Received: 3 June 2020 | Revised: 9 July 2020 | Accepted: 29 July 2020

DOI: 10.1111/jan.14551

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ORIGINAL RESEARCH:
EMPIRICAL RESEARCH – QUALITATIVE

Patterns of behaviour in nursing staff actioning the afferent limb of the rapid response system (RRS): A focused ethnography

Duncan Smith[1,2] | Martin Cartwright[1] | Judith Dyson[1] | Jillian Hartin[2] | Leanne M. Aitken[1,3]

[1]School of Health Sciences, City University of London, London, UK

[2]University College London Hospitals NHS Foundation Trust, London, UK

[3]School of Nursing and Midwifery, Griffith University, Nathan, QLD, Australia

Correspondence
Duncan Smith, City University of London, School of Health Sciences, Northampton Square, London EC1V 0HB, UK.
Email: Duncan.smith.1@city.ac.uk

Funding information
Duncan Smith is funded by a National Institute for Health Research (NIHR) Clinical Doctoral Research Fellowship for this research project. This paper presents independent research. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR, or the Department of Health and Social Care.

Abstract

Aim: To improve understanding of afferent limb behaviour in acute hospital ward settings, to define and specify who needs to do what differently and to report what afferent limb behaviours should be targeted in a subsequent multi-phase, theory-based, intervention development process.

Design: Focused ethnography was used including direct observation of nursing staff enacting afferent limb behaviours and review of vital signs charts.

Methods: An observation guide focused observation on "key moments" of the afferent limb. Descriptions of observations from between 7 January 2019–18 December 2019 were recorded in a field journal alongside reflexive notes. Vital signs and early warning scores from charts were reviewed and recorded. Field notes were analysed using structured content analysis. Observed behaviour was compared with expected (policy-specified) behaviour.

Results: Observation was conducted for 300 hr. Four hundred and ninety-nine items of data (e.g., an episode of observation or a set of vital signs) were collected. Two hundred and eighty-nine (58%) items of data were associated with expected (i.e. policy-specified) afferent limb behaviour; 210 (42%) items of data were associated with unexpected afferent limb behaviour (i.e. alternative behaviour or no behaviour). Ten specific behaviours were identified where the behaviour observed deviated (negatively) from policy or where no action was taken when it should have been. One further behaviour was seen to expedite the assessment of a deteriorating patient by an appropriate responder and was therefore considered a positive deviance.

Conclusion: Afferent limb failure has been described as a problem of inconsistent staff behaviour. Eleven potential target behaviours for change are reported and specified using a published framework.

Impact: Clear specification of target behaviour will allow further enquiry into the determinants of these behaviours and the development of a theory-based intervention that is more likely to result in behaviour change and can be tested empirically in future research.

KEYWORDS
critical care, ethnography, nurse roles, nursing observations, qualitative approaches, research implementation

1 | INTRODUCTION

Sub-optimal care of the deteriorating ward patient was first reported in the academic literature over 20 years ago (McQuillan et al., 1998). Sub-optimal care is a complex and multi-faceted concept that has no absolute definition. However, in the context of the deteriorating patient, key characteristics have been reported as delays in diagnosis, treatment or referral, poor assessment and/or inappropriate or inadequate treatment (Quirke, Coombs, & McEldowney, 2011). Sub-optimal care may precede a serious adverse event (SAE) such as unplanned intensive care unit (ICU) admission, cardiac arrest or death (Tirkkonen et al., 2013; Trinkle & Flabouris, 2011).

To improve responses to deteriorating patients and mitigate the risk of sub-optimal care, acute hospitals have implemented rapid response systems (RRS) in the UK, North America, and Australasia (DeVita et al., 2006; Johnstone, Rattray, & Myers, 2007; Lyons, Edelson, & Churpek, 2018). While there is international and inter organizational variance in the operational characteristics of these systems, RRS are broadly seen to include an afferent (detection) limb and an efferent (response) limb. Behaviours of the afferent limb typically include the routine monitoring of vital signs, identification of physiological abnormality, escalation to an appropriate responder (e.g., a doctor or specialist nurse) and a subsequent increase in the frequency of monitoring (DeVita et al., 2006; Lyons et al., 2018). The afferent limb is modelled on evidence that at least 60% of patients who deteriorate in hospital have antecedent changes in vital signs preceding SAE (Andersen et al., 2016; Kause et al., 2004). Efferent limb behaviours (enacted by the responder) include further assessment, initiation of treatment or stabilizing interventions, and facilitation of patient transfer to a higher-care setting, for example, a critical care unit (Bannard-Smith et al., 2016; DeVita et al., 2006). In this work, the behaviours of interest were those of the afferent limb.

Given the relatively high frequency of premonitory signs in deteriorating patients, the use of "track and trigger" tools is recommended in national guidelines from the UK (National Institute of Health and Care Excellence (NICE), 2007), Australia (Australian Commission on Safety & Quality in Health Care, 2017) and by the Institute for Healthcare Improvement in the USA (Institute for Healthcare Improvement (n.d.)). Broadly, "track and trigger" is a universal term describing a tool (either paper-based or electronic) on which vital signs are recorded. The tool provides a signal to clinical staff when the vital signs fall outside of acceptable parameters and then prompts staff to follow an escalation protocol (Grant, 2018).

Historically, different tools have been used creating inconsistency within and between organizations (Jansen & Cuthbertson, 2010; Shiloh, Lominadze, Gong, & Savel, 2016). To standardize UK practice, the National Early Warning Score (NEWS) was developed, published (Royal College of Physicians, 2012) and subsequently revised as NEWS2 (Royal College of Physicians, 2017). NEWS2 signals patient risk on the basis of the total score (total score range 0–20) aggregated from individual scores assigned to six routinely recorded vital signs (Table 1). The patient's risk level is then stratified according to the aggregate score (File S1) which aligns to an associated escalation algorithm (Royal College of Physicians, 2017). Since its original inception, an expansive body of literature has emerged validating the ability of NEWS to discriminate patients at risk of SAE in medical, surgical, and emergency department settings (Green et al., 2018; Klepstad, Nordseth, Sikora, & Klepstad, 2019; Spångfors, Bunkenborg, Molt, & Samuelson, 2019).

