Exploring omissions in nursing care using retrospective chart review: An observational study

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ABSTRACT

Background: Omissions in nursing care can compromise patient safety. To date, this phenomenon has been investigated almost exclusively via nurse surveys. However, such surveys restrict the range of activities which can be assessed for omissions, and patient level analysis. As an alternative, retrospective chart review methodology has been used successfully in other research fields, but not yet for omitted nursing care.
Objectives: To describe characteristics and frequency of omitted nursing care using a retrospective chart review methodology.
Design, setting and participants: Observational single center study in two German neurological inpatient units. A random sample of 100 patient admissions was used.
Methods: A structured chart review protocol to detect nursing omissions was developed and applied. The full range of expected nursing care activities were assessed regarding the importance of documenting them and whether they had been fully or partially omitted. Vital sign measurements were assessed regarding both the measurement target number and the number of measurements recorded.
Results: In total, 1885 activities—a mean of 19 per patient—were identified. Of the reviewed activities, 52% ($n = 971$) were fully or partially omitted. Patients experienced between one and 22 omitted nursing care activities during their hospital stay (8–84% of expected care activities). Ranging from 6% to 100% some activities were more commonly omitted than others during admission. The most frequently omitted nursing activity was *giving emotional care* (88%, $n = 66$); the least frequently omitted was *teaching* (10%, $n = 29$). Vital signs were recorded only 50% ($n = 141$) of the targeted number of times.
Conclusions: Using a retrospective chart review protocol to identify omissions in nursing care allows the assessment of a broad range of nursing activities. Additionally, this is the first-time patient-level data on a broad range of activities have been analyzed. The newly developed chart review methodology can complement established survey methods and provide a new perspective on the phenomenon of omitted nursing care.

What is already known

- Omissions in nursing care are a mediating factor between nursing care and patient safety outcomes.
- While many studies have assessed omissions in nursing care, they have mostly used survey methods.
- Routine data and retrospective chart reviews are used successfully in other research fields.

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What this paper adds

- Omissions in nursing care can be quantified using retrospective chart reviews for a broad range of nursing activities.
- Omissions are present in 52% of the examined expected nursing care activities.
- Patients experience omissions regarding 8–84% of their expected nursing care activities.

1. Introduction

Omissions in nursing care are "…error[s] of omission, occurring when any aspect of required patient care is omitted or significantly delayed" (Kalisch et al., 2009). The omission of necessary tasks compromises patient safety (Recio-Saucedo et al., 2018) and can even lead to the patient's death (Ball et al., 2018). Other patient safety issues related to omissions include medication errors, patient falls with injury and nosocomial infections (Lucero et al., 2010). This is explained by omissions, acting as a mediating factor between nursing care and patient outcomes (Zhu et al., 2019). For example, units with higher rates of omitted care show increased incidences of blood stream infections (Ausserhofer et al., 2013). In addition to their influence on patient safety, nursing care omissions lower patient satisfaction (Aiken et al., 2018) and patient-centered care (Bachnick et al., 2018). Not only patients suffer from omitted care: nurses who omit care experience feelings of guilt (Rooddehghan et al., 2018) and increased burnout rates (Liu et al., 2019). Drivers for omitted care are for example low staffing resources (Griffiths et al., 2018) or the nurses personal accountability (Drach-Zahavy and Srulovici, 2019). Also, patient characteristics, like the care needs of the patients have an influence on omitted nursing care. It has been shown that most nurses set their priorities according to different patient characteristics, like the severity of the disease or the patients age and the perceived benefit a treatment brings (Suhonen et al., 2018).

Depending on the survey instrument used, the care activities most frequently reported as omitted are emotional and psychological support, educating patients and families, mobility activities such as ambulating, and hygiene activities such as bathing or oral care. The least frequently reported are those involving infection control, treatment (e.g., medication administration), nutrition, and elimination (Jones et al., 2015; Mandal et al., 2020).

So far, the phenomenon of omitted nursing care has been almost exclusively investigated via various survey methodologies (Jones et al., 2015; Mandal et al., 2020). Those have their strengths—ease of use, relatively satisfying psychometric properties (VanFosson et al., 2016) and feasibility with large sample sizes (Jones et al., 2015). However, they restrict the range of care activities to a (pre-) selected set (Ausserhofer et al., 2014; Ball et al., 2018; Jones et al., 2015; Mandal et al., 2020). Furthermore, while some patients clearly experience more omissions than others (Suhonen et al., 2018), only one patient-level analysis using survey-collected data has yet, to our knowledge, been performed (Kalisch et al., 2014). However, in that case, the survey was restricted to a set of activities that were both pre-defined and recognisable to patients. Another weakness of a self-reporting instrument is the recall bias. A nurse, who forgot to do something will not report this in a survey, because it is not even on the nurses' mind that this was omitted. Additionally, there are certain errors that are less likely communicated by nurses than others because they are related to sensible topics (Milliken et al., 2003). Activities like "patient surveillance" and "timely administration of medication" could underly those social desirability bias in surveys (Ausserhofer et al., 2014).

Another source of a bias, Ball et al. (2014) found, is the subjective understanding of the questions. Which care activities a nurse considers to be necessary depends on clinical judgement and can vary with nurse education and characteristics. Also, the inability to reflect task shifting (Ball et al., 2014), is limiting results from surveys. Using survey data is also limiting the informative value of prediction models for example for nurse staffing or job satisfaction due to a single source bias (Griffiths et al., 2016). Taking all those biases together, ideally, then, a method complementary to surveys, might provide additional and more probably for some activities even more reliable knowledge in the field omitted nursing care.

One alternative to surveys are retrospective chart reviews using routine data. Retrospective chart reviews are used in various research fields as a data extraction method. Nurse charts are an important source of information about the needs of the patient (De Groot et al., 2020). For the detection of adverse events, which also can be due to omitted care, chart reviews are the gold standard for data collection (Gregory and Radovinsky, 2012). Using this method revealed that adverse event rates are up to ten times higher than previously measured with other detection methods (Classen et al., 2011). Additionally, different studies, including one of the WHO (Michel, 2003), showed the advantages of using various methods to explore the phenomenon (Naessens et al., 2009; Olsen et al., 2007). In the omitted care research this is not yet the case as almost no other method than surveys has been used (Jones et al., 2015; Mandal et al., 2020). The review method involved searching closed patient charts for evidence of certain events or activities. To date, a small number of studies have used retrospective chart review methodology or structured routine data from the electronic health record (EHR) to assess omitted care. However, each of those have focused on a single predefined nursing activity, e.g., surveillance (Dall'Ora et al., 2019, Redfern et al., 2019; Smith et al., 2020), pneumonia prevention measures (Tesoro et al., 2018) or use of a nursing assessment (Recio-Saucedo et al., 2021). And while several have assessed care omissions on the activity (Tesoro et al., 2018) and unit level (Dall'Ora et al., 2019; Redfern et al., 2019), none have reported on the patient level. Showing omissions on the patients' level would have the advantage of supplying a person-centered perspective and identifying patients particularly at risk regarding omitted nursing activity. Therefore, in addition to helping overcome some of the above-named challenges, we hope that retrospective chart review will deepen our understanding of omitted care.

