, standards, guidelines, etc.	3.8	4.1	2.9	.46

of a dressing change was carried out due to *unclear instructions* (29.2% once a year, total N = 596), *missing prescriptions* (25.5% once a year, total N = 589), *insufficient equipment* (25.1% once a year, total N = 602) and *neglecting to follow instructions* (20.1% once a year, total N = 591). Disregarding instructions caused minor damages in 13.1%, medium damage in 2.6% and severe damage in 0.2% out of a total of N = 498 events. *Nursing interventions were carried out incorrectly* once a year in 17.0% (total N = 577). Out of a total of N = 583 events, where the *urgency of a client request* has not been recognized, 23.2% took place once a year resulting in minor damages (14.6%), medium damages (3.2%), severe damages (0.2%) and death (0.2%) (total N = 471).

Figure 1 shows mean frequency and mean perceived consequence at a glance for each of the 16 items ranging from 1 *daily* to 6 *never* for frequency and from 0 *no damage* to 4 *death* (5 *Don't know*—treated as missing) for perceived consequences. All items are presented in four quadrants showing higher frequencies in the quadrants above 5.00 and higher perceived consequences in the quadrants above 0.15. The items with the highest error frequencies and perceived consequences were 3—*wrong dosage/quantity of medication*; 5—*necessary medication not administered*; 9—*deficient discipline regarding hand disinfection or*

other hygienic measures; 10—*insufficient equipment*, 11—*unclear instructions* and 12—*missing prescriptions for dressing changes*.

3.4 | Errors made in correlation with nurses' and nursing assistants' qualification, work experience, training and working hours

Associations between errors nursing staff members indicated they made themselves and selected personal characteristics were examined in bivariate error analysis. Table 3 showed that nurses who were fully qualified indicated more errors regarding *hygiene* (38.5%; $p < .01$) and *medication administration* (25.1%; $p < .04$) than nursing assistants with limited qualification (25.4% and 15.6%, respectively). Nurses and nursing assistants with work experience > 16 years indicated to commit more or a similar number of errors in almost all categories, except for *direct care* (21.2%), whereas those with work experience < 16 years indicated mistakes in *direct care* in 31.7% ($p < .01$). Regarding error management trainings on a regular basis, nurses and nursing assistants with trainings > 2 years ago appeared to make errors in *hygiene* in 48.2%, while those with trainings < 2 years indicated mistakes in 26.9% ($p < .001$). Regarding

TABLE 2 Error frequencies and perceived consequences (N = 656)

Event in %	Never in the past 12 months but at least once before						N	Damage					N	
	Daily	Weekly	Monthly	Once a year	5	6		No damage	1	2	3	4		5
Wrong or incorrect administration or dispensing of medication due to:														
1—wrong active substance	0.0	0.5	4.4	17.2	17.3	60.5	588	91.7	7.3	0.8	0.2	0.0	-	505
2—wrong dosage form	0.7	1.0	5.6	17.1	14.7	60.9	586	93.0	6.4	0.4	0.2	0.0	-	501
3—wrong dosage/quantity	0.3	1.2	15.0	32.9	13.4	37.2	599	85.6	13.2	1.0	0.0	0.2	-	521
4—incorrect timing of intake	5.5	6.4	14.7	19.6	12.5	41.2	577	89.5	9.9	0.4	0.2	0.0	-	505
5—necessary medication not administered (medication not available due to forgotten order or prescription)	0.3	3.8	22.2	27.6	13.0	33.1	577	83.4	15.6	1.0	0.0	0.0	-	519
Incorrect or no hand disinfection or other hygienic measures (e.g. wear protective clothing) due to:														
6—insufficient equipment (no disinfection or protective clothing on site)	1.3	2.2	5.1	12.7	11.9	66.7	604	87.6	5.2	1.0	0.0	0.0	6.2	502
7—unclear hygiene regulations	0.5	1.3	3.8	11.0	10.4	72.9	598	88.4	4.4	1.4	0.0	0.0	5.8	502
8—skin incompatibilities	1.7	1.5	4.9	18.0	14.3	59.6	589	77.8	12.4	2.2	0.2	0.0	7.5	510
9—deficient discipline	8.9	8.8	13.6	15.5	9.8	43.4	594	75.5	12.3	2.7	0.2	0.0	9.2	511
Incorrect or no execution of a dressing change due to:														
10—insufficient equipment (no disinfection or dressing materials on site)	0.8	4.3	19.4	25.1	10.8	39.5	602	72.9	19.3	1.9	0.2	0.0	5.7	524
11—unclear instructions	0.8	2.9	14.8	29.2	10.4	41.9	596	74.0	17.4	2.5	0.2	0.0	5.8	516
12—missing prescriptions	0.8	3.2	20.9	25.5	12.1	37.5	589	75.0	15.9	2.9	0.2	0.0	6.0	521
13—neglecting to follow instructions	0.7	2.4	8.3	20.1	8.3	60.2	591	78.1	13.1	2.6	0.2	0.0	6.0	498
14—incorrect nursing intervention carried out (e.g. subcutaneous injection carried out, intramuscular injection prescribed)	0.3	0.7	1.2	6.9	12.2	78.6	590	87.5	4.7	0.8	0.2	0.0	6.8	471
15—correct nursing intervention carried out incorrectly	0.3	1.0	4.5	17.0	13.0	64.1	577	82.8	8.5	1.7	0.2	0.0	6.8	483
16—urgency of client request not recognized	0.5	1.2	6.2	23.2	14.6	54.4	583	74.5	14.6	3.2	0.2	0.2	7.2	471