Despite international implementation of RRS and the availability of NEWS2 in the UK, there is evidence that staff do not change their behaviour to increase the frequency of vital signs monitoring or escalate care when criteria are met (Credland, Dyson, & Johnson, 2018). This lack of compliance has been termed "afferent limb failure" (ALF) (Johnston, Arora, King, Stroman, & Darzi, 2014; Trinkle & Flabouris, 2011). There is an abundance of literature describing the potential causes of ALF (Olsen, Søreide, Hillman, & Hansen, 2019; Treacy & Stayt, 2019; Wood, Chaboyer, & Carr, 2019) but paucity of work reporting interventions to target it (Bucknall et al., 2017; Connell et al., 2016; Duff, Massey, Gooch, & Wallis, 2018). Further, most of the interventions described are educational with methodological limitations including risks of bias and/or consistently poor detailing of the development process, suggesting that these interventions may have been developed pragmatically (i.e., based on clinician or researcher intuition) rather than using a replicable method. Given its pervasive nature, there is an argument for using more systematic behavioural approaches to investigate and address ALF.

2 | BACKGROUND

While several different approaches for developing interventions are reported, we used a theory-based approach for intervention

TABLE 1 Vital signs measured and aggregated to calculate a NEWS2

Respiratory rate (RR)
Peripheral oxygen saturations (with a score uplift of 2 for any patient requiring supplementary oxygen therapy) ($Sp0_2$)
Heart rate (HR)
Blood pressure (BP)
Temperature (Temp)
Level of consciousness (graded as **A**lert, new **C**onfusion, responsive to **V**oice, responsive to **P**ain, **U**nresponsive)

Note: (Royal College of Physicians, 2017).

development (O'Cathain et al., 2019) modelled on the Medical Research Council's guidance for developing and evaluating complex interventions (Medical Research Council, 2006). The application of theory enables determinants (i.e., barriers and enablers) of behaviour to be identified and for intervention components that specifically target these determinants to be selected and tailored to context (Cadogan et al., 2015; Patton et al., 2018). To develop a theory-based intervention, clear specification of target behaviours is required to enable measurement of behaviour change in subsequent intervention testing (Atkins et al., 2017; Presseau et al., 2019). Before reporting undesirable or deviant behaviours (i.e., those that will be targeted by the intervention), expected behaviour must first be specified. To specify expected behaviours of the afferent limb, a documentary analysis of policy and guidelines was carried out (Smith, Sekhon, Francis, & Aitken, 2019) using a simple behaviour specification framework incorporating five elements (action, actor, context, target, time – AACTT) (Presseau et al., 2019).

3 | THE STUDY

3.1 | Aim and objectives

The aim of this project was to improve understanding of afferent limb behaviour in an acute hospital ward setting. Specific objectives were:

- To compare expected (i.e., policy specified) behaviours of nursing staff with those observed on hospital wards
- To report where afferent limb failure was occurring in the sequence of observed behaviours
- To define and specify the behaviours that could be targeted by a theory-based intervention, using the five criteria of a published behaviour specification framework - action, actor, context, target, and timing (Presseau et al., 2019).

3.2 | Design

This project is one component of a multi-phase intervention development process, for which a protocol has been published (Smith, Francis, et al., 2019). Focused ethnography was conducted to explore the behaviour of nursing staff, working in acute hospital wards, when they were actioning behaviours of the afferent limb of the RRS. Focused ethnography is an applied qualitative methodology that is well suited to research where participants reflect a small sub-group of society (e.g., a particular professional group), where the objective is to elucidate a reported problem in a particular context, and where the researcher's access to participants is limited to brief, episodic contact (Cruz & Higginbottom, 2013; Knoblauch, 2005).

3.3 | Sample

This research was conducted in an acute metropolitan hospital in England that provides care for the local population as well as specialist services. The organization comprises seven geographically separate hospitals with a total bed-base of 1,161. This study was conducted in the largest in-patient site in the organization. In 2018, it was confirmed that the hospital would be switching from paper-based patient records to an Electronic Health Record System (EHRS). Part of this process was migration from a paper-based NEWS chart to an electronic version of NEWS2. These plans were announced after this study had been designed and the original protocol written. It was identified that this period of transition would provide a unique opportunity for data collection before and after the implementation of an EHRS and an embedded electronic version of NEWS2. Aside from the implementation of the EHRS and electronic NEWS2, all other aspects of the RRS remained the same throughout data collection. Specifically, no changes occurred regarding how patients' vital signs were monitored or how the efferent limb was activated. The hospital in question has an established RRS that was implemented in 2000. The efferent limb response is provided by the primary medical team and a critical care outreach team (CCOT) which is available 24/7.

To capture a variety of different behaviours, two contrasting clinical floors were selected using local data. One area (floor B) had an open investigation into a case of ALF at the time of recruitment. The other area (floor A) had no such investigations in progress. Further characteristics of the clinical floors are described in Table 2. Based on methodological precedent (Mackintosh, Humphrey, & Sandall, 2014), we proposed to observe for 180 hr on different days of the week and at different times of day and night, or until data saturation was achieved (i.e., no new behaviours were seen). A purposive sample (balance of clinical banding) of nurses enacting behaviours of the afferent limb were observed.

3.4 | Data collection

Data collection activities were conducted in two phases. Between 7 January 2019 – 27 March 2019, data were collected in the paper-based context. Between 1 January 2019 – 18 December 2019 data were collected in the electronic context. We acknowledged that staff behaviour immediately after EHRS implementation was unlikely to reflect usual practice. As such, an acclimation period of 3 months (Bedoya et al., 2019) was allowed when no data were collected.