1.1. Objectives

The aim of this study was to describe the characteristics and frequencies of omitted nursing care activities using a retrospective chart review methodology.

2. Methods

2.1. Design and setting

This observational single-center descriptive study was conducted in two of four inpatient units in the neurological department of a German university hospital. The hospital has 1600 beds and roughly 3000 nurses, who care for 72,000 inpatients per year. During the inclusion period (June 2018–May 2019) these two units had a total of 3591 admissions. On the two units, 25 fulltime registered nurses equivalents and 4.5 fulltime equivalent nurse aids cover three shifts. In total, the two units have 46 beds, with a 77% occupancy. Mean patient length of stay (LOS) was 4.5 days (range 0–34, SD 4.4). Except for acute strokes and neuro-surgical procedures, the full range of neurological disorders were treated on both units.

2.2. Participants

We limited this study to patients with LOSs $\geq$ 24 h and $\leq$ 16 days (two SDs greater than the mean LOS). This selection removed outliers while retaining approximately 95% of the sample. From a total of 3591 patient admissions, 562 stayed less than 24 h and 100 admissions lasted more than 2 SD from the mean length of stay. This left 2929 patients who fulfilled both inclusion criteria, making them eligible for random selection. One hundred admissions were then randomly selected using the statistical software *R*'s *sample* function (R Core Team, 2019).

2.3. Development of the review protocol

Following a multistep iterative approach, a study-specific review protocol was developed to systematically review patient charts for each included admission and extract the relevant data.

For the development of the protocol, the research group met repeatedly to discuss ways, to reliably detect omissions in the patients' chart. The review was conducted by the first author using the hospital's EHR system (Meona© system (Meona, 2020)).

As a registered nurse experienced with structured chart review methodology, she had worked on another unit of the same neurological department for the last seven years.

This study's median chart review time was 25 min (range 6–88, IQR 18.5). During the development process, a study nurse was involved to use the protocol and give feedback both on the protocol and on the review process.

2.4. Data collection

To detect omissions in nursing care, we identified the need for a three-step process. First, the full chart was read by the reviewer. In addition to the required demographics, the review protocol's first page asks for notes outlining the patient's treatments and needs. Based on this information, the reviewer's second step was to formulate a list of expected care activities. Expected care activities included those which had been prescribed, those based on good clinical practice or those serving a patient need, which he or she could not perform by himself/herself (Schubert et al., 2007). Some expected care activities were relevant for almost all patients (e.g. measuring blood pressure). To simplify the review process, these activities were pre-printed on the protocol.

In the final step, all expected care activities were reviewed for the entire length of hospital stay and were assessed according to two key dimensions:

2.4.1. How important was it to document this care activity? (4-point Likert scale: 0. not applicable 1. somewhat important; 2. important; 3. very important)

We used this single item to rank the importance of documentation regarding each respective care activity. The ranking was based on the consideration that, depending on the care activity, documentation is more or less important (and there for reliable) depending on whether it provides key information highly relevant for the clinical process and/or whether it is important to document from a legal perspective. Therefore, the importance of documenting each task was ranked depending on the possible consequences of a loss of this information. In other words, this item was added to the usual chart review methodology to enhance the reliability of the results obtained by the documentation of an activity. Because even though we know, that the chart is an invaluable source of information about patients and their needs, the completeness and accuracy of information is not always satisfying (De Groot et al., 2020).

2.4.2. Had the activity been omitted? (Trichotomous: yes/no/partly)

The full chart was reviewed for omissions of this activity. If an expected activity was never performed during the hospital stay, it was classified as fully omitted. An activity which was sometimes performed or sometimes omitted was rated as 'partly' omitted. If there were reasons mentioned, why the activity was omitted (e.g., patient was absent from the ward), it was not rated as an omission.

Several of the vital sign measurement activities were quantified as a percentage of omissions per targeted number ((1-delivered/targeted)*100). Results were divided into 3 categories: '$\leq$5%' for patients receiving 95–100% of their targeted vital signs measurements. '5–25%' for 94–75% and '>25%' for patients receiving less than 75% of their targeted number of vital sign measurements.

To be able to structure the results on the activity level and to compare them to other studies we assigned all activities to seven major categories. Following Jones (2014) six categories were used: *Assistance with physical care, Implementation of treatment plan, Emotional support and teaching, Surveillance/Vigilance, Coordination of care and discharge planning, Documentation.* We added one category, *Preventive measures*, separated one—*Emotional support and teaching*—into two and deleted one (*Coordination of care and discharge planning*).

2.5. Statistical methods

We analyzed the data either by individual patient or by activity. We used descriptive statistics, giving the frequencies with percentages, medians, inter quartile ranges (IQR), and ranges. For all statistical analyses we used *R* Version 3.6.1 (R Core Team, 2019).

2.6. Ethical considerations

This study has been approved by the Ethics committee of the Albert-Ludwigs-Universität Freiburg (314/19). By signing the treatment contract, the patients gave permission to use their routine data for research purposes. On the review protocol, no patient identifiers, only their study numbers, were used. Likewise, none of the collected data can be traced back to any of the nurses. Mixing the two units guaranteed the de-identification of team members; therefore, no consequences can be expected for any of the nurses.

3. Results

3.1. Demographics

The 100 studied patient admissions resulted in a total of 607 patient days reviewed. All patient demographics are presented in Table 1.

3.2. Individual patient level

On the individual patient level, between 11 and 32 care activities were identified (Table 2). However, of the 32 identified care activities, our reviews indicated that between one and 22 (8% to 84%) had been partly or fully omitted during each patient's stay (Table 2).

3.3. Activity level

We extracted a total of 66 distinct nursing care activities. Overall, there were 1885 instances where care activities were expected. Of those, 52% (*n* = 971) were partly or fully omitted (Table 3). Adding the layer of the importance of documentation on the activity level, 28% (*n* = 525) of expected activities have been partly

Table 1
Patient demographics ($n = 100$).

