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RESEARCH ARTICLE

# Early warning scores and trigger recommendations must be used with care in older home nursing care patients: Results from an observational study

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## Abstract

**Aims:** To explore modified early warning scores (MEWSs) and deviating vital signs among older home nursing care patients to determine whether the MEWS trigger recommendations were adhered to in cases of where registered nurses (RNs) suspected acute functional decline.

**Design:** Prospective observational study with a descriptive, explorative design.

**Methods:** Participants were included from April 2018 to February 2019. Demographic, health-related and clinical data were collected over a 3-month period.

**Results:** In all, 135 older patients participated. Median MEWS ($n$ = 444) was 1 (interquartile range (IQR) 1–2). Frequently deviating vital signs were respiratory (88.8%) and heart rate (15.3%). Median habitual MEWS ($n$ = 51) was 1 (IQR 0–1). Deviating vital signs were respiratory (72.5%) and heart rate (19.6%). A significant difference between habitual MEWS and MEWS recorded in cases of suspected functional decline was found ($p$ = 0.002). MEWS' trigger recommendations were adhered to in 68.9% of all MEWS measurements.

**KEYWORDS**
acute functional decline, clinical decision-making, clinical judgement, modified early warning scores, observational study, vital signs

## 1 | INTRODUCTION

Despite radically different contexts, early warning score (EWS) tools are recommended in both hospital and community care settings to detect early clinical deterioration and to support clinical decisions in cases of clinical deterioration (NICE, 2007; The Norwegian Directorate of Health, 2020). The implementation of various EWS in home nursing care, care homes and skilled nursing homes is ongoing, and research exploring how EWSs are used and how they impact clinical practice is increasing (Ammitzbøll & Maarslet, 2015; Barker et al., 2020; Brangan et al., 2018; Hodgson et al., 2022; Jeppestøl et al., 2022a). Normal and pathological physiological changes are well known to occur with aging (Chester & Rudolph, 2011; Churpek et al., 2015), and older peoples' vital signs often deviate from standard reference values. This study explores older home nursing care patients' vital signs and modified EWSs (MEWSs), and how registered nurses (RNs) navigate clinical decisions using MEWS in cases of suspected acute functional decline in home nursing care.

## 2 | BACKGROUND

### 2.1 | Acute functional decline

Older persons receiving home nursing care are characterized by frailty and multimorbidity (Næss et al., 2017; Vegda et al., 2009). When older persons become acutely ill, the symptoms are often vague, with an atypical and diffuse presentation of symptoms and a combination of physical, psychological, social and functional manifestations (Bell et al., 2016; Cigolle et al., 2007; Hébert, 1997; Hsin-Ju Tang et al., 2016; Wester et al., 2013). Acute functional decline is characterized by fatigue, weakness, loss of activities of daily living (ADL) capacity, loss of appetite, falls, incontinence, loss of attention and/or general cognitive impairment. These symptoms frequently reflect reduced functional and psychological reserves (Chester & Rudolph, 2011) and are often caused by somatic diseases common among the elderly, such as infections and cardiovascular, cerebrovascular, pulmonary, neurological, musculoskeletal, metabolic and endocrine diseases (Bell et al., 2016; Hébert, 1997). The symptoms of acute functional decline often coincide with symptoms of multiple chronic diseases and present RNs with challenges in detecting the condition and distinguishing between acute and chronic symptoms (X et al., 2021a). Suspicion of acute functional decline initiates a process in which healthcare professionals must assess the likelihood of acute illness (Hébert, 1997). Health professionals decide whether referral for medical service is needed and how quickly it must occur by comparing the changes in functional abilities and vital signs to the patient's normal and stable habitual state, taking the rapidity of the changes into account (Jeppestøl et al., 2022a; Hodgson et al., 2022).

### 2.2 | Older persons' vital signs

Older people are at great risk of hypotension, which is related to a reduction in the cardiovascular system's ability to respond to and compensate for stressors (Chester & Rudolph, 2011). The maximum heart rate decreases with increasing age (Lakatta, 2000), whereas the resting heart rate is often observed to increase (Coupé et al., 2009). Loss of chest wall compliance and reduced diaphragmatic efficiency result in increased respiratory rate (Lalley, 2013; Ridley, 2005), and older persons commonly have lower core body temperatures and altered thermoregulatory responses (Sund-Levander & Grodzinsky, 2009). Changes in vital signs are well known to occur with increasing age, especially among the frail oldest (Chester & Rudolph, 2011; Churpek et al., 2015). However, vital signs do not appear to change as quickly with physiological deterioration in the older population as among younger people (Churpek et al., 2015), and a combination of normal aging, multimorbidity and polypharmacy can affect the physiological response and thus challenge the interpretation of vital signs.