In keeping with the concept of focused ethnography, observation concentrated on the activities of specific clinical personnel (Registered Nurses - RNs and Healthcare Assistants - HCAs) undertaking specific activities (behaviours of the afferent limb) in the ward environment. To focus observation on the behaviours of interest, an observation guide was developed. The observation guide (File S2) was initially populated with broad descriptions of afferent

TABLE 2 Characteristics of the ward-level sample

Floor A	Floor B
Two adjacent wards	Two adjacent wards
Thirty-eight inpatient beds (open bays and side rooms)	Sixty-two inpatient beds (open bays and side rooms)
Provides care for patients under the following specialties: acute internal medicine, respiratory medicine, infectious/tropical diseases	Provides care for patients under the following specialties: gastro-intestinal medicine and surgery (upper and lower), hepato-biliary medicine and surgery, gut failure and clinical pharmacology
Nursing staff (RNs and HCAs) rotate across the entire floor	Nursing staff (RNs and HCAs) work in two separate teams
Staffed by 32 RNs; 21 HCAs	Staffed by 61 RNs; 27 HCAs
Fully staffed during data collection period (i.e., no vacancies declared)	Fully staffed during data collection period (i.e., no vacancies declared)
No serious incident investigations related to ALF at the time of recruitment	One open serious incident investigations related to ALF at the time of recruitment

limb behaviour (termed "key moments" of the afferent limb) from published literature (Davies, DeVita, Ayinla, & Perez, 2014; Lyons et al., 2018). Each key moment was then elaborated with more specific content derived from documentary analysis of the organization's local policy for deteriorating patients, using previously reported methods (Smith, Sekhon, et al., 2019) and guided by a behaviour specification framework (Presseau et al., 2019). The guide focused observation on five key moments of the afferent limb (Table 3).

In conjunction with the observation guide, a document for recording field notes was developed (File S3). This document was structured to enable descriptions of staff behaviour to be recorded in addition to data from vital signs charts (paper and electronic). The document also provided a space for "reflexive notes," that is, a space for the researcher to record thoughts, feelings and interpretations of events.

The researcher conducted NEWS chart reviews throughout the data collection period. Individual vital signs and aggregate scores from the NEWS chart were extracted and recorded in the field notes. Chart review was frequently performed alongside, or in response to, direct observation. A chart review was also performed if the researcher overheard discussions about an unwell patient at nursing staff handover or a "huddle," or if the researcher observed "heightened activity" around a particular patient (e.g., staff bringing emergency equipment to the bedside).

In adult patients hospitalized for a range of clinical diagnoses respiratory rate was found to be an independent predictor of adverse events (Escobar et al., 2012; Fieselmann, Hendryx, Helms, & Wakefield, 1993; Fine et al., 1997). Unlike the other vital signs entered into NEWS, the respiratory rate is typically not measured using electronic equipment and must be measured visually by a healthcare provider (Badawy, Nguyen, Clark, Halm, & Makam, 2017). Despite its importance, there is evidence that recorded respiratory rates are frequently inaccurate (Badawy et al., 2017; Treacy & Stayt, 2019). Based on this evidence, we elected to compare the respiratory rate recorded on NEWS with the respiratory rate counted by the researcher in situ. If the researcher directly observed vital signs being measured, or the NEWS chart indicated that they had been recorded within 15 min, then he counted the patient's respiratory rate himself over 1 min. This allowed direct comparison with the respiratory rate recorded by the ward staff (i.e., the data on the chart). The decision to undertake this measurement was contingent on the researcher being able to discretely position himself where he could reliably observe the patient's breathing, without his presence interrupting clinical care or being intrusive to the patient. These measurements were taken on an *ad hoc* basis, typically alongside direct observation and chart review. Where the researcher respiratory rate was considerably different to the recorded respiratory rate (i.e., different enough to change the NEWS risk level), an agreed safety algorithm was followed to safeguard the patient. This algorithm prompted the researcher (DS) to take a stepwise series of actions beginning with notification of the responsible RN, followed by escalation to the nurse in charge of the ward, followed by, if necessary, a call to the medical team or CCOT. The response was proportionate to the degree of physiological abnormality (i.e., how high the NEWS or how deranged the vital signs) and also the appropriateness of the observed response from the ward-based nursing staff (e.g., if the researcher prompted the RN to take action and they appeared to enact the policy specified behaviour, then no further escalation was taken by DS). Further detail of this escalation algorithm can be found in the study protocol (Smith, Francis, et al., 2019).

3.5 | Ethical considerations

Permission to conduct this research was granted by the National Health Service North of Scotland Research Ethics Committee (REC) (reference:18/NS/0118). Subsequently, favourable opinions

TABLE 3 Five key moments of the afferent limb of the Rapid Response System

Key moment	Description
Routine monitoring of vital signs	Monitoring a group of patients' vital signs consecutively at a specified time
Responsive monitoring of vital signs	A targeted episode of vital signs monitoring that occurs outside of – or more frequently than – routine monitoring
Recording the vital signs and/or calculating the aggregate NEWS	Actions related to documenting vital signs on a paper NEWS chart/entering the data into the EHRS and/or calculating an aggregate NEWS (if using a non-automated system)
Escalation within the ward-based nursing team	Notifying a nursing colleague within the same ward-based team that a patient is deteriorating
Escalation outside of the ward-based nursing team	Notifying a colleague from outside of the ward-based team (doctor or specialist nurse/practitioner) that a patient is deteriorating

to proceed with the research were granted by the Health Research Authority (reference as for REC) and the hospital's Research and Development Department (reference: 18/0569). We received ethical approval to use an "opt-out" consent approach for this research, meaning that nursing staff were provided with multiple opportunities to opt out of participating in the study. At the beginning of a shift where DS was present, staff were reminded that they should declare (verbally or in written form) if they did not wish to be observed or approached during the period of observation. These staff were asked to prospectively sign an opt-out form. Copies of the opt-out form were also left in the staff room along with a sealed box so that staff could privately complete and return an opt-out form, if they did not wish to approach DS in person. Staff who opted out were not required to specify their reasons for doing so. The completed opt-out form allowed DS to identify staff on duty who did not wish to participate (by cross-checking with the roster and staff allocation board) so that no further information was collected from these individuals. Further details of the consent procedures can be found in the study protocol (Smith, Francis, et al., 2019).

3.6 | Data analysis

One member of the research team (DS) used structured content analysis (Hsieh & Shannon, 2005) to analyse field notes as follows:

- Handwritten descriptions of direct observations and chart review data were read superficially and then more thoroughly to ensure familiarization with the subject matter.
- Data were initially labelled and categorized by the five key moments of the afferent limb.
- Within each of the five categories, data were examined further and compared directly to policy-specified behaviour (obtained from documentary analysis). If the observational data, or information extracted from chart review, aligned to policy-specified behaviour, this was categorized as "expected behaviour." Where the recorded data did not align to the policy-specified behaviour, it was categorized as "unexpected behaviour." A lack of action was also categorized as "unexpected behaviour."
- Where the extracted data included a researcher respiratory rate measurement alongside a recorded respiratory rate, a sub-analysis was performed by comparing the two respiratory rate measurements. If the difference between the two measurements was greater than 5, or the difference was sufficient to change the aggregate NEWS, the episode was categorized as "unexpected behaviour." If these criteria were not met, the episode was categorized as "expected behaviour." The difference between the researcher respiratory rate and the recorded respiratory rate was summarized descriptively.
- Frequencies and proportions of expected and unexpected behaviours were counted across the corpus of data and for each of the key moments of the afferent limb.
- Unexpected behaviours were scrutinized and statements describing "who needs to do what differently" were synthesized and structured using the AACTT framework (Presseau et al., 2019) to report target behaviours for a behaviour change intervention (to be reported in a subsequent paper).