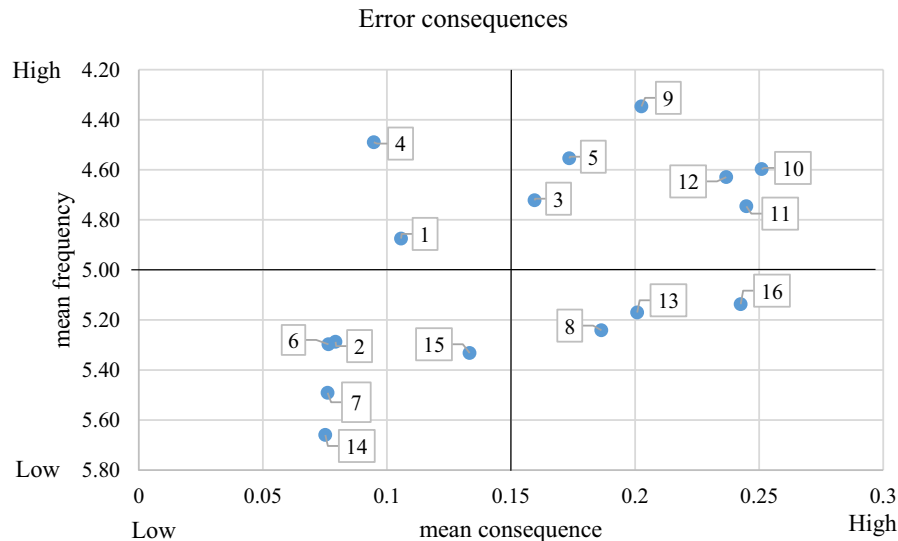


FIGURE 1 Frequency and perceived consequences of errors in patient safety. Wrong or incorrect administration or dispensing of medication due to: 1—wrong active substance; 2—wrong dosage form; 3—wrong dosage/quantity; 4—incorrect timing of intake; 5—necessary medication not administered (medication not available due to forgotten order or prescription). Incorrect or no hand disinfection or other hygienic measures (e.g. wear protective clothing) due to: 6—insufficient equipment (no disinfection or protective clothing on site); 7—unclear hygiene regulations; 8—skin incompatibilities; 9—deficient discipline. Incorrect or no execution of a dressing change due to: 10—insufficient equipment (no disinfection or dressing materials on site); 11—unclear instructions; 12—missing prescriptions; 13—neglecting to follow instructions; 14—incorrect nursing intervention carried out (e.g. subcutaneous injection carried out, intramuscular injection prescribed); 15—correct nursing intervention carried out incorrectly; 16—urgency of client request not recognized

medication administration, nurses and nursing assistants trained on a regular basis occurred to commit errors in 29.7%, whereas those with training < 2 years ago indicated mistakes in 18.8% ($p < .001$). Nurses and nursing assistants working on a part-time basis indicated to make more errors in almost all categories compared with those working full-time, except for *organization*; the term *organization* comprises, for example procedures in practice with the client as well as handing over and passing on important information between colleagues of the home care service. In total, most errors arose in *documentation* ranging from 53.7%–62.7%, regardless employees' status on qualification, work experience, training and working hours.

Results found in bivariate analysis were largely confirmed in multivariate error analysis in Table 4. Binary logistic regression showed that chances for errors in *direct care* were almost twice as high (odds ratio (OR) 1.8; confidence interval (CI) 1.1–2.8), if nurses and nursing assistants had working experience of >16 years. With regard to *hygiene* (OR 2.5; CI 1.7–3.7) and *medication administration* (OR 1.8; CI 1.1–2.8) error analysis showed that mistakes were more likely to occur, if nurses and nursing assistants attended a training in error management more than 2 years ago.

