Applying the Modified Early Warning Score (MEWS) to assess geriatric patients in home care settings: A qualitative study of nurses' and general practitioners' experiences

Kristin Jeppestøl (✉ kristin.jeppestol@tvedestrand.kommune.no)

Tvedestrand kommune <https://orcid.org/0000-0002-1932-8685>

Marit Kirkevold

Universitetet i Oslo

Line Kildal Bragstad

Universitetet i Oslo

Research article

Keywords: Early warning score system, MEWS, Home care, Elderly, Acute functional decline, Clinical decision-making, Community care.

Posted Date: April 13th, 2020

DOI: <https://doi.org/10.21203/rs.2.16666/v2>

License: This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Background: Acute functional decline is a common clinical syndrome in geriatric health care that is typically characterised by nonspecific symptoms and presents with a mix of physical, psychological, social and functional manifestations.

Early warning score (EWS) systems are widely implemented in nursing homes and home care to detect clinical deterioration. The effects of EWS systems have been thoroughly evaluated in hospital care settings, but few studies have evaluated these systems in community health care.

The purpose of this study is to describe the experiences of registered nurses (RNs) and general practitioners (GPs) when using the Modified Early Warning Score (MEWS) to support clinical reasoning and decision-making with geriatric home care patients who suffer from acute functional decline.

Method: A qualitative methodology was used with a descriptive exploratory design. Data were collected from seven focus group interviews. GPs and RNs were purposively sampled from large, medium and small municipalities in Norway. Data were analysed using an inductive content analysis method.

Results: MEWS was used as an additional decision-making tool with elderly home care patients when acute functional decline was detected. RNs and GPs emphasised that MEWS supported the clinical reasoning and decision-making process. Additionally, those applying MEWS required comprehensive reasoning skills and specific knowledge of the patients. RNs identified the need for contextual adjustments to the use of MEWS in home care settings. Implementing MEWS has improved the collaboration and clinical practice of RNs and GPs. The adherence to MEWS follow-up recommendations was adjusted to the home care setting, accounting for potentially limited medical availability.

Conclusion: MEWS supported RNs and GPs in conducting comprehensive clinical assessments and reasoning when acute functional decline was detected. Interdisciplinary communication and collaboration appeared to be strengthened, and GPs' work was streamlined. Several limitations were identified with the use of MEWS reference values with geriatric patients, which could lead to ambiguity and misjudgements. MEWS trigger recommendations were experienced as inappropriate in the home care context. This study identifies the need for a modified, evidence-based EWS adjusted for geriatric patients in home care.

Introduction

The transfer of responsibility for medical treatment from the specialist to primary health care has led primary care setting to provide advanced health care services to the elderly population [1]. Proactive measures developed for hospital practice, such as early warning score (EWS) systems, are widely implemented in nursing homes and home care in order to detect clinical deterioration and start medical treatment at an early stage and at the lowest level of care [2]. Despite the lack of research into the effect of these systems on elderly persons in general and in the community health care service in particular, the Norwegian patient safety programme recommends that EWS be applied [3] in all services.

Background

Acute functional decline

The elderly population receiving home care are a frail group of individuals with complex diseases and needs for comprehensive health care [4-6]. When frail elderly persons become acutely ill, the symptoms are often nonspecific, with an atypical presentation that combines physical, psychological, social and functional manifestations [7-11]. In Norway and in this paper, this group of symptoms is referred to as 'acute functional decline'. Internationally, the term 'geriatric syndrome' is often used to describe the same condition, and there is a lack of consensus on the definition of the condition [8, 9]. In this paper, the following symptoms characterise acute functional decline: physical symptoms, such as fatigue, weakness, loss of activities of daily living (ADL) capacity, loss of appetite, falls, incontinence and psychological symptoms, such as loss of attention, initiative and motivation and general cognitive impairment. Furthermore, acute functional decline is often caused by somatic diseases common among the elderly [7, 11], such as infections and cardiovascular, cerebrovascular, pulmonary, neurological, musculoskeletal, metabolic and endocrine diseases. Medication side effects and trauma can also cause acute functional decline [7], and hospital admission is often required. An

interdisciplinary and comprehensive geriatric approach is recommended to improve patient outcomes [12]. The magnitude of the symptoms and functional manifestations may be interpreted by family members or health care professionals as a trigger for the need of a higher level of care rather than signs of acute disease [7]. However, identifying the symptoms and targeting the causes of acute functional decline and treatment of its cause(s) is crucial to preventing frailty [7, 12, 13].