3.7 | Rigour

In qualitative research, multiple data collection strategies may be employed (i.e., use of triangulation) to facilitate a deeper understanding of the phenomena under investigation and to ensure rigour within the research process (O'Cathain, Murphy, & Nicholl, 2010). Specifically in the context of ethnographic research, use of participant observation and examination of relevant documents are reported methods (Cruz & Higginbottom, 2013). Both these approaches were incorporated into this design.

Comprehensive field and reflexive notes were taken throughout the period of data collection to ensure dependability of the

data. The observation guide and field journal were both piloted for 1 week. After this period, field and reflexive notes were presented to two other members of the research team (LMA, MC) allowing data collection decisions to be challenged and defended and enabling revisions to the documents. Similarly, target behaviours (synthesized during data analysis) were presented to and critically discussed with other stakeholders in the research team which includes a Professor of Critical Care (LMA), an Implementation Scientist (MC), and the lead for the hospital's CCOT (JH).

All data collection activities were carried out by a single researcher (DS); a clinical-academic nurse with a background in acute/critical care nursing, including 10 years of experience working in critical care outreach teams. While DS has not worked clinically in a ward environment for 17 years, he is clinically experienced in the recognition and response to deteriorating patients and in clinical assessment more broadly. Prior to data collection, DS undertook training on qualitative methods including specific training on ethnographic methods (delivered by a Professor of Anthropology).

4 | FINDINGS

Across the two clinical floors, a total of 300 hr of observation was carried out; 150 hr when a paper-based NEWS chart was in use (i.e., pre EHRS implementation) and 150 hr when an electronic NEWS2 chart was in use (i.e., post EHRS implementation) (Figure 1 shows a detailed breakdown of these hours by floor). Four members of staff (all HCAs) prospectively opted-out of being observed (staff were not required to declare why they chose to opt out).

Four hundred and ninety-nine discrete items of data (e.g., a single episode of observational data, or a single set of vital signs from one occurrence of patient monitoring) were extracted from field notes and analysed; 253 items of data were collected pre EHRS; 246 items of data were collected post EHRS. Two hundred and eighty-nine (58%) items of data were associated with expected (e.g., policy-specified) afferent limb behaviour; 210 (42%) items of data were associated with unexpected afferent limb behaviour (e.g., alternative behaviour or no behaviour) (Table 4 displays the frequency of expected and unexpected behaviour for each of the five key moments of the afferent limb). Ten specific behaviours were identified where the behaviour observed deviated (negatively) from policy or where no action was taken when it should have been (these potential targets for behaviour change are described in Table 5). One further behaviour was seen to expedite the assessment of a deteriorating patient by an appropriate responder and was therefore considered a positive deviant behaviour. Descriptive accounts of field data are reported below in relation to each key of the key moments of the afferent limb. File S4 contains exerts extracted directly from field notes in support of each of these accounts.

4.1 | Routine monitoring of vital signs

Expected routine monitoring of vital signs was observed on both floors and typically occurred in 4-hr intervals. All routine monitoring witnessed involved the use of electronic equipment (except respiratory rate measurement). These activities were observed in both the pre and post EHRS context. On floor A, both HCAs and RNs were observed enacting routine monitoring behaviours. On floor B, only HCAs were witnessed carrying out routine monitoring.

In some cases, it was very clear that the HCA or RN being observed were enacting expected behaviour in counting the patient's respiratory rate as part of routine monitoring. In these instances, staff were seen looking at a fob watch on their uniform, at a wall-mounted clock or, more frequently, at a timer on an electronic thermometer. Often, it was less clear if the respiratory rate had been counted as expected. On one occasion, a HCA was heard openly

TABLE 4 Frequencies and proportions of expected and unexpected behaviour for each of the five key moments of the afferent limb in the paper based and EHRS NEWS context

Key moment of the afferent limb	Context in which behaviour witnessed	Frequency (%) expected behaviour	Frequency (%) unexpected behaviour	Total frequency (%) of data for this key moment
Routine monitoring of vital signs	Paper-based NEWS	22 (63)	13 (37)	35 (7)
	EHRS based NEWS	11 (44)	14 (56)	25 (5)
Responsive monitoring of vital signs	Paper-based NEWS	27 (36)	48 (64)	75 (15)
	EHRS based NEWS	29 (39)	45 (61)	74 (14)
Recording the vital signs and/or calculating the NEWS	Paper-based NEWS	65 (57)	53 (43)	118 (24)
	EHRS based NEWS	103 (79)	28 (21)	131 (26)
Escalation within the ward-based nursing team	Paper-based NEWS	9 (82)	2 (18)	11 (2)
	EHRS based NEWS	4 (50)	4 (50)	8 (2)
Escalation outside of the ward-based nursing team	Paper-based NEWS	12 (86)	2 (14)	14 (3)
	EHRS based NEWS	8 (100)	0	8 (2)
Frequency (%) of discrete items of data		289 (58)	210 (42)	499