### 2.3 | EWS with clinical deterioration

Various EWS are used in health care, such as MEWS (Morgan et al., 1997) and national early warning score (NEWS) (Royal College of Physicians, 2022). The higher the EWS, the greater the severity of a patient's state of health (Alam et al., 2014; Kyriacos et al., 2011; Mapp et al., 2013; McGaughey et al., 2017; Morgan et al., 1997; Smith et al., 2014).

In hospitals, increased EWS are associated with acute illness, mortality and transition to higher levels of hospital care, including transition to intensive care units (Jayasundera et al., 2018). Research conducted in a community care setting shows that slightly increased EWS are associated with higher levels of clinical responses and mortality among older home nursing care patients in the case of acute functional decline (Jeppestøl et al., 2022a).

Previous research has investigated staff experiences using the EWS in prehospital, primary care and community settings (Brangan et al., 2018) and among older patients in cases of acute functional decline in home nursing care (Jeppestøl et al., 2022b). These studies found that the use of EWS strengthened healthcare personnel's communication, but they also indicated the need for adjustments of the tools' reference values and trigger recommendations to the context and patient groups. EWS increased healthcare personnel's ability to identify and respond to abnormal vital signs, and the use of EWS may help reduce the number of serious incidents (Jayasundera et al., 2018; Le Lagadec & Dwyer, 2017). However, concerns that the tool could lead to underestimating RNs' clinical judgement and special knowledge of the patient have been raised (Downey et al., 2017). One major concern is whether the EWS can reduce a complex patient situation to a simple score, running the risk of ignoring clinical signs, small changes and subtle deterioration (Petersen et al., 2017). Nurses have no difficulty referring patients to medical services when presented with high EWS, but difficulties arise when the EWS is low (Dalton et al., 2018). Early signs of deterioration have been identified through nurses' intuition before measurable deviating signs were apparent (Osborne et al., 2015). The EWS has been used to confirm the suspicion of clinical deterioration. RNs' pattern recognition and analytical assessment suggest that RNs' clinical judgement and sense of worry can accurately predict clinical deterioration in hospital settings with the support of EWS (Romero-Brufau et al., 2019).

Studies recently conducted in hospital and community care settings show that older patients present generally low habitual EWS (Barker et al., 2020) and researchers question whether EWS triggers the appropriate responses for older patients in care homes in cases of clinical deterioration (Barker et al., 2020; Bunkenborg et al., 2019; Jeppestøl et al., 2022a; Wang et al., 2020; Scott et al., 2019).

Research describing EWS characterizations, specifically among older care home residents, found a statistically significant link between older care home patients' EWS and Barthel ADL scores and healthcare personnel's reported role empowerment, improved communication and decision-making with the use of EWS (Hodgson et al., 2022). Hodgson et al. (2022) concluded that although EWS is a useful tool, it could not be used as a diagnostic tool for clinical deterioration due to the complexity of older care home patients' health condition. The authors suggested

using additional assessment tools, such as the Barthel ADL or Rockwool Frailty scale, to support assessments of changes in health conditions.

Research regarding the use of EWS in clinical practice shows broad, if implicit, agreement that these tools do not replace healthcare personnel's clinical judgement; rather, they should be used to support clinical reasoning and decision-making processes (Chester & Rudolph, 2011; Downey et al., 2017; Dundar et al., 2016; Foley & Dowling, 2019; Fox & Elliot, 2015; Fullerton et al., 2012; Jensen et al., 2017; Jeppestøl et al., 2022a; Jeppestøl et al., 2021b; Stafseth et al., 2015; Subbe et al., 2001).

Despite the growing implementation of EWS in community care, few specific national or international recommendations for the use of EWS with the older patient group or in the home nursing care context have been developed. Only a few studies have examined the characteristics of vital signs and EWS of older home nursing care patients with suspected acute functional decline and how these scoring systems' trigger recommendations support RN' decisions. This study aims to fill this knowledge gap.