Gender, *n* (%)	
Female	59 (59)
Male	41 (41)
Age in years, median (range, IQR)	64 (18–95, 28)
ICD – 10[a] Codes, *n* (%)	
Cerebral-vascular diseases	25 (25)
Other neurological diseases	23 (23)
ED[b]/Demyelinating diseases	11 (11)
Epilepsy/Seizure	11 (11)
Infectious diseases of CNS[c]	8 (8)
Other non-neurological diseases	6 (6)
Extrapyramidal diseases	6 (6)
Polyneuritis	6 (6)
Psychiatric/ behavioral diseases	4 (4)
Length of stay, median (range, IQR)	5 (2–16, 5.25)

[a] International Statistical Classification of Diseases and Related Health Problems – Tenth Revision.
[b] Encephalomyelitis disseminata.
[c] Central nervous system.

Table 2
Activities and omissions on individual patient level.

	Median (Min-Max, IQR)
Expected activities	19 (11–32, 7)
Omissions[a] in expected activities	9 (1–22, 7)
Percentage of omissions[a] in expected activities	49% (8–84, 27)

[a] Partly and fully omitted merged.

or fully omitted with very high importance of documentation (Table 4).

Table 3 provides an overview of the party or fully omitted care activities and their respective categories. Regarding the categories, *Surveillance/vigilance/assessments* was the category with the highest frequency of expected care activities. Of 964 expected interactions, 469 (49%) were omitted entirely or partially. The category with the lowest activity frequency was *Teaching* ($n = 34$), which was also the least-omitted category (29%, $n = 10$). The most omitted category was *Giving emotional support* (88%, $n = 60$), followed by *Preventive measures* (62%, $n = 115$) and *Implementation of a treatment plan* (56%, $n = 104$).

On the activity level, *Giving emotional support* was one of the most frequently omitted care activities (88%, $n = 60$), when merging partial and full omissions. Partial omissions in this category mean, that not every shift has written something about the emotional status of the patient, fully omitted means there was never anything written, which happened in 21 cases (31%). Ten of the care activities were only expected to be performed to one or two patients, making 100% omission rates more probable. Of those activities that were fully omitted, three were applicable more than twice: *Measuring mean arterial blood pressure* ($n = 3$), *Incontinence training* ($n = 4$) and *Preparing and giving inhalations* ($n = 5$). The next highest rate of omission—92% ($n = 12$)—was *Observing and treating skin* (Category of *Preventive measures*). This was followed by *Measuring* SpO$_2$ (80%, $n = 43$) and *Reaction on deterioration* (78%, $n = 32$). By far, *Enabling personal hygiene* was the least frequently omitted care (6%, $n = 2$). Five activities were performed with no omissions and occurred more than once: *Organizing discharge* ($n = 6$), *Taking measures against aspiration* ($n = = 4$), *Organizing permanent watch* ($n = = 2$), *Measuring vital capacity* ($n = 4$) and *Monitoring vital signs in end of life care* ($n = 3$).

Table 4 shows the omissions (partly and fully omitted merged) sorted by category and adding information about the rating of importance of documentation. Of the 971 omissions, 644 (34%) were rated either "important" ($n = 119$) or "very important to document" ($n = 525$). Twenty-eight% (525 of 1885) of the care activities were partly or fully omitted and had a very high importance of documentation. The order of the number of omissions does not change by adding the layer of the importance of documentation. Still, *Giving emotional support* is the most omitted category but with a lower percentage without making the distinction of importance to document (57% omitted when important or very important to document versus 88% omission without the distinction of the importance of documentation). Looking at those omissions when it was *very* important to document, we found most omissions in the category of *Implementation of a treatment plan* (50%, $n = 94$), followed by *Surveillance/vigilance/assessments* (39%, $n = 375$). In the category of *Assistance with physical care*, we found 17 (24%) expected care activities omitted. *Preventive measures* which were very important to document have been almost equally often omitted like activities in *Teaching* (16%, $n = 30$ and 15%, $n = 5$). *Giving emotional support* is from the perspective of omissions with very high importance of documentation the least frequently omitted category (6%, $n = 4$).

Table 5 shows the four routinely measured patient vital signs rated "very important to document". Half of the patients received 95–100% ($n = 141$) of the targeted vital sign measurements, while approximately one-quarter received fewer than 75% ($n = 76$) of the necessary number.

4. Discussion

This is the first use of retrospective chart reviews to assess the full range of nursing care omissions. In a sample of 100 patients admitted for a total of 607 patient-days, our analyses revealed that patients experienced between one and 22 (8–84%) fully or partly omitted care activities of 11 to 32 expected care activities during their hospital stays. The chart reviews indicated that, of 1885 applicable instances of nursing care activities, 52% ($n = 971$) were partly or fully omitted. Of the omitted activities, 28% ($n = 525$) were rated as very important to document and 34% ($n = 644$) as either important or very important to document. As a percentage of expected instances, rates varied between 6% and 100%. The category with the most frequently omitted care activities was *emotional support,* with 88% ($n = 66$). The least frequently omitted care category was *teaching,* with 29% ($n = 10$).

Giving emotional support was the most frequently omitted care category (88%, $n = 60$). This finding is congruent with those of previous studies (Ausserhofer et al., 2014; Griffiths et al., 2018; Jones et al., 2015). As giving emotional support is not documented in a structured way, there is a high risk of overestimating omissions with our approach, and we can only show a simple and vague representation of the emotional support that might have been provided. To validate this risk, we ranked the importance of documenting emotional care only as 'important' or 'very important' if we found, for example psychiatric co-morbidities, or if it was noted that the patient had problems coping or was agitated/delirious. Finally, even if we remove cases where it was only 'somewhat important' to document *Giving emotional support*, still only 57% ($n = 39$) of applicable instances were partially or fully omitted. In four of those cases (6%) it was even very important to document. The example of *Giving emotional support* shows the importance of the judgement of the reviewer how reliable an activity is documented in a chart. To get a sense of the reliability of the documentation, we assessed how important the documentation was judged. Also adding, if it was only partly or fully omitted, is important to get a perspective on an activity like *Giving emotional support*. It was partly omitted in 39 cases (57%), which means that patients emotional needs where recognised, even though not all shifts provided information on the patient's emotional status.

The category with the second highest omission rates was *Preventive measures* (62%, $n = 115$). One of this category's most fre-

Table 3
Omitted categories and care activities sorted by percentage of 'all omitted' on category level.