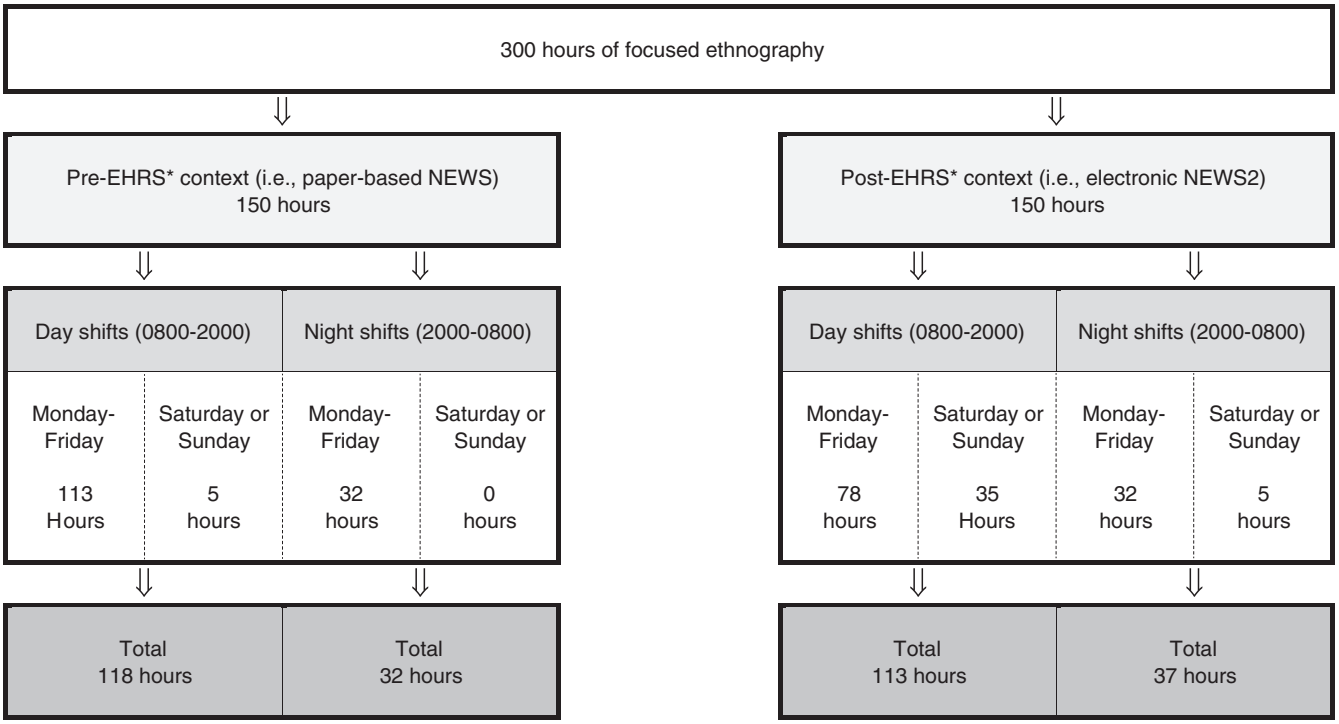

FIGURE 1 Breakdown of fieldwork hours

stating to a colleague that they did not have sight of a clock. Despite this, they proceeded to record a respiratory rate on the NEWS chart.

Some staff were also seen enacting unexpected behaviour in relation to the use of electronic monitoring equipment. On several occasions, HCAs were observed applying finger probes for measuring $Sp0_2$ to a patient's ear. This was often seen in response to the monitoring equipment alarming when first applied to a digit.

Chart reviews were frequently conducted to assess the timeliness of repeat monitoring after a NEWS trigger. Examples of expected behaviour were found illustrating monitoring frequency being increased, according to policy, for medium and high-risk NEWS. There was also evidence of unexpected behaviour in view of delayed monitoring (i.e.,> 1 hr between episodes) for patients with both medium and high-risk scores.

4.2 | Responsive monitoring of vital signs

The expected behaviour of responsive monitoring typically involved the monitoring of vital signs in a single patient more frequently than other patients in their bay. Both RNs and HCAs were seen enacting these behaviours in the pre and post EHRS context. RNs were more frequently observed enacting responsive monitoring compared with routine monitoring. On some occasions, electronic monitoring devices were left connected to the patient and stationed in the patient's bed space to permit more frequent measurement of vital signs. This was recorded as expected behaviour in the context of a deteriorating patient.

When approached by a HCA about a patient with an elevated NEWS or abnormal vital signs, RNs were seen to delegate further monitoring back to a HCA or student nurse, rather than assessing the patient further themselves (the expected behaviour). This was observed on multiple occasions involving different patients including a patient with an un-recordable blood pressure, a patient who had already been reviewed by critical care and a patient with a high NEWS.

4.3 | Recording vital signs and/or calculating the NEWS

The behaviours related to the recording of vital signs and the generation of an aggregate NEWS, were the most variable between the pre and post EHRS periods. In the pre EHRS context, review of paper NEWS charts highlighted inconsistency in the accuracy of recorded information. On some occasions, evidence of expected behaviour was found whereby all vital signs were recorded legibly and an accurate NEWS was calculated. On other occasions, specific vital signs were missing, or an aggregate NEWS was not recorded, or the aggregate NEWS was recorded but was not calculated correctly. Infrequently, the time recorded on the NEWS tool (paper and electronic) appeared to reflect the time that the vital signs were due rather than the time that they were seen to be measured. This was considered unexpected behaviour.

The EHRS appeared to remedy errors in the calculation of NEWS, however, there were still occasions where incomplete recording of vital signs by staff (unexpected behaviour) prevented the

TABLE 5 Description of policy-practice gaps and specification of afferent limb behaviours that could be targeted by a theory-based behaviour change intervention