## 3 | THE STUDY

### 3.1 | Aim

The study aim was to explore older home nursing care patients' MEWS and deviating vital signs and determine whether RNs adhered to the MEWS' trigger recommendations. The following research questions were formulated:

- What characterized older home nursing care patients' symptoms, MEWS and frequently deviated vital signs when RNs suspected acute functional decline?
- Was there a significant difference between MEWS when RNs suspected acute functional decline compared to the patients' habitual MEWS in cases where habitual score is available?
- To what extent did RNs adhere to MEWS' trigger recommendations when suspecting acute functional decline?

### 3.2 | Design

This was a prospective observational study with a descriptive, explorative design. This study is reported in compliance with the STROBE guideline (von Elm et al., 2007) (see Appendix S1).

### 3.3 | Sample/participants

Home nursing care patients were recruited from eight municipalities in X. In 2018, the total population of home nursing care patients aged 65 and older in these eight municipalities were 1214 (SSB, 2022). Home nursing care personnel invited patients to participate in the study. A consecutive sampling procedure screening all eligible participants from April 2018 to February 2019 was applied. The inclusion criteria were as follows:

- 65 years or older.
- Receiving home nursing care
- Assessed with MEWS because RNs suspected acute functional decline

The exclusion criteria were as follows:

- Terminal illness.
- Severe cognitive diseases precluding informed consent.

### 3.4 | Data collection

Data were collected from electronic patient records by the first author between April 2018 and May 2019. A structured web-based data collection form developed for this study and used to collect demographic, health-related and clinical data. Documented symptoms and reasons which initiated RNs suspicion of acute functional decline were collected. Recorded MEWS and vital signs were collected when acute functional decline was initially suspected. When available, MEWS and vital signs recorded in patient's habitual state were collected. Information about referrals to medical services was collected; a maximum of 10 subsequent MEWS per patient, vital signs and referrals to medical services were collected over a 3-month period from the time of inclusion into the study (Figure 1).

### 3.5 | Measurements

#### 3.5.1 | The Modified Early Warning Score

A version of the MEWS (Morgan et al., 1997) has been implemented in home care in eight municipalities in southern Norway. The MEWS consists of five vital parameters:

- heart rate
- temperature
- respiratory rate
- blood pressure
- level of consciousness

In home nursing care, MEWS is performed when acute functional decline is suspected.

Every MEWS measurement is intended to be performed and assessed in a uniform way by healthcare personnel, regardless of patient and situation. Vital signs that deviate from reference values represent scores in points and colour codes and generate support for healthcare personnel to determine when measurements should be repeated and which actions should be taken for seeking medical help. A MEWS > 4 triggers immediate medical service referral (Figure 2).

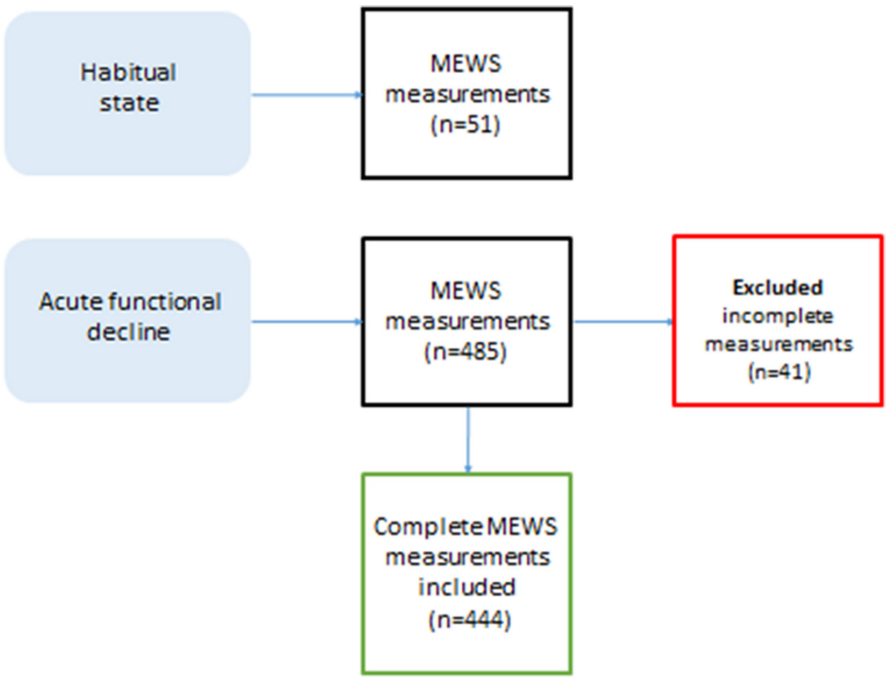


FIGURE 1 Data collection.