Category / Care activity	Expected n	All omitted[a] n (%)	Partly omitted n (%)	Fully omitted n (%)
Emotional support	**68**	**60 (88)**	**39 (57)**	**21 (31)**
Give emotional care	68	60 (88)	39 (57)	21 (31)
Preventive measures	**185**	**115 (62)**	**76 (41)**	**39 (21)**
Care for port system	1	1 (100)	1 (100)	
Observe and treat skin	13	12 (92)	10 (77)	2 (15)
Perform ventilation exercises	14	11 (79)	7 (50)	4 (29)
Perform oral care (more than usual)	8	6 (75)	4 (50)	2 (25)
Interventions to avoid thrombosis	75	54 (72)	26 (35)	28 (37)
Enable positioning and ambulation	43	25 (58)	24 (56)	1 (2)
Care of gastric tubes	4	2 (50)	1 (25)	1 (25)
Care for urinary catheter	15	4 (27)	3 (20)	1 (7)
Organize discharge	6	[c]		
Take measures against aspiration	4	[c]		
Organize permanent watch	2	[c]		
Implementation of treatment plan	**187**	**104 (56)**	**78 (42)**	**26 (14)**
Prepare and give inhalations	5	5 (100)	5 (100)	
Give oxygen	1	1 (100)		1 (100)
Apply eye drops	5	4 (80)	4 (80)	
React on deterioration	41	32 (78)	18 (44)	14 (34)
Use watch glass bandage	4	3 (75)	2 (50)	1 (25)
Treat wounds (with control)	10	7 (70)	2 (20)	5 (50)
Give insulin	4	2 (50)	1 (25)	1(25)
Give all medication during shift	99	44 (44)	41 (41)	3 (3)
Care of phlebitis or extravasate	3	1 (33)	1 (33)	
Give IVIG[b]/Cytostatic according scheme	13	4 (31)	2 (15)	2 (15)
Support with sleeping rhythm	1	[c]		
Use CPAP[b]-device at night	1	[c]		
Documentation	**376**	**189 (50)**	**132 (35)**	**57 (15)**
Fill out care plan	100	67 (67)	67 (67)	
Evaluate care plan	64	41 (64)	15 (23)	26 (41)
Document all catheters	53	35 (40)	10 (11)	25 (28)
Write report each shift	100	39 (39)	39 (39)	
Document all wounds	11	4 (36)		4 (36)
Protocol to document IVIG[b]/Cytostatic	13	3 (23)	1 (8)	2 (15)
Surveillance/Vigilance/Assessments	**964**	**469 (49)**	**372 (39)**	**97 (10)**
Measure mean arterial pressure	3	3 (100)	2 (67)	1 (33)
Check PH value from feeding tube	2	2 (100)		2 (100)
Check circulation, sensory and motoric	2	2 (100)	1 (50)	1 (50)
Measure heat frequency variability	1	1 (100)	1 (100)	
Evaluate need for urinary catheter	7	6 (86)		6 (86)
Measure oxygen saturation (SpO$_2$)	54	43 (80)	39 (72)	4 (7)
Watch fluid balance	5	4 (80)	2 (40)	2 (40)
Assess elimination each day	90	65 (72)	58 (64)	7 (8)
Control peripheral venous catheter	87	60 (69)	34 (39)	26 (30)
Measure blood glucose level	26	17 (65)	12 (46)	5 (19)
Measure blood pressure	96	50 (52)	50 (52)	
Measure heart frequency	96	47 (49)	47 (49)	
Assess pain	98	44 (45)	37 (38)	7 (7)
Measure temperature	96	41 (43)	40 (42)	1 (1)
Surveillance after scheme for IVIGs[b]	13	5 (38)	4 (31)	1 (8)
Use applicable risk assessment tools	91	34 (37)	17 (19)	17 (19)
Observe signs of withdrawal	3	1 (33)	1 (33)	
Use bladder scan	3	1 (33)		1 (33)
Collect information about the patient	96	28 (29)	20 (21)	8 (8)
Write electrocardiogram	4	1 (25)		1 (25)
Take blood	61	13 (21)	7 (11)	6 (10)
Take samples (like urine)	23	1 (4)		1 (4)
Measure vital capacity	4	[c]		
Monitor vital signs in end of life care	3	[c]		
Assistance with physical care	**71**	**24 (34)**	**12 (17)**	**12 (17)**
Monitor fluid intake	17	12 (71)	5 (29)	7 (41)
Give food through gastric tube	3	2 (67)	1 (33)	1 (33)
Enable patient to use toilet	2	1 (50)	1 (50)	
Help with defecation	10	4 (40)	1 (10)	3 (30)
Help and ensure nutrition intake	5	2 (40)	2 (40)	
Suctioning of secreta from lung	3	1 (33)		1 (33)
Enable personal hygiene with oral care	31	2 (6)	2 (6)	

Table 3 (*Continued*).

Category Care activity	Expected n	All omitted[a] n (%)	Partly omitted n (%)	Fully omitted n (%)
Teaching	**34**	**10 (29)**	**1 (3)**	**9 (26)**
Incontinence training	4	4 (100)		4 (100)
Train patient to cope with neglect	1	1 (100)		1 (100)
Educate about medication	3	1 (33)	1 (33)	
Inform patient about fall risk	25	4 (16)		4 (16)
Educate the family	1	[c]		
Total	**1885**	**971 (52)**	**710 (83)**	**261 (14)**

[a] Partly and fully omitted merged.
[b] IVIG, Intravenous immunoglobulins; CPAP, continuous positive airway pressure.
[c] Not omitted.

quently omitted activities was *Perform ventilation exercises* (omitted 79%, *n* = 11). This activity has previously been studied via retrospective chart review methodology by Tesoro et al. (2018). In that case, the authors assessed whether selected activities had been documented 24 h before diagnosing hospital acquired non-ventilator associated pneumonia in inpatients. Reviewing 205 patient charts, they found 83% had no ventilation exercises documented. They also found that 48% had no documentation regarding any out of bed activity, which is comparable to our finding of 58% (*n* = 25) omission of *Enable positioning and ambulation*. Survey methods indicate that this is omitted in Germany in a far smaller percentage (22%) of cases (Ausserhofer et al., 2014). As *Enable positioning and ambulation* is necessary for patients with a high risk for developing pressure ulcers or pneumonia, we rated it as omitted if no activity was documented for more than 4 h. Together with *Observe and treat skin* (omitted 92%, *n* = 12), which was one of the most frequently omitted care activities in the category *Preventive measures, Enable positioning and ambulation* is a core element of pressure ulcer prevention.

According to other studies, *Implementation of treatment plan* is one of the least frequently omitted nursing activities (Jones et al., 2015). Results from a German nurse survey even reported that, with 14% omissions, "Treatments and procedures" was its least frequently omitted nursing activity (Ausserhofer et al., 2014). However, in our study this category was the third most-omitted: its omission rate was 56% (*n* = 104, *Implementation of treatment plan*). This category's most striking omissions are found in *React on deterioration* (omitted 78%, *n* = 32) and *Give all medication during shift* (omitted 44%, *n* = 44). In the German nurse reported survey (Ausserhofer et al., 2014), the omission rate for *Give all medication during shift* was assessed at 20%. In our study we counted a 2 h delay in administering prescribed medication, or not giving it at all with no explanation (e.g., absence or loss of vigilance), as an omission. Likewise, for *Reaction on deterioration* (medication and/or re-assessment) was documented within 2 h after a deteriorated vital sign (systolic blood pressure <100/ >180 mmHg, heart frequency <50/ > 100 bpm, temperature >37.5 °C, oxygen saturation <94%), we rated it as an omission. An omission rate of 78% in *React on deterioration* is enormous, as this is a key characteristic underlying the concept of failure to rescue (Mushta et al., 2018).