Policy-specified behaviour	Actual behaviour (from field notes)	Context in which the behaviour was observed	Who needs to do what differently (potential target for the behaviour change intervention)
Every time an HCA/RN measures vital signs, all 6 parameters should be recorded, and an accurate NEWS calculated (this is automated on the EHRS)	HCAs were observed writing vital signs on a piece of paper or handover sheet or paper towel, and were later were seen entering a whole bay/group of patients' vital signs into NEWS	Paper and EHRS	All vital signs should be recorded directly on the NEWS chart/EHRS *(action)* by HCAs *(actor)*, every time a ward patient's *([a]secondary target)* vital signs are measured *(context)*, within 5 minutes of measurement *(timing)*. Information should not be recorded on handover sheets or other miscellaneous pieces of paper.
Every time an HCA/RN measures vital signs, all 6 parameters should be recorded accurately and contemporaneously	HCAs and RNs do not consistently measure or record the respiratory rate accurately when taking vital signs	Paper and EHRS	Ward patients' *(secondary target)* respiratory rates should be counted *(action)* by HCAs and RNs *(actors)* for a full minute *(timing)*, every time vital signs are measured *(context)*.
	HCAs do not always document the time that the vital signs were actually taken on the NEWS chart. Instead, they write the time that they were due to be taken.	Paper and EHRS	HCAs *(actor)* should record the exact time that the vital signs were measured *(action)* for every episode of patient monitoring *(context)*, on all ward patients *(secondary target)*, during the day or night *(timing)*.
	When measuring vital signs, HCAs sometimes place the oximetry finger probe on the patient's ear, or on a finger on the same side as the arm to which the BP cuff is also attached	Paper	Whenever *(timing)* vital signs are measured *(context)* on a ward patient *(secondary target)*, HCAs *(actor)* should attach the pulse oximetry probe to a digit on the opposite side to the blood pressure cuff *(action)*. Finger probes should only be applied to a digit and not to the ear to ensure accurate readings (unless a specific ear probe is being used).
NEWS should be uplifted by 3 points for patients with new confusion	HCA and RNs do not score patients for 'new confusion', using the ACVPU tool	Paper	If a ward patient *(secondary target)* appears to have new confusion during the measurement of vital signs *(context)*, by RNs/HCAs *(actor)*, the level of consciousness should immediately *(timing)* be recorded as 'C' - for confusion on the NEWS tool *(action)* (resulting in a NEWS uplift of 3 points).
When the patient's NEWS is low risk (1-4), the RN/HCA should measure vital signs 4 hourly (at minimum)	If a patient is sleeping, HCAs sometimes write 'patient sleeping do not disturb' (or similar) on the paper NEWS chart and do not measure the routine vital signs when they are due	Paper	HCAs *(actor)* should seek guidance *(action)* from the RN *([a]primary target)*, if they are unsure about whether or not to disturb a sleeping patient *(secondary target)* to take routine vital signs *(context)* during the day or at night *(timing)*.
Abnormal vital signs/raised NEWS must always be reported to the RN responsible for the patient	HCAs do not always escalate to RNs when the NEWS ≥5	Paper and EHRS	HCAs *(actor)* should escalate *(action)* to a RN *(primary target)* whenever a ward patient's *(secondary target)* NEWS is ≥5 *(context)*, after every episode of vital signs monitoring *(timing)* unless a reasonable variance has been agreed and documented.
If a RN is notified about a patient with an elevated NEWS (i.e., ≥5), they respond by performing further bedside assessment e.g., further vital signs monitoring, ABCDE assessment	When abnormal vital signs are communicated to RNs by HCAs, the vital signs are infrequently repeated by the responsible RN to check the accuracy. More commonly, the RN delegates back to an HCA	Paper and EHRS	RNs *(actor)* should re-measure vital signs *(action)* on a ward patient *(secondary target)* if they are informed that said patient's NEWS is elevated *(context)* prior to further escalation *(timing)*.

(Continues)

TABLE 5 (Continued)

Policy-specified behaviour	Actual behaviour (from field notes)	Context in which the behaviour was observed	Who needs to do what differently (potential target for the behaviour change intervention)
After recording a NEWS ≥5, the RN should escalate to the parent medical team +/- CCOT +/- night nurse practitioners	RNs do not consistently escalate patients with elevated NEWS. This includes patients under CCOT and/or those flagged as 'at risk' (at safety huddles etc.)	Paper	Escalation (*action*) to the parent medical team and/or CCOT and/or night nurse practitioners *(primary targets)* should be carried out by RNs *(actor)* when NEWS is ≥5 *(context)*, in any ward patient *(secondary target)*, after they have re-measured vital signs and/or completed an ABCDE assessment *(timing)* unless a reasonable variance has been agreed and documented.
	If the first responder to whom the RN escalates does not respond as expected, then the RN contacts other personnel (e.g., a different doctor or CCOT nurse) to ensure that the patient is assessed and/or a clear plan is made	EHRS	Further escalation (*action*) to second responder (e.g., a different doctor or CCOT nurse) *(primary target)* should be carried out by a RN *(actor)*, if the first practitioner they approached cannot attend or does not respond as policy states, during any episode of escalation to any responder *(context)* at any time of day or night *(timing)*.
After recording a NEWS ≥5, the frequency of vital signs monitoring should be increased to a minimum of 1 hourly measurements	HCAs/RNs do not always repeat vital signs within 1 hour, when the NEWS is medium or high risk	Paper and EHRS	A ward patient's *(secondary target)* vital signs should be repeated *(action)* by HCAs/RNs *(actor)*, when the NEWS ≥5 *(context)*, every hour (at minimum) *(timing)* unless a reasonable variance has been agreed and documented.

[a]The *primary target(s)* of the specified behaviour are the individual(s)/group(s) who must decide whether subsequent behaviours are required, while the *secondary target(s)* are the individual(s)/group(s) who benefit from the specified behaviour but are not required to enact anything themselves.

EHRS generating an aggregate score. Also, where patients were visibly confused/delirious, this was not always recorded and scored as expected on the NEWS chart.

The practices of staff when recording the vital signs was highly variable. In the post EHRS context, some HCAs and RNs were seen to enter vital signs directly into either a desktop computer or a workstation on wheels. Some HCAs used hand-held devices to enter the vital signs immediately after they had measured them. All these behaviours facilitated contemporaneous recording and were therefore considered expected. Other HCAs were observed jotting several patients' vital signs down on a piece of paper (typically a paper towel or clinical handover sheet) before then entering them into the EHRS later using a desktop computer. These behaviours created a delay in recording and were therefore considered unexpected.

4.4 | Differences between recorded respiratory rate and researcher respiratory rate

On 37 occasions (across the pre and post EHRS data collection periods), a researcher respiratory rate was counted and compared with values recorded by HCAs and RNs. The median difference between the recorded respiratory rate and researcher respiratory rate was 5 (IQR 1–10). In 28 (76%) cases, the researcher respiratory rate was higher than the recorded respiratory rate. In 24 (65%) cases, the researcher's calculated NEWS was higher than the recorded NEWS; in 17 (46%) cases, the researcher NEWS resulted in an upgrade of the NEWS risk level and therefore a different recommended course of action. In 10 (27%) cases, the level of risk would have been upgraded to either medium (19%) or high (8%) risk, from a lower-risk category.