4 | DISCUSSION

The current study aimed to examine factors for and perceived consequences of nursing errors by nursing staff in home care services. The findings confirmed that nursing errors are associated with qualification, work experience, working hours and trainings

on error management for nurses and nursing assistants. Findings showed that the most common factors for errors were *high workload* and *lack of information and knowledge* with 39%–48%. Divided by qualification, *high workload* was perceived as being a more important factor for errors from the nurses' perspective, while *staff shortage* was rated higher by nursing assistants. Since these two categorizations require evidence-based policy-level measures, this information is important for future nursing research and knowledge development in home healthcare services. Future research is warranted to identify in more detail why *staff shortage* might be more threatening and stressful for nursing assistants compared with a *high workload* and how this important factor for errors may be addressed. Highest error frequencies associated with the most severe perceived consequences by nursing staff regarding their own provision of care were the result of wrong medication, deficient discipline regarding hand disinfection or other hygienic measures, insufficient equipment, unclear instructions and missing prescriptions for dressing changes. These findings drawn from a home care services' setting in our study are comparable to results by Berland and colleagues, investigating a focus group study on medication errors in home care (Berland & Bentsen, 2017). Findings in the Supplementary Material reveal that nurses perceived higher error frequencies (daily, weekly, monthly, once a year), while from the nursing assistants' perspective the perceived consequences appeared to be more severe (severe damage, death).

However, when associated with qualification, work experience, training and working hours, nursing errors regarding nursing staff's

TABLE 3 Errors during the past 12 months in combination with qualification, work experience, training, and working hours (N = 656)

% Direct care Documentation Healthcare instructions Organization Hygiene Medication administration	Qualification		Work experience		Training		Working hours					
	Complete	Limited	p*	<16 years	>16 years	p*	<2 years	>2 years	p*	Full-time	Part-time	p*
	26.0	27.3	.77	31.7	21.2	.01	25.8	26.7	.83	23.8	28.9	.20
	60.6	53.7	.17	59.9	59.2	.86	60.1	59.2	.84	55.4	62.7	.09
	17.6	12.3	.18	15.8	18.0	.53	13.6	19.0	.11	15.0	17.8	.40
	38.3	30.6	.13	36.1	37.4	.78	34.3	38.7	.32	37.5	34.5	.50
	38.5	25.4	.01	34.0	38.2	.32	26.9	48.2	<.01	31.3	38.7	.07
	25.1	15.6	.04	21.2	26.5	.16	18.8	29.7	<.01	21.8	23.9	.56

*p-values based on Wald test.

own provision of care indicated by the different groups differed. With regard to qualification, more errors were reported by nurses with complete qualification compared with nursing assistants with limited qualification. Although this might seem controversy at first sight, identifying (own) errors as such can also count as a positive signal referring to an increased awareness due to higher qualification, which has been shown in other studies as well, pointing out different aspects of defining, distinguishing and disclosing nursing errors (Chen et al., 2019; Johnstone & Kanitsaki, 2006).

The same is true for error frequencies associated with nurses' and nursing assistants' work experience. Those with work experience > 16 years indicated to make more or a similar number of errors in almost all categories, except for *direct care*. Results may be interpreted in two ways as well: On the one hand, nurses and nursing assistants with more years of work experience appeared to commit more errors; on the other hand, since errors have been indicated by the nurses and nursing assistants themselves, more experience in nursing may also increase awareness regarding mistakes resulting in more precise error reports. However, regarding *direct care*, work experience seemed to reduce error frequencies by more than 10% in our investigation. Other studies have revealed that implementing a safety climate and culture including regular trainings on error management, supports nurses to identify and indicate possible errors earlier and more precisely (Singer & Vogus, 2013).

Regarding working hours, nurses and nursing assistants working on a part-time basis indicated slightly higher error frequencies than their colleagues working full-time. Yet, the results were not significantly relevant. What seems to be more important is the association between adverse events and nursing workload as several studies have already shown (Kakemam et al., 2019; Kang et al., 2016; Rogers et al., 2004).

Finally, with regard to frequent trainings on error management results showed significant higher error frequencies indicated by nurses and nursing assistants who had attended their last training more than 2 years ago, especially in the categories *hygiene* (48.2% vs. 26.9%) and *medication administration* (29.7% vs. 18.8%). Studies focusing on hospital nursing staff have also shown that a lack of professional training is a factor that hinders the implementation of safe patient care (Oliveira et al., 2015).