To be able to realize deteriorations, surveillance activities are essential. *Surveillance/Vigilance/Assessments* is the category with the most instances where activities were expected (*n* = 964). Studies using the MISSCARE survey (Kalisch and Williams, 2009) reported *Surveillance* (in the MISSCARE Survey called: "Vital signs assessed as ordered" and "Bedside glucose monitoring") as amongst the least frequently omitted nursing activities (Griffiths et al., 2018). However, we found it more common than expected, with 49% (*n* = 469) of surveillance activities omitted, including 65% (*n* = 17) of required blood glucose measurements and 50% (*n* = 141) of the targeted vital signs measurements. We assessed the targeted vital sign measurements based on the physicians' orders or the unit standard, which was usually twice per day. Our findings are supported by two studies using routine data to assess omissions in vital sign measurements (Dall'Ora et al., 2019; Redfern et al., 2019). Dall'Ora et al. (2019) found 53% (*n* = 99,043) of required vital sign measurements undertaken too late and 44% (*n* = 81,568) omitted entirely. Their study population consisted of high acuity patients who required vital sign measurements at least every 4 h. And in what is, to our knowledge, the only study to measure nursing care omissions in neurological units, Redfern et al. (2019) analysis of routine data indicated 52–61% delayed and 36–45% missed vital sign observations in neuro and stroke rehabilitation—the highest rates of their 32 included units. The authors assessed the frequency of required vital sign measurements based on the computed National Early Warning Score (Royal College of Physicians, 2017) recorded for each patient at admission.

In our study, the cumulative incidence of partial or full omission of documentation activities was 50% (*n* = 189). At the top of this list was *Fill out care plan* (67% omitted, *n* = 67), followed by *Evaluate care plan* (64% omitted, *n* = 41). Survey studies tend to report omissions rates of 41% ("Adequately documenting nursing care") and 55% ("Develop or update nursing care plans") (Ausserhofer et al., 2014). To prevent omissions in care plan documentation from leading us to overestimate omissions of activities documented there (e.g., *positioning and ambulation*), we did not rate those activities for shifts where nothing was filled out in the plan. Although we found high numbers of omissions in the category of documentation, we rated and considered the value of documenting each activity when estimating omissions in other categories.

One of the lowest rates of omission we found related to one of nursing's traditional core activities: *Enable personal hygiene* (6% omitted, *n* = 2). This can be explained by the relatively high rates of nursing aides working on the units. Their main task is to support patients in the morning with their personal hygiene and to serve food. Another possible factor is that, at least partially because *Enable personal hygiene* is culturally embedded in nurses' role understanding in Germany, it is afforded a high priority in daily care. Compared to this activity's 6% omission rate, the 78% omission rate for *Reaction on deterioration* calls for a discussion on priority setting. Also, considering that basic care is delivered but the system fails on important surveillance measures, more appropriate skill mixes might be worthwhile.

Compared to other studies (Ausserhofer et al., 2014; Griffiths et al., 2018; Jones et al., 2015), we found few omissions in *Teaching* (29%, *n* = 10) and none in *Organization of discharge* (0%, *n* = 0). However, the need for patient education cannot always be identified in the EHR. Therefore, while we assume that the need for it was higher than indicated, we only reviewed cases for which this need was identified and documented by staff, or where a risk assessment pointed to a need for education (e.g., fall risk; *Inform*

Table 4
Omitted categories and care activities sorted by percentage of 'all omitted' by category.

Category Care activity	Expected *n*	All omitted[a] *n* (%)	Important or very important to document[a] *n* (%)	Only very important to document[a] *n* (%)
Emotional support	**68**	**60 (88)**	**39 (57)**	**4 (6)**
Give emotional care	68	60 (88)	39 (57)	4 (6)
Preventive measures	**185**	**115 (62)**	**99 (54)**	**30 (16)**
Care for port system	1	1 (100)	1 (100)	1 (100)
Observe and treat skin	13	12 (92)	7 (54)	
Perform ventilation exercises	14	11 (79)	11 (79)	
Perform oral care (more than usual)	8	6 (75)	3 (38)	
Interventions to avoid thrombosis	75	54 (72)	54 (72)	17 (23)
Enable positioning and ambulation	43	25 (58)	17 (40)	10 (23)
Care of gastric tubes	4	2 (50)	2 (50)	2 (50)
Care for urinary catheter	15	4 (27)	4 (27)	
Organize discharge	6	c		
Take measures against aspiration	4	c		
Organize permanent watch	2	c		
Implementation of treatment plan	**187**	**104 (56)**	**101 (54)**	**94 (50)**
Prepare and give inhalations	5	5 (100)	5 (100)	3 (60)
Give oxygen	1	1 (100)	1 (100)	1 (100)
Apply eye drops	5	4 (80)	4 (80)	2 (40)
React on deterioration	41	32 (78)	32 (78)	32 (78)
Use watch glass bandage	4	3 (75)		
Treat wounds (with control)	10	7 (70)	7 (70)	5 (50)
Give insulin	4	2 (50)	2 (50)	2 (50)
Give all medication during shift	99	44 (44)	44 (44)	44 (44)
Care of phlebitis or extravasate	3	1 (33)	1 (33)	
Give IVIG[b]/Cytostatic according scheme	13	4 (31)	4 (31)	4 (31)
Support with sleeping rhythm	1	c		
Use CPAP[b]-device at night	1	c		
Documentation	**376**	**189 (50)**	d	
Fill out care plan	100	67 (67)	d	
Evaluate care plan	64	41 (64)	d	
Document all catheters	53	35 (40)	d	
Write report each shift	100	39 (39)	d	
Document all wounds	11	4 (36)	d	
Protocol to document IVIG[b]/Cytostatic	13	3 (23)	d	
Surveillance/Vigilance/Assessments	**964**	**469 (49)**	**376 (39)**	**375 (39)**
Measure mean arterial pressure	3	3 (100)	3 (100)	3 (100)
Check PH value from feeding tube	2	2 (100)	2 (100)	2 (100)
Check circulation, sensory and motoric	2	2 (100)	2 (100)	2 (100)
Measure heat frequency variability	1	1 (100)	1 (100)	1 (100)
Evaluate need for urinary catheter	7	6 (86)		
Measure oxygen saturation (SpO$_2$)	54	43 (80)	37 (69)	37 (69)
Watch fluid balance	5	4 (80)	4 (80)	4 (80)
Assess elimination each day	90	65 (72)	31 (34)	31 (34)
Control peripheral venous catheter	87	60 (69)	60 (69)	60 (69)
Measure blood glucose level	26	17 (65)	17 (65)	17 (65)
Measure blood pressure	96	50 (52)	38 (40)	38 (40)
Measure heart frequency	96	47 (49)	36 (38)	36 (38)
Assess pain	98	44 (45)	42 (43)	41 (42)
Measure temperature	96	41 (43)	35 (36)	35 (36)
Surveillance after scheme for IVIGs[b]	13	5 (38)	5 (38)	5 (38)
Use applicable risk assessment tools	91	34 (37)	26 (29)	26 (29)
Observe signs of withdrawal	3	1 (33)		
Use bladder scan	3	1 (33)	1 (33)	1 (33)
Collect information about the patient	96	28 (29)	21 (22)	21 (22)
Write electrocardiogram	4	1 (25)	1 (25)	1 (25)
Take blood	61	13 (21)	13 (21)	13 (21)
Take samples (like urine)	23	1 (4)	1 (4)	1 (4)
Measure vital capacity	4	c		
Monitor vital signs in end of life care	3	c		
Assistance with physical care	**71**	**24 (34)**	**20 (28)**	**17 (24)**
Monitor fluid intake	17	12 (71)	12 (71)	11 (65)
Give food through gastric tube	3	2 (67)	2 (67)	2 (67)
Enable patient to use toilet	2	1 (50)		
Help with defecation	10	4 (40)	4 (40)	4 (40)
Help and ensure nutrition intake	5	2 (40)	1 (20)	
Suctioning of secreta from lung	3	1 (33)		
Enable personal hygiene with oral care	31	2 (6)	1 (3)	