4.5 | Escalation within the ward-based nursing team

In both the pre and post EHRS context, escalation behaviours were less frequently observed than monitoring, recording, and scoring behaviours. HCAs were observed escalating, as expected, to RNs in the pre and post EHRS contexts and were typically overheard reporting concerns with specific vital signs. Less frequently, HCAs were overheard raising concerns about an elevated NEWS. However, on both floors, there were situations where patients with abnormal vital signs and elevated NEWS had not been escalated, as expected, by the HCA who undertook the measurements to the responsible RN.

4.6 | Escalation outside of the ward-based nursing team

On both floors, RNs were observed escalating, as expected, to external personnel including medical staff and CCOT. These behaviours were enacted in both the pre and post EHRS contexts. In most cases, the escalation occurred via the hospital pager system, which

involved staff dialling a pager number into the telephone, entering their contact extension for the responder and then waiting by the telephone for the responder to return their call. On floor A, there were several occasions where escalation to medical staff occurred in person rather than over the telephone. Typically, this involved an RN approaching a doctor from the office on the ward and bringing them to the bedside of a patient.

There were instances where patients met the criteria for escalation but had not been escalated by RNs to the CCOT. One example of this unexpected behaviour involved a patient who had already been identified as potentially needing a step-up of care to ICU, who was not escalated in response to an elevated NEWS.

5 | DISCUSSION

During the period of observation, expected and unexpected behaviours were observed in four of the five key moments of the afferent limb in both the paper and EHRS contexts. For the key moment of "escalation outside of the ward-based nursing team," only expected (policy-specified) behaviour was observed in the EHRS context. More than 90% of the data collected related to monitoring, recording and, when required, scoring behaviours. Less than 10% of the data collected reflected behaviours of escalation. There were clear areas of "role overlap" where the expected behaviour was enacted by both RNs and HCAs, particularly in responsive monitoring of vital signs. Other behaviours were more delineated by role. In particular, routine monitoring of vital signs was nearly always enacted by HCAs. Conversely, higher level escalations (i.e., outside of the ward-based nursing team) were exclusively actioned by RNs. Some unexpected behaviours involved actions that deviated from policy or practice guidelines. In these cases, the behaviour was broadly enacted but not to the standard of best practice, for example, monitoring vital signs but misusing equipment (e.g., applying a pulse oximetry probe designed to be applied to a patient's finger, to the ear). More commonly, unexpected behaviour involved no action, for example, an RN not escalating an elevated NEWS to CCOT.

Most routine monitoring of vital signs involved the use of electronic monitoring equipment and was typically performed by HCAs. These findings are consistent with other literature (Ede, Jeffs, Vollam, & Watkinson, 2019; Mackintosh et al., 2014; Smith & Aitken, 2016) implying this may be common practice. There were exceptions where RNs were seen undertaking routine monitoring, this typically occurred in the context of short staffing or when a HCA was re-deployed to a "heavier" part of the ward. The assumption that HCAs will undertake what Ede et al. (2019) describe as "bulk monitoring" (p4) presents several potential challenges. First, it establishes a disconnect within the afferent limb between the actor responsible for collecting the clinical data, that is, measuring the vital signs and the actor expected to evaluate the information and act (Mackintosh et al., 2014). Arguably, it also denies the RN a further opportunity to interact with the patient and capture additional clinical information (Cardona-Morrell et al., 2015). In the context of patient deterioration, there is evidence that "nurse worry" is important in predicting adverse patient outcomes (Douw, Huisman-de Waal, van Zanten, van der Hoeven, & Schoonhoven, 2016; Romero-Brufau et al., 2019). While "nurse worry" has been linked to tacit knowledge, it may also arise from a more comprehensive assessment and the collection of additional clinical cues (e.g., patient appearing agitated or skin clammy to touch) (Douw et al., 2015). Through undertaking routine monitoring, RNs would be well positioned to identify these additional cues alongside the vital signs. At present, there is no information in the published literature about HCA worry, including whether or not HCAs are sensitive to the same cues of deterioration as RNs, or if their sense of worry has predictive validity. In view of this, deteriorating patient policies typically stipulate that HCAs, carrying out routine monitoring, should have a low threshold to escalate if the NEWS is elevated or vital signs abnormal (Smith, Sekhon, et al., 2019). Despite this, situations were observed where HCAs had measured and recorded an elevated NEWS but not notified the RN. The lack of expected behaviour from the HCA created a "hard stop" in the sequence (i.e., no further action taken), as the RN behaviours were contingent on activation from the HCA. Some authors have argued that increasing reliance on un-registered staff to undertake safety-critical aspects of nursing, reflects a wider challenge facing the workforce where RN expertise is increasingly devalued and diluted (Leary, 2019). This is particularly concerning, given the evidence that adverse outcomes are reduced when patients are cared for in organizations with higher numbers of well-educated registrants (Aiken et al., 2011).

Using focused ethnography, we identified unexpected behaviour in the monitoring and recording of patients' respiratory rate by HCAs and RNs. In three quarters of cases, the observed respiratory rate by the researcher was higher than the respiratory rate recorded on the chart and, in almost half of the cases, the NEWS would have been higher if the recorded respiratory rate was replaced with the researcher respiratory rate. Our finding that respiratory rate is often under reported, leading to a potential underestimation of patient acuity, is consistent with other research including a study that compared respiratory rate measured by an electronic wearable device to respiratory rate measured by nurses (Weenk et al., 2019). Cited explanations for this unexpected behaviour include a lack of skill in obtaining the measurement and a lack of knowledge of its importance (Treacy & Stayt, 2019). Use of wearable continuous respiratory rate monitoring devices offer one solution to this pervasive problem (Weenk et al., 2019). However, a targeted intervention to ensure more consistent staff behaviour in this area could be a feasible alternative.