| Score | 3 | 2 | 1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| Respiratory rate | | <9 | | 9-14 | 15-20 | 21-29 | >30 |
| Heart rate | | <40 | 41-50 | 51-100 | 101-110 | 111-129 | >130 |
| Systolic blood pressure | <70 | 71-80 | 81-100 | 101-199 | | >200 | |
| Temperature | | <35 | | 35-38,4 | | >38,5 | |
| Level of consciousness | | | | Alert | Voice | Pain | Unresponsive |
| Contact physician when MEWS score > 4, if oxygen saturation drops to <90 % with oxygen treatment, or if you are concerned about the patient's condition. | | | | | | | |

| Color-code | MEWS score | Follow up/new measurements |
|---|---|---|
| Blue | 0 | 24 hours |
| Yellow | 1 | 8-12 hours |
| Orange | 2 | 4-8 hours |
| Red | 3-4 | 1-4 hours |
| | >4 | Contact physician |

FIGURE 2 Modified Early Warning Score (MEWS).

### 3.6 | MEWS in cases of suspected acute functional decline

We recorded the MEWS documented at the initial episode of suspected acute functional decline, followed by a maximum of 10 consecutive follow-up MEWS measurements per patient within the 3-month study period.

### 3.7 | MEWS in habitual state

When MEWS was implemented in home nursing care, a routine measurement of MEWS in habitual state was part of the guideline. The habitual MEWS reflects the patient's state of health in a stable situation without acute illness. In home nursing care, the habitual MEWS is recorded in the medical record as a 'baseline' for comparison in the event of any change in a patient's health condition. The implementation of MEWS was a recent event at the time of the study, and the relative lack of habitual MEWS may indicate that the guideline had not been fully implemented in the municipalities. When available, we recorded the most recent habitual MEWS documented in the patients' electronic record prior to the study start.

### 3.8 | Ethical considerations

Ethical approval was obtained on 17 April 2018 from the Regional Committee for Medical and Health Research Ethics (approval number: 2018/469). Nurses and nurses' assistants obtained written informed consent from all patients before data were collected. The healthcare personnel explained to the patients that their participation was voluntary and the aim of evaluating MEWS among older

home nursing care patients in cases of suspected acute functional decline.

### 3.9 | Data analysis

Descriptive data analyses were conducted on all variables to obtain frequency distributions of all categorical variables, medians and interquartile ranges for continuous variables. Wilcoxon signed-ranks test, with a significance level of $\alpha = 0.05$, was used to compare habitual MEWS with the MEWS in cases of suspected acute functional decline (Kirkwood, 2003). The SPSS v. 26.0 software package was used to analyse the data (IBM Corp (2019)).

### 3.10 | Potential bias

Sample selection bias could be present due to the lack of knowledge of the variations of the patient's health condition and possible events of acute illness that could have affected their vital signs and MEWS prior to inclusion in this study. Furthermore, we have no record of patients who declined to participate in the study, or eligible patients who were too ill to be asked to participate in the study. These sample selection biases could potentially reduce the sample's representativeness. However, generalizing was not the purpose of this study, but rather to explore and describe the characteristics of the eligible patients and the scores recorded in the given data collection period. The results must be interpreted with caution due to the potential lack of representativeness. It should be noted, however, that our results correspond with existing research demonstrating that slightly elevated habitual EWS scores (Barker et al., 2020) and acute illness (Barker et al., 2020; Bunkenborg et al., 2019; Jeppestøl et al., 2022a; Wang et al., 2020; Scott et al., 2019) are common with older patients, which suggests that this bias is limited. The limited availability of habitual MEWS could be a potential bias. However, we used a suitable non-parametric test to compare the MEWS in the habitual state with scores at suspected acute functional decline (Kirkwood, 2003). Missing data were limited, as structured data collection was carried out by the first author, who is highly experienced in navigating municipal patient records. The reliability of the collected data was strengthened by including only the complete MEWS in the analyses. Since this study was explorative, no forms used in prior research were appropriate; however, the MEWS and vital signs are highly standardized measures that substantially increase the validity of this study.

## 4 | RESULTS

### 4.1 | Characteristics of the sample

A total of 135 patients, constituting 11.1% of the population 65 and older (Statistics Norway, 2022), consented to participate in this study: 64.4% (88) female and 35.6% (47) male. The median patient age was 85 (interquartile range (IQR) 79–89.25). The patients were registered with a median of three diagnostic groups (IQR 2–4) and a median of eight daily medications (IQR 5–11). Demographic, health-related and clinical characteristics are presented in Table 1.

**TABLE 1** Demographic, health-related and clinical characteristics of the participants.

| | *n* = 135 (%) | Median (IQR) |
|---|---|---|
| Age | | 85 (79–89.25) |
| Gender | | |
| Male | 47 (34.8) | |
| Female | 88 (65.2) | |
| Diagnosis groups[a] | | 3 (2–4) |
| Daily medications | | 8 (5–11) |
| Living arrangements | | |
| Private | 76 (56.3) | |
| Community care home | 59 (43.7) | |
| Home nursing care | 135 (100.0) | |
| Number of visits per week | | 2 (1–5) |
| MEWS in habitual state | 51 (37.8) | 1 (0–1) |
| Score 0–4 | 51 (100) | |
| Score 5–8 | 0 | |
| Deviating vital signs | | |
| Respiratory rate | 37 (72.5) | |
| Heart rate | 10 (19.6) | |
| Blood pressure | 3 (5.9) | |
| Temperature | 3 (5.9) | |
| Level of consciousness | 1 (2.0) | |
| None | 14 (27.5) | |
| MEWS in cases of acute functional decline[b] | 444 | 1 (1–2) |
| Scores 0–4 | 432 (97.3) | |
| Scores 5–8 | 12 (2.7) | |
| Deviating vital signs | | |
| Respiratory rate | 326 (88.8) | |
| Heart rate | 56 (15.3) | |
| Blood pressure | 36 (9.8) | |
| Temperature | 18 (4.9) | |
| Level of consciousness | 2 (0.39) | |
| None | 78 (17.5) | |

aClassified by the International Statistical Classification of Diseases and Related Health Problems (ICD), ICD-10.

bMaximum 10 MEWS measurements per patient including vital signs were collected after the initial MEWS measurement in cases of suspected acute functional decline.

### 4.2 | Recorded symptoms and reasons for performing MEWS in cases of suspected acute functional decline

Symptoms that deviated from the home nursing care patient's habitual state were stated as reasons for performing MEWS. Common

symptoms described by the nurses were as follows: 'The patient express that he is feeling unusually unwell', or 'The patient is unusually quiet today and seems a bit confused'. Examples of more diffuse symptoms could be 'The patient walks slower than usual' (indicating reduced ADL function) and 'The patient is pale and does not want anything to eat' (indicating nutritional deficiencies). Multiple symptoms and reasons were recorded in electronic patient records of the older home nursing care patients when RNs suspected acute functional decline. The most frequent reasons for suspecting acute functional decline were diffuse and uncharacteristic symptoms (35.5%), followed by symptoms of infection (10.3%), pain (11.4%), falls (8.8%) and reduced ADL functions (7.5%). In Table 2, frequent symptoms which resulted in RN's suspicion of acute functional decline and subsequent MEWS measurements are presented.

### 4.3 | MEWS and deviated vital signs with suspected acute functional decline

During the 3-month study period, a total of 444 complete MEWS assessments were carried out in cases of suspected acute functional decline. The median MEWS was 1 (IQR 1–2). The most frequently deviating parameters were respiratory rate and heart rate, which were elevated in 326 (88.82%) and 56 (15.25%) of the MEWS measurements with suspected acute functional decline. Table 1 presents a detailed summary of the patients' habitual MEWS and when acute decline was suspected.

**TABLE 2** Recorded symptoms and reasons for performing MEWS measurements/symptoms of acute functional decline documented in patients' medical record.

| Reasons for performing MEWS measurements/ symptoms of suspected acute functional decline documented in patients' medical records[a] | *N* = 228 (%) |
|---|---|
| Diffuse and vague symptoms which deviated from the patient's habitual condition | 81 (35.5) |
| Infection symptoms | 44 (19.3) |
| Pain | 26 (11.4) |
| Falls | 20 (8.8) |
| Reduced ADL functions | 17 (7.5) |
| Dizziness | 11 (4.8) |
| Dyspnoea | 10 (4.4) |
| Anxiety | 5 (2.2) |
| Relatives' concern | 4 (1.8) |
| Vomiting and diarrhoea | 3 (1.3) |
| Nutritional deficiencies | 3 (1.3) |
| Suspected incorrect drug use | 2 (0.9) |
| Syncope | 1 (0.4) |
| Incontinence | 1 (0.4) |

Abbreviation: MEWS, modified early warning score.

aSeveral symptoms pr. MEWS measurement/patient were registered.

### 4.4 | MEWS in habitual state compared with MEWS in cases of suspected acute functional decline

Habitual MEWS was documented for 51 patients (37.8%). The median habitual state MEWS was 1 (IQR 0–1). The most frequently deviating vital signs in the habitual state were respiratory and heart rates, which were elevated in 37 (72.54%) and 10 (19.60%) habitual MEWS (Table 1).

There was a statistically significant difference in the median scores comparing habitual MEWS with scores in cases of suspected acute functional decline ($z = 3.024$, $p = 0.002$). The Wilcoxon signed ranks test showed that changes from habitual state to acute functional decline predominately leaned toward higher scores with acute functional decline (47%), but in 35% of the cases, the total score was unchanged, and in 18% of the cases, the score was lower than the habitual score.

### 4.5 | Adherence to trigger recommendations

RNs adhered to MEWS' trigger recommendations in 306 (68.9%) cases of all MEWS measurements performed when RNs suspected acute functional decline ($n = 444$). RNs disregarded MEWS' trigger recommendations in the remaining 138 (31.1%) cases. A total of 137 MEWS measurements with scores between 0 and 4 (92.6%) resulted in the referral of the patient to the medical service. Table 3 shows an overview of MEWS, adherence to trigger recommendations and referrals (or lack of referrals) to medical services.

## 5 | DISCUSSION

In the following sections, we discuss and compare older home nursing care patients' MEWS scores and frequently deviating vital signs in cases of suspected acute functional decline and in habitual state. Finally, we discuss RNs' adherence to MEWS' trigger recommendations in cases of suspected acute functional decline.

### 5.1 | MEWS and frequently deviating vital signs with suspected acute functional decline

The sample in this study was characterized by multimorbidity, polypharmacy and advanced age, which represent complex health conditions. The MEWS following suspected acute functional decline were generally low, with a median score of 1 (IQR 1–2). These results are consistent with another study concluding that older patients present lower scores than younger patients prior to adverse events (Churpek et al., 2015). In cases where healthcare personnel suspected acute functional decline, the patients' respiratory rate (88.8%) and heart rate (15.1%) frequently deviated. These findings are in keeping with other studies that have found elevated respiratory and heart rates in clinically deteriorated hospital

**TABLE 3** Distribution of MEWS scores and referrals to medical service in adherence with MEWS' trigger recommendations.

| | MEWS scores *n* (%) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Referrals in adherence with MEWS' trigger recommendations | Referrals not in adherence with MEWS' trigger recommendations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Referred to medical service | | | | | | | | | | | | |
| Yes | 148 (33.3) | 16 | 44 | 41 | 25 | 11 | **4** | **2** | **4** | **1** | 11 (7.4) | 137 (92.6) |
| No | 296 (66.7) | **60** | **130** | **75** | **26** | **4** | 1 | | | | 295 (99.7) | 1 (0.3) |
| Total | 444 (100) | 76 | 174 | 116 | 51 | 15 | 5 | 2 | 4 | 1 | 306 (68.9) | 138 (31.1) |

*Note*: MEWS scores > 4 triggers medical service referral.MEWS scores referred to medical services in adherence with MEWS' trigger recommendations are highlighted in bold lettering.

Abbreviation: MEWS, modified early warning score.

patients (Bunkenborg et al., 2019; Chester & Rudolph, 2011) and are significantly associated with further clinical deterioration (Bunkenborg et al., 2019). Reasoning whether an elevated respiratory rate in older multimorbid patients is caused by age-related changes, chronic illness, acute illness or a combination of these has been shown to be challenging (Jeppestøl et al., 2022a). A rise from 15 to 28 breaths per minute, indicating tachypnea, should generate 2 MEWS points. Although tachypnea is considered an adverse sign of clinical deterioration (Bunkenborg et al., 2019), this change alone does not indicate medical service referrals according to the trigger recommendations (Morgan et al., 1997) (Figure 2). Similarly, a rise from 70 heartbeats per minute to 100 in a case of suspected acute functional decline would not generate a higher MEWS, although it could be considered a major physiological change with the risk of clinical deterioration in older multimorbid patients with complex health conditions (Bunkenborg et al., 2019; Coupé et al., 2009).