(Continued on next page)

Table 4 (*Continued*).

Category Care activity	Expected n	All omitted[a] n (%)	Important or very important to document[a] n (%)	Only very important to document[a] n (%)
Teaching	**34**	**10 (29)**	**9 (26)**	**5 (15)**
Incontinence training	4	4 (100)	4 (100)	
Train patient to cope with neglect	1	1 (100)		
Educate about medication	3	1 (33)	1 (33)	1 (33)
Inform patient about fall risk	25	4 (16)	4 (16)	4 (16)
Educate the family	1	[c]		
Total	1885	971 (52)	644 (34)	525 (28)

[a] Partly and fully omitted merged.
[b] IVIG, Intravenous immunoglobulins; CPAP, continuous positive airway pressure.
[c] Not omitted.
[d] Importance of documentation not applicable for documentation activities.

Table 5
Counted vital sign measurements, sorted by the most frequently omitted.

Activity, Min-Max (median, IQR)	n[a]	Targeted	Delivered	Omitted, n (%)		
				<5%	5–25%	>25%
Oxygen saturation	46	2–31 (9, 6)	0–27 (5, 5)	9 (20)	10 (22)	27 (59)
Temperature	80	1–19 (5, 8)	0–16 (4, 7)	45 (56)	16 (20)	19 (24)
Blood pressure	78	2–50 (9, 12)	1–39 (8, 12)	42 (54)	20 (26)	16 (21)
Heart frequency	78	2–50 (9, 12)	1–39 (8, 12)	45 (58)	19 (24)	14 (18)
Total	282	1–50 (8, 10)	0–39 (7, 9)	141 (50)	65 (23)	76 (27)

[a] Partly and fully omitted merged **and** ranked as 'very important' to document.

patient about fall risk (16% omitted, n = 4)). As for *Organization of discharge* (n = 6), which was never omitted, this might be because social workers normally organize discharge, with little input normally required from registered nurses. Furthermore, as patient charts end with discharge, chart review cannot indicate whether any steps for discharge were omitted: assessing this would require a follow-up study.

The range of omitted care activities indicated here is broad (8–84%). Although we illustrate which activities are more likely to be omitted, so large a range of omissions across a patient sample this size should be studied in more depth. For instance, it is possible that nurses prioritize not only activities but also patient groups (Suhonen et al., 2018).

4.1. Strength and limitations

As almost all studies to date used survey methodology (Jones et al., 2015), the National Institute for Health and Care Excellence (NICE) (2014) concluded, that "there is [...] a lack of research on measures of missed care that could be routinely monitored and therefore easily collected and investigated." Using chart reviews, the relevant data's routine collection and ready availability lead to considerable cost savings (Gearing et al., 2006). To our knowledge, this is the first study to show the cumulative prevalence (Jones et al., 2015) of patient-level omissions of such a comprehensive set of required care activities. For the full hospital episode of inpatients, all required tasks performed (or omitted) by all engaged nurses were reviewed, i.e., this study supported a comprehensive perspective of care (Mandal et al., 2020). Also, assessing all required nursing activities reduces one major risk of focusing on preselected activities: limitation of the discussion and study of other care activities (VanFosson et al., 2016). By working from the patients' perspective, we also avoid depending either on individual nurses' subjective self-reports (Dhaini et al., 2020) or on their interpretations of required care.

The methodology employed here could also add a valuable perspective to monitoring the quality of care. Searching

for care omissions might enable managers to note—and halt or reverse—reductions in the quality of care before incidents occur (VanFosson et al., 2016). Because, to date, quality of care is often measured by counting adverse events (e.g., pressure ulcers) (National Quality Forum (NQF), 2004), corrections can only be initiated reactively, i.e., after an incident has occurred.

Despite its strengths, this methodology is also subject to certain limitations. The main limitation is its dependence on the structure and quality of documentation. To reduce our need to gauge whether a care activity had been performed but not documented (overestimation of omissions), we assessed the importance of documenting it. Thus, we distinguished omissions of activities for which documentation is often skipped from those for which documentation is rarely skipped. While this process was arguably subject to biases on the reviewer's side, it allowed us, to some extent, to differentiate negligent documentation from omitted activity. We could show that this perspective supports assessing, whether an activity has been omitted or simply might not be documented (see example of emotional support). Hence, in future retrospective chart reviews, the question, how important it was to document the assessed care should be considered.

Conversely, social desirability bias could lead nurses to over-document some partially performed, or document omitted ones. For example, it is possible that the nurses documented activities such as *Enabling personal hygiene* more often than performed because its performance reflects their own role expectations; moreover, documenting it entails only the ticking a box in the care plan. As the EHR depends upon accurate reporting, we could only manage this type of risk to a limited extent. As indicated in Ausserhofer et al. (2014) comparison of data from 12 European countries—seeking reasons for inter-regional variability—similar biases exist for survey methods. Furthermore, as discussed above regarding *Organization of discharge*, even in cases where an activity has clearly been performed, it is impossible to assess the conscientiousness of its performance.