As the use of technology in healthcare becomes increasingly pervasive, interest has grown on the impact of technology on patient safety, more specifically on its impact on the RRS (Wilson & Khansa, 2018). In the paper context, errors have been reported in the recording and calculation of aggregate early warning scores (EWS) often leading to an under estimation of patient risk and sub-optimal responses (Kolic, Crane, McCartney, Perkins, & Taylor, 2015; Odell, 2015). Our findings broadly corroborate these reports, as more than 40% of observed recording and scoring behaviours

were categorized as unexpected in the paper NEWS context. Comparatively, there is evidence that scoring automation within an EHRS-embedded EWS completely eliminates human error in score calculation (Credland et al., 2018; Jones et al., 2011). However, in some EHRSs, the healthcare provider is still required to manually key the data into the system. We observed cases where the NEWS was not calculated by the EHRS due to missing or inaccurately entered data. Our findings align to other published literature, also reporting the problem of incomplete vital signs in an EHRS context (Stevenson, Israelsson, Nilsson, Petersson, & Bath, 2016). This unexpected behaviour could be the result of a lack of knowledge among nursing staff about the importance of an aggregate NEWS in determining risk, or lack of awareness of the potential consequences of not completing a thorough and timely patient assessment (Treacy & Stayt, 2019; Wood et al., 2019).

In view of unexpected behaviour in the recording and scoring key moment, we also observed staff (predominantly HCAs) writing a series of vital signs on paper before, then entering them all into the EHRS. This appeared to delay the availability of the data to other members of the healthcare team (including the RN), delayed the generation of a NEWS and led to transcription error. While this unexpected behaviour was seen in both the paper and EHRS contexts, the frequency of this specific behaviour increased after implementation of the EHRS. These behaviours, described in the literature as use of paper "workarounds" (Stevenson, Israelsson, Petersson, & Bath, 2018), have been attributed to dissatisfaction of staff with the layout and presentation of vital signs on the EHRS and a lack of equipment to enter the data, leading them to enact alternative behaviours (Stevenson et al., 2016, 2018). What is clear, is that the implementation of the EHRS is not a panacea for ALF. While some negative deviant behaviours are reconciled, others may increase suggesting these systems may have the potential to improve patient safety (Jones et al., 2011), however, careful consideration of the environmental and behavioural context is required.

We elected to collect data before and after the implementation of an EHRS to maximize researcher exposure to different behaviours of the afferent limb. While our study was not designed to signal cause and effect of EHRS implementation, it is noteworthy that 6 of 10 negative deviant behaviours were observed in both the pre and post EHRS contexts, suggesting these behaviours may be deeply entrenched. Further, in light of evidence that habit plays a significant role in health professional behaviour (Potthoff et al., 2019), it is plausible that some of these behaviours are enacted automatically, rather than based on careful and deliberative reasoning (Presseau et al., 2014). If this is the case, carefully selected and tailored intervention components will be required to change staff behaviour.

5.1 | Strengths and Limitations

In the context of the deteriorating hospital patient, we believe that this is the first paper to report, comprehensively, the use of focused ethnography to describe and specify behaviours that could be targeted by a theory-based implementation intervention. In the wider behaviour change literature, researchers have used local audit to identify who needs to change their behaviour (Taylor et al., 2016). While an acceptable approach, there is arguably a risk that some of the more nuanced and context-specific aspects of behaviour may not be captured. By comparison, focused ethnography has the potential to provide deeper insight into behaviour as it occurs within the "natural setting" (Leslie, Paradis, Gropper, Reeves, & Kitto, 2014; Vindrola-Padros & Vindrola-Padros, 2018).

Methodological limitations of our research include the use of a single hospital site and collection and analysis of the data by a single researcher. We mitigated the former through careful selection of clinical floors with different profiles. The latter we addressed by the researcher (DS) maintaining detailed reflexive notes and having meetings (throughout the period of data collection) with other members of the research team (LMA, MC) to discuss observations, feelings, and potential areas of unconscious bias. Similarly, at numerous intervals during data analysis findings were presented to other members of the team permitting critical discussion. Further, once specified, all of our potential target behaviours were scrutinized by academic (LMA, MC, JD) and clinical stakeholders (JH) for theoretical and clinical face validity.

As stated, there was an open serious incident investigation into ALF on floor B at the point of recruitment. As such, some of our participants may have been involved in the investigation, or the related activities, immediately before or during the period of data collection. It is plausible that participating in the investigation may have increased their familiarity with deteriorating patient guidance and/or influenced some of their behaviours. Consequently, the reported findings may underestimate the range and scale of "unexpected behaviours" that would have been present on one ward prior to the ALF incident and subsequent investigation.

Our procedure for the counting and comparing of respiratory rates had inherent limitations. First, it is plausible that the respiratory rate may have changed in the period (maximum 15 min) between it being recorded by the nurse/HCA and the researcher. In these circumstances, the behaviour may have been reported as unexpected when, in fact, the change was physiological rather than "user error," that is, a miscount by the RN or HCA. Further, it is possible that the "user error" belonged to the researcher rather than the ward staff. However, the researcher is an experienced RN with expertise in clinical assessment, specifically the assessment of deteriorating patients. In addition, the researcher was arguably less likely to be distracted by other activity on the ward and was able to repeatedly measure the respiratory rate, over a full minute, until he felt confident in the measurement.

6 | CONCLUSION

Using focused ethnography, we identified and specified 10 deviant afferent limb behaviours that could be targeted for change and a further

behaviour that could be enabled, by a theory-based implementation intervention. Five of these behaviours were only observed in the pre or post EHRS context. However, it is possible that these behaviours were enacted in both settings but not detected by the observer. As such, all 11 specified behaviours could be considered as potential intervention targets. Further theory-based inquiry is required to elucidate the determinants of these behaviours, to map these determinants to intervention components and tailor the delivery to context.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Professor Jill J Francis, who played an integral role in designing the study within which this research is situated.

CONFLICT OF INTEREST

No conflict of interest has been declared by the author(s).

AUTHOR CONTRIBUTIONS

All authors have agreed on the final version and meet at least one of the following criteria (recommended by the ICMJE (http://www.icmje.org/recommendations/): (1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; (2) drafting the article or revising it critically for important intellectual content.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/jan.14551.

ORCID

Duncan Smith https://orcid.org/0000-0003-4290-8423

TWITTER

Duncan Smith @duncan281013
Martin Cartwright @MCartwrightPhD
Judith Dyson @JudithDyson1
Jillian Hartin @jhartin
Leanne M. Aitken @Leanne_Aitken

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SUPPORTING INFORMATION

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

How to cite this article: Smith D, Cartwright M, Dyson J, Hartin J, Aitken LM. Patterns of behaviour in nursing staff actioning the afferent limb of the rapid response system (RRS): A focused ethnography. *J Adv Nurs*. 2020;76:3548–3562. https://doi.org/10.1111/jan.14551