Results from the bivariate analysis have also been largely confirmed in the multivariate regression analysis in our study. Therefore, we recommend mandatory error management trainings for nurses and nursing assistants in home care services on a regular basis, especially on hygiene and medication administration. Furthermore, as several studies have revealed, providing appropriate framework conditions by healthcare suppliers and demonstrating leadership commitment to safety is key to cultivating a culture of patient safety (Fischer et al., 2018; Kirwan et al., 2013; McFadden et al., 2015). Nevertheless, most errors arose in *documentation*, regardless employees' status on qualification, work experience, training and working hours. In addition to frequent error management trainings, a starting point might be

TABLE 4 Multivariate error analysis ($N = 656$)

	Qualification			Work experience			Training			Working hours		
	OR	95% CI	p^*	OR	95% CI	p^*	OR	95% CI	p^*	OR	95% CI	p^*
Direct care	0.9	0.6–1.6	.78	1.8	1.1–2.8	.02	1.1	0.7–1.8	.56	1.4	0.9–2.2	.10
Documentation	0.7	0.5–1.2	.17	1.2	0.8–1.7	.41	1.0	0.7–1.4	.92	1.4	1.0–2.0	.07
Healthcare instructions	0.6	0.3–1.3	.18	1.0	0.6–1.7	.94	1.3	0.8–2.1	.35	1.3	0.8–2.2	.29
Organization	0.6	0.4–1.0	.06	1.2	0.8–1.7	.49	1.2	0.8–1.8	.34	0.9	0.6–1.3	.58
Hygiene	0.6	0.4–1.0	.05	1.1	0.7–1.6	.74	2.5	1.7–3.7	.00	1.4	0.9–2.0	.11
Medication administration	0.8	0.4–1.4	.41	0.8	0.5–1.2	.32	1.8	1.1–2.8	.01	1.1	0.7–1.7	.00

Note: Qualification: 0 = limited qualification; 1 = complete qualification.

Work experience: 0 = less than 16 years; 1 = 16 years or more.

Training: 0 = less than 2 years; 1 = more than 2 years or no training.

Working hours: 0 = part-time; 1 = full-time.

* p -values based on Wald test.

to approach new, innovative documentation technologies, such as interactive tools for electronic documentation transfers as shown in a recent systematic review by Hanratty and colleagues (Hanratty et al., 2019), or to implement newly developed data registry systems for nursing-sensitive indicators as presented in an investigation by Sim and colleagues (Sim et al., 2019) or similar toolkits as revealed in the evidence-based study approach by Parker and colleagues (Parker et al., 2019) to ensure and increase patient safety in home care services.

4.1 | Limitations

This study was based on responses by employees of German home care services. Due to socially desirable response behaviour, bias may have occurred, for example regarding the actual number of errors perceived or trainings attended. Answers may also have been affected by recall bias, since it is well known, that events or trainings longer than 3 months ago are more difficult to recall precisely. Besides, relying on nursing staff perceptions of error rather than on more objective measures results in a subjective description representing solely one perspective and does not include other parties involved, for example the nursing homes, family caregivers or the patients themselves. In addition, due to the cluster random sampling method used in the study, bias regarding variable estimates cannot be excluded entirely. Furthermore, certain groups of the associated population might not be presented appropriately in the sample, for example nurses and nursing assistants who were unable to participate in the survey for linguistic reasons. Moreover, quite several nurses and nursing assistants in home care services are leasing staff. In comparison with permanent employees, regular training courses are less frequent among this group, as participation in trainings is often less easy to plan for leasing staff and must also be financed by themselves. Finally, when interpreting the study results, it must be taken into account that professional nurses and nursing assistants

participated. However, most home care is provided by relatives or family caregivers who were not included in the study.

5 | CONCLUSION

We examined the relationship between factors for and perceived consequences of nursing errors by nursing staff in home care services and nurses' as well as nursing assistants' qualification, work experience, working hours and trainings on error management. This study identified highest error frequencies associated with the most severe perceived consequences in wrong medication and deficient hygiene discipline. Findings indicate that insufficient hygiene and medication administration might be reduced by implementing error management trainings on a regular basis in home care services. In practice, it is essential for healthcare providers to create necessary framework conditions to give nurses and nursing assistants the ability to participate in mandatory trainings and thus, to increase patient safety.

ACKNOWLEDGEMENTS

The authors would like to express their gratefulness to the participating home care services who supported this study.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

DJ, NL: Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. DJ, NL: Involved in drafting the manuscript or revising it critically for important intellectual content. DJ, NL, UMW: Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. DJ, NL, UMW: Agreed to be accountable for all aspects of the

work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

ETHICAL APPROVAL

Ethical committee approval (EA4/098/16) of the study and a positive data protection vote were obtained from a university (November 2016). The questionnaire was approved prior to conducting any participant recruitment. At the outset, nurses and nursing assistants were given a comprehensive Participant Information Sheet which, in addition to verbal communication, explained in full the voluntary nature of participation and the right to withdraw from the study at any time without giving a reason. It also explained the research purpose, significance and benefits. While written consent was not sought, the participants' voluntary completion of the survey implied their consent to participation. Besides, for anonymity, demographical information that could identify the participants was not collected.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Jachan DE, Müller-Werdan U, Lahmann NA. Patient safety. Factors for and perceived consequences of nursing errors by nursing staff in home care services. *Nurs Open*. 2021;8:755–765. <https://doi.org/10.1002/nop2.678>