Additionally, while we were able to assess more activities than would be possible via a survey, certain activities, e.g., hand hy-

giene, simply cannot be assessed via the EHR (Schubert et al., 2007). Also, as discussed in the case of *Teaching,* the patient's expectations are only occasionally documented. Therefore, using the EHR as the sole data source could lead to an unreliable estimation of the need to perform this activity. To appropriately assess the unmet patient expectations, a patient survey might be more suitable. For certain activities, then, a survey would more reliably detect omissions. That is, to identify omitted care activities, surveys and retrospective chart reviews actually offer complementary methodologies.

Also nursing care is sometimes unpredictable, therefor clinical documentation, might not prospectively cover all activities that might take place. However, nursing notes offer a source of exactly that information and are therefore detectable by chart reviews.

One final, serious limitation of the method is its dependency on the reviewer's skills. Previous studies have showed that, when using retrospective chart review methodology, the kappa value (which we did not assess) can differ depending on the reviewer's skills (Hibbert et al., 2017). To reduce this limitation, we chose a patient population, setting and documentation system matching the first reviewer's professional experience. Still, while the protocol used is adapted to the study setting, the review required considerable time to execute.

The approach used to detect omissions using chart review has not yet been fully assessed in terms of reliability or validity and further studies are needed to validate the method for detecting omissions in nursing care. One option for such validation is a second and independent reviewer for assessing the inter-rater reliability. This could help to explore how reliable patients' needs and the rating of the importance of documentation are assessed. This will not solve the question, whether the documentation itself is complete, valid and/or reliable. Therefore, chart reviews could be used in parallel with a survey or with direct observations to explore concurrent validity of these methods. Another option is to use nurses experience and ask them how they would rate the data extraction protocol regarding face and content validity and how they would judge the importance of documentation of activities.

5. Conclusions

Compared to survey-based studies, our retrospective chart review of routine data turned up high percentages of omitted care activities. Our chart review methodology allowed us not only to detect a wide range of nursing activities, but also to analyze omissions both per patient and per activity. This suggests that, in addition to current reactive measures of adverse incidents, routine data will soon enable nursing leaders to monitor and correct the relevant aspects of nursing care before such events occur. This method would also bring a new perspective to the field of omitted care research. Further research in this field, using alternative and combined methodologies, might also be of value.

CRediT authorship contribution statement

Lili Saar: Conceptualization, Data collection, Data Analysis, Methodology, Writing Original Draft. **Maria Unbeck:** Methodology, Writing - Review & Editing. **Stefanie Bachnick:** Writing - Review & Editing. **Beatrice Gehri:** Writing - Review & Editing. **Michael Simon:** Supervision, Conceptualization, Methodology, Data Analysis, Writing - Review & Editing.

Declaration of Competing Interest

None.

References

Aiken, L.H., Sloane, D.M., Ball, J., Bruyneel, L., Rafferty, A.M., Griffiths, P., 2018. Patient satisfaction with hospital care and nurses in England: an observational study. BMJ Open 8 (1), e019189.

Ausserhofer, D., Schubert, M., Desmedt, M., Blegen, M.A., De Geest, S., Schwendimann, R., 2013. The association of patient safety climate and nurse-related organizational factors with selected patient outcomes: a cross-sectional survey. Int. J. Nurs. Stud. 50 (2), 240–252.

Ausserhofer, D., Zander, B., Busse, R., Schubert, M., De Geest, S., Rafferty, A.M., Ball, J., Scott, A., Kinnunen, J., Heinen, M., Sjetne, I.S., Moreno-Casbas, T., Kozka, M., Lindqvist, R., Diomidous, M., Bruyneel, L., Sermeus, W., Aiken, L.H., Schwendimann, R., 2014. Prevalence, patterns and predictors of nursing care left undone in European hospitals: results from the multicountry cross-sectional RN4CAST study. BMJ Qual. Saf. 23 (2), 126–135.

Bachnick, S., Ausserhofer, D., Baernholdt, M., Simon, M., 2018. Patient-centered care, nurse work environment and implicit rationing of nursing care in Swiss acute care hospitals: a cross-sectional multi-center study. Int. J. Nurs. Stud. 81, 98–106.

Ball, J.E., Bruyneel, L., Aiken, L.H., Sermeus, W., Sloane, D.M., Rafferty, A.M., Lindqvist, R., Tishelman, C., Griffiths, P., 2018. Post-operative mortality, missed care and nurse staffing in nine countries: a cross-sectional study. Int. J. Nurs. Stud. 78, 10–15.

Ball, J.E., Murrells, T., Rafferty, A.M., Morrow, E., Griffiths, P., 2014. Care left undone' during nursing shifts: associations with workload and perceived quality of care. BMJ Qual. Saf. 23 (2), 116–125.

Classen, D.C., Resar, R., Griffin, F., Federico, F., Frankel, T., Kimmel, N., Whittington, J.C., Frankel, A., Seger, A., James, B.C., 2011. Global trigger tool' shows that adverse events in hospitals may be ten times greater than previously measured. Health Aff. 30 (4), 581–589 (Millwood).

Dall'Ora, C., Griffiths, P., Redfern, O., Recio-Saucedo, A., Meredith, P., Ball, J., 2019. Nurses' 12-hour shifts and missed or delayed vital signs observations on hospital wards: retrospective observational study. BMJ Open 9 (1), e024778.

De Groot, K., De Veer, A.J.E., Paans, W., Francke, A.L., 2020. Use of electronic health records and standardized terminologies: a nationwide survey of nursing staff experiences. Int J Nurs Stud 104, 103523.

Dhaini, S.R., Simon, M., Ausserhofer, D., Abed Al Ahad, M., Elbejjani, M., Dumit, N., Huijer, H.A., 2020. Trends and variability of implicit rationing of care across time and shifts in an acute care hospital: a longitudinal study. J. Nurs. Manag. 28 (8), 1861–1872. doi:10.1111/jonm.13035.

Drach-Zahavy, A., Srulovici, E., 2019. The personality profile of the accountable nurse and missed nursing care. J. Adv. Nurs. 75 (2), 368–379.

Gearing, R.E., Mian, I.A., Barber, J., Ickowicz, A., 2006. A methodology for conducting retrospective chart review research in child and adolescent psychiatry. J. Can. Acad. Child Adolesc. Psychiatry 15 (3), 126–134.

Gregory, K.E., Radovinsky, L., 2012. Research strategies that result in optimal data collection from the patient medical record. Appl. Nurs. Res. 25 (2), 108–116.

Griffiths, P., Ball, J., Drennan, J., Dall'Ora, C., Jones, J., Maruotti, A., Pope, C., Recio Saucedo, A., Simon, M., 2016. Nurse staffing and patient outcomes: strengths and limitations of the evidence to inform policy and practice. A review and discussion paper based on evidence reviewed for the National Institute for Health and Care Excellence Safe Staffing guideline development. Int. J. Nurs. Stud. 63, 213–225.