Fundamental aspects of practice

Registered nurses (RNs) need broad clinical expertise to identify acute illness and perform systematic follow-up to collaborate with general practitioners (GPs) in addressing the cause of functional decline and providing appropriate, timely health care [4]. Clinical reasoning and decision-making are fundamental aspects of home care, central to independent practice and the foundation for health professionals to carry out the right measures in different situations and contexts. Higgs and Jones [14] describe clinical reasoning and decision-making as the sum of thinking and decision-making processes in clinical practice; they further recognise clinical reasoning and decision-making as a complex and multidimensional phenomenon that includes individual cognitive and non-cognitive processes in interdisciplinary teamwork [14].

In the Norwegian home care sector, health personnel with university education (RNs) represent 35% of employees, health personnel with upper secondary education (nurses' assistants) comprise 40% and the remaining 25% employees are classified as unskilled workers [15].

Organising the proper competence and continuity in home care is important to assuring patient safety but is simultaneously challenging, due to a serious RN shortage [16]. Although continuity of health care is a legislatively mandated, political and health services goal [17], a study of continuity in Norwegian home care shows that older recipients of daily and long-term home care must cope with many different people when receiving health care at home [18]. This lack of interpersonal continuity may threaten the ability of the personnel to recognise subtle changes in the health conditions of frail older persons.

Formal home care service

In Norway, municipalities are responsible for the primary health care of the elderly living at home. Elderly individuals in need of assistance with personal and instrumental activities of daily living receive individual help based on their needs and provided by home care services. The service hours are set for a certain number of visits and times for daily or around-the-clock care; service is based on individual assessment and is adjusted as needed [19]. In the home care team, RNs have the highest formal competence and education, and they have the responsibility of providing care and assessing acutely ill patients, in cooperation with nurses' assistants and unskilled workers. The overall responsibility for medical treatment is assigned to the patient's GP, who cooperates with RNs mainly through telephone or electronic messages. All GPs are required to perform after-hours emergency service duty, which ensures medical availability in the evening, at night and on weekends and public holidays. An intermunicipal after-hours emergency service can be contacted when the GP's office is closed if there is a need for acute medical supervision in home care.

Early warning score systems in hospital and pre-hospital settings

EWS systems, or physiological 'track-and-trigger' systems, were designed to support health care professionals in identifying and responding to acutely unwell patients at risk of clinical deterioration [20]. The effects of EWS systems have been thoroughly evaluated in hospital care settings. Various scoring systems used in hospital settings perform well for predicting cardiac arrest and death within 48 hours [21-23]. Furthermore, studies show that EWS systems cannot replace clinical judgement, and EWS systems in combination with clinical judgement are important for making clinical decisions in pre-hospital and hospital settings [20, 24-28]. Several studies have noted the challenges of using EWS in a variety of clinical settings and patient groups and pointed out the need to adjust EWS approaches to ensure their proper use [20, 23-25].

One study showed that EWS and rapid response systems (RRS) improved RNs' decisions about whether to summon help and their collaboration and communication during the referral process [26]. Conversely, RNs found it challenging to contact the physician when their clinical intuition caused them to be concerned about a patient, but the score was low. The findings from that study could indicate that the hierarchical hospital culture might influence nurses' ability to assess and manage patients in clinical deterioration [26].

Studies investigating how RNs used an EWS tool in acute hospital settings have revealed that nurses' clinical judgement was challenged regarding escalation protocols, especially when parameter adjustments were not performed by senior medical personnel for patients with vital parameters outside the reference values due to chronic diseases [24, 25]. RNs working in a hospital setting also reported challenges with getting physicians to review patients according to the escalation protocol [24, 25].

Studies indicate that EWS in pre-hospital settings could identify patients at risk of deterioration and in need of hospitalisation, with patients at low risk of deterioration safely managed at home [29]. Another study explored RNs' and GPs' experiences of using the UK's track-and-trigger National Early Warning Score (NEWS) system in pre-hospital, primary and community health care settings [20], with participants reporting that NEWS could support clinical decision-making around the escalation of care and could provide a clear means of clinical communication between clinicians and across different health care organisations. However, modifications were needed to make the tool relevant for certain patient populations in community services [20].

The early warning score system in southern Norway

In the Hospital of Southern Norway, an EWS system for early identification of life-threatening conditions with the Norwegian acronym TILT was developed in 2014 [30]. TILT consists of a five-item Modified Early Warning Score (MEWS), an observational curve for vital parameter registration and an e-learning system for training health care personnel. In 2016, eight municipalities in southern Norway decided to use MEWS, the same EWS tool as the regional hospital, to ensure consensus and common terminology. The present study evaluates MEWS.

MEWS consists of five items of vital parameters: heart rate, temperature, respiratory rate, blood pressure and level of consciousness (14, 15) (Figure 1). The score is calculated based on vital sign measurements. These parameters provide information about the person's physical condition and vital parameters that deviate from reference values, represent scores in points and colour codes and generate support concerning when the measurements are to be repeated and when