## 5.2 | Comparison of MEWS in habitual state with MEWS with suspected acute functional decline

The median MEWS was 1 (IQR 0–1) in habitual state, and MEWSs were elevated in the majority (72.5%) of the 51 patients measured. These results are in keeping with a study showing slightly elevated EWS in older care home residents' habitual state (Barker et al., 2020). Respiratory rate and heart rate were slightly elevated, and the most frequently deviating vital signs in habitual state. These findings are in line with previous research exploring older persons' typical habitual vital signs (Lalley, 2013; Ridley, 2005).

Heart rate was the second most frequent deviating vital sign in the habitual state (19.6%), a result supported by research showing that an increased resting heart rate is common in the habitual state of older persons (Coupé et al., 2009). However, studies have also shown that slightly increased respiratory rate and/or heart rate are associated with possibly higher levels of clinical responses and death (Bunkenborg et al., 2019; Jeppestøl et al., 2021b). This study contributes important knowledge that elevated respiratory- and/or heart rate may represent a combination of physiological normal aging processes and chronic diseases, as well as acute disease for older multimorbid home nursing care patients. Healthcare personnel must therefore use MEWS as support in clinical reasoning and make decisions with care.

This study showed that changes in the MEWS from habitual state relative to scores recorded at the time of suspected acute, functional decline predominately leaned towards higher scores (47%). Slightly increased MEWS in older patients in hospital settings has been associated with clinical deterioration and death (Bunkenborg et al., 2019; Churpek et al., 2015). In home nursing care settings, slightly increased MEWS has been associated with higher levels of clinical responses and death (Jeppestøl et al., 2021b). Although the use of the EWS in clinical practice has been shown to be important and useful, it is also challenging. Barker et al. (2020) concluded NEWS to be feasible but also challenging to use as a supportive reasoning and decision-making tool with older care home residents, due to unclear interpretation of slightly elevated habitual scores and few high scores with clear interpretations.

Furthermore, in 35% of the cases in this study, the total MEWS was unchanged, and in 18% of the cases, the score was lower than the habitual score. These results highlight the challenges of interpreting slight changes in vital signs and the difficulties in adhering to MEWS' trigger recommendations when suspecting clinical deterioration with only slightly increased heart rate and respiratory rate (Jeppestøl et al., 2021b). In this study, only 51 patients (37.8%) had recorded habitual measures for comparison. Minor changes in vital signs and low MEWS can easily be overlooked and misinterpreted in clinical practice, especially with a lack of habitual measurements that could be compared and combined with vague, non-characteristic and slight changes in functional abilities in cases of suspected acute functional decline in older patients (Bell et al., 2016; Cigolle et al., 2007; Hébert, 1997). Unchanged or low MEWS cannot exclude the possibility of acute illness among older people because one parameter can compensate for another, and lower scores than habitual scores in cases of suspected acute functional decline could actually represent severe clinical deterioration. One example of an unchanged MEWS that could be misinterpreted to mean stability in clinical status can occur in an older patient with a habitual state MEWS of 1 due to an elevated respiratory rate. In the case of suspected acute functional decline, the patient may still have a MEWS of 1 but may demonstrate changes in respiratory and heart rates (Figure 2).

### 5.3 | Adherence to MEWS' trigger recommendations

The MEWS trigger recommendations were adhered to in 68.9% of all 444 registered measurements in this study. The MEWS clearly supported RN's concerns and clinical judgement regarding patients' health conditions in 11 of the 12 (91.7%) high MEWS (5–8). Referring patients to medical services in response to high scores is in line with the core principle of EWS in general, based on the fact that a high MEWS indicates increased severity of a patient's state of health (Alam et al., 2014; Kyriacos et al., 2011; Mapp et al., 2013; McGaughey et al., 2017; Morgan et al., 1997; Smith et al., 2014).

In this study, MEWS' trigger recommendations were not adhered to when patients with slightly increased low MEWS were referred to medical services. Referrals were made regardless of MEWS' recommendation to await the situation. This practice is in line with other studies, showing that rather than replacing or overruling clinical judgement, MEWS was used together with, and as a support to qualify the clinical judgement (Downey et al., 2017; Dundar et al., 2016; Foley & Dowling, 2019; Subbe et al., 2001).

### 5.4 | MEWS in combination with clinical judgement

This study and recent research show the complexity of identifying and interpreting physiological changes with the use of the EWS in older multimorbid patients (Barker et al., 2020; Bunkenborg et al., 2019; Downey et al., 2017; Hodgson et al., 2022; Jeppestøl et al., 2022a). Although slightly increased vital signs and MEWS are associated with adverse events, low MEWS are found in both habitual state and in cases of suspected acute functional decline, which may challenge healthcare personnel's clinical reasoning and decision-making processes and require alertness and clinical competency beyond MEWS in clinical situations. Furthermore, measuring and recording habitual MEWS for older home nursing care patients, can give healthcare personnel important support when suspecting acute functional decline. Availability of scores for comparison may prevent unnecessary new measures or referrals to the medical service (Jeppestøl et al., 2022a).

Hodgson et al. (2022) explored and discussed additional tools, such as the Barthel ADL score and Rockwool Frailty scale that could be used with EWS to identify changes related to functional decline in older community care-dwelling patients with complex health conditions in cases with clinical deterioration. Romero-Brufau et al. (2019) found that RNs' cognitive reasoning strategies, such as pattern recognition and intuition, can predict clinical deterioration, and the researchers suggest combining a simple nurse worry factor score with EWS or incorporating nurse worry into the existing EWS. The results of this study, consistent with healthcare personnel's experiences with the use of EWS (Hodgson et al., 2022; Jeppestøl et al., 2022a), underline that identification of clinical deterioration in the older patient population is complex, given the nature of the older patient's health conditions (Hodgson et al., 2022; Jeppestøl et al., 2021b). The complexity of older home nursing care patients' health conditions challenges the use of MEWS as the only support in clinical reasoning and decision-making processes and highlights the need to consider additional systematic assessment tools in addition to EWS, which can complement assessments by identifying changes in functional ability and support RN's clinical judgement.

### 5.5 | Strengths and limitations

A strength of this study is that we analysed a high number of MEWS from older home nursing care patients in cases of suspected acute functional decline. A limitation is however that we have limited data on what caused the functional decline and what happened to them further in the care trajectories beyond the first 3 months. Another strength is that all participating municipalities used the same type of medical equipment (blood pressure monitors, ear thermometers, pulse oximeters, etc.), and all healthcare personnel received the same training in the use of the equipment and MEWS. We collected data regarding patients' medication use and comorbidities that may have impacted their physiology, vital signs and MEWS, which is also a strength in discussing and interpreting these results in comparison with prior research. One limitation of the study is that we did not have data to determine how old the registered habitual scores were, which may also complicate the comparison with the acute-phase scores. Furthermore, the low proportion of habitual MEWS measurements registered (37.8%) meant that the interpretation of the results comparing habitual scores with scores in suspected acute deterioration should be interpreted with caution. Lastly, quantitative data alone can only to some degree describe RNs' decision-making processes or older home nursing care patient's state of health. Larger quantitative studies are recommended to further explore characterizations of older home nursing care patients' MEWS and vital signs in cases of suspected acute functional decline. Qualitative studies and mixed methods studies are suitable for expanding knowledge of how MEWS impact healthcare personnel's clinical reasoning and decision-making processes.

## 6 | CONCLUSION

Generally, low MEWS and slightly deviated respiratory and heart rates characterize patients in cases of suspected acute functional decline and in habitual state. Although changes from the habitual state to suspected acute functional decline were generally accompanied by increased MEWS, the majority of the scores in this sample would not trigger referrals to the medical services if trigger recommendations were adhered to. The RNs adhered to the MEWS trigger recommendations to a large extent, but they also frequently referred patients to medical services, despite lower MEWS. Low MEWS are found in both habitual state and in cases of suspected acute functional decline, which may challenge healthcare personnel's clinical

reasoning and decision-making processes and require alertness and clinical competency beyond MEWS in clinical situations.

This study shows that the MEWS is used as support by RNs in home nursing care but cannot be used alone as a decision support tool in cases of suspected acute illness due to older patients' complex state of health. A combination of assessments of changes in older home nursing care patients' functional abilities and RNs' clinical judgement may provide additional support together with MEWS in clinical practice.

## AUTHOR CONTRIBUTIONS

Kristin Jeppestøl is the corresponding author for this manuscript. Jeppestøl was involved in study design, data collection, data analysis, data interpretation and writing. Marit Kirkevold was involved in study design, data analysis, data interpretation and writing. Line K. Bragstad was involved in study design, data analysis, data interpretation and writing

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## CONFLICT OF INTEREST STATEMENT

No conflict of interest has been declared by the authors.

## RESEARCH ETHICS COMMITTEE APPROVAL

The Regional Committee for Medical and Health Research Ethics approved the study (approval number: 2018/469).

## DATA AVIALBILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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