Griffiths, P., Recio-Saucedo, A., Dall'Ora, C., Briggs, J., Maruotti, A., Meredith, P., Smith, G.B., Ball, J., 2018. The association between nurse staffing and omissions in nursing care: a systematic review. J. Adv. Nurs. 74 (7), 1474–1487.

Hibbert, P.D., Molloy, C.J., Hooper, T.D., Wiles, L.K., Runciman, W.B., Lachman, P., Muething, S.E., Braithwaite, J., 2017. The application of the Global Trigger Tool: a systematic review. Int. J. Qual. Health Care 28 (6), 640–649.

Jones, T.L., 2014. Validation of the perceived implicit rationing of nursing care (PIRNCA) instrument. Nurs. Forum 49 (2), 77–87.

Jones, T.L., Hamilton, P., Murry, N., 2015. Unfinished nursing care, missed care, and implicitly rationed care: state of the science review. Int. J. Nurs. Stud. 52 (6), 1121–1137.

Kalisch, B.J., Landstrom, G.L., Hinshaw, A.S., 2009. Missed nursing care: a concept analysis. J. Adv. Nurs. 65 (7), 1509–1517.

Kalisch, B.J., Williams, R.A., 2009. Development and psychometric testing of a tool to measure missed nursing care. J. Nurs. Adm. 39 (5), 211–219.

Kalisch, B.J., Xie, B., Dabney, B.W., 2014. Patient-reported missed nursing care correlated with adverse events. Am. J. Med. Qual. 29 (5), 415–422.

Liu, J., Zheng, J., Liu, K., You, L., 2019. Relationship between work environments, nurse outcomes, and quality of care in ICUs: mediating role of nursing care left undone. J. Nurs. Care Qual. 34 (3), 250–255.

Lucero, R.J., Lake, E.T., Aiken, L.H., 2010. Nursing care quality and adverse events in US hospitals. J. Clin. Nurs. 19 (15–16), 2185–2195.

Mandal, L., Seethalakshmi, A., Rajendrababu, A., 2020. Rationing of nursing care, a deviation from holistic nursing: a systematic review. Nurs. Philos. 21 (1), e12257.

Meona, 2020. Meona.

Michel, P., 2003. Strengths and weaknesses of available methods for assessing the nature and scale of harm caused by the health system: literature review WHO.

Milliken, F.J., Morrison, E.W., Hewlin, P.F., 2003. An exploratory study of employee silence: issues that employees don't communicate upward and why. J. Manag. Stud. 40 (6), 1453–1476.

Mushta, J., K, L.R., Andersen, E., 2018. Failure to rescue as a nurse-sensitive indicator. Nurs. Forum 53 (1), 84–92.

Naessens, J.M., Campbell, C.R., Huddleston, J.M., Berg, B.P., Lefante, J.J., Williams, A.R., Culbertson, R.A., 2009. A comparison of hospital adverse events identified by three widely used detection methods. Int. J. Qual. Health Care 21 (4), 301–307.

National Institute for Health and Care Excellence (NICE), 2014. Expert paper 3: report from the Safe Staffing Advisory Committee Sub-group meeting 11 April 2014. National Institute for Health and Care Excellence (NICE).

National Quality Forum (NQF), 2004. National Voluntary Consensus Standards For Nursing-Sensitive care: An initial Performance Measure set. A consensus Report. National Quality Forum, Washington, DC.

Olsen, S., Neale, G., Schwab, K., Psaila, B., Patel, T., Chapman, E.J., Vincent, C., 2007. Hospital staff should use more than one method to detect adverse events and potential adverse events: incident reporting, pharmacist surveillance and local real-time record review may all have a place. Qual. Saf. Health Care 16 (1), 40–44.

R Core Team, 2019. R: A language and Environment For Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.

Recio-Saucedo, A., Dall'Ora, C., Maruotti, A., Ball, J., Briggs, J., Meredith, P., Redfern, O.C., Kovacs, C., Prytherch, D., Smith, G.B., Griffiths, P., 2018. What impact does nursing care left undone have on patient outcomes? Review of the literature. J. Clin. Nurs. 27 (11–12), 2248–2259.

Recio-Saucedo, A., Smith, G.B., Redfern, O., Maruotti, A., Griffiths, P., Group, M.C.S., 2021. Observational study of the relationship between nurse staffing levels and compliance with mandatory nutritional assessments in hospital. J. Hum. Nutr. Diet. (Jan) doi:10.1111/jhn.12847, In press.

Redfern, O.C., Griffiths, P., Maruotti, A., Recio Saucedo, A., Smith, G.B., 2019. The association between nurse staffing levels and the timeliness of vital signs monitoring: a retrospective observational study in the UK. BMJ Open 9 (9), e032157.

Rooddehghan, Z., Yekta, Z.P., Nasrabadi, A.N., 2018. Ethics of rationing of nursing care. Nurs. Ethics 25 (5), 591–600.

Royal College of Physicians, 2017. National Early Warning Score (NEWS) 2: Standardising the Assessment of Acute-Illness Severity in the NHS. Updated report of a Working Party. RCP, London.

Schubert, M., Glass, T.R., Clarke, S.P., Schaffert-Witvliet, B., De Geest, S., 2007. Validation of the basel extent of rationing of nursing care instrument. Nurs. Res. 56 (6), 416–424.

Smith, G.B., Redfern, O., Maruotti, A., Recio-Saucedo, A., Griffiths, P., 2020. The association between nurse staffing levels and a failure to respond to patients with deranged physiology: a retrospective observational study in the UK. Resuscitation 149, 202–208.

Suhonen, R., Stolt, M., Habermann, M., Hjaltadottir, I., Vryonides, S., Tonnessen, S., Halvorsen, K., Harvey, C., Toffoli, L., Scott, P.A., 2018. Ethical elements in priority setting in nursing care: a scoping review. Int. J. Nurs. Stud. 88, 25–42.

Tesoro, M., Peyser, D.J., Villarente, F., 2018. A retrospective study of non-ventilator-associated hospital acquired pneumonia incidence and missed opportunities for nursing care. J. Nurs. Adm. 48 (5), 285–291.

VanFosson, C.A., Jones, T.L., Yoder, L.H., 2016. Unfinished nursing care: an important performance measure for nursing care systems. Nurs. Outlook 64 (2), 124–136.

Zhu, X., Zheng, J., Liu, K., You, L., 2019. Rationing of nursing care and its relationship with nurse staffing and patient outcomes: the mediation effect tested by structural equation modeling. Int. J. Environ. Res. Public Health 16 (10), 1672. doi:10.3390/ijerph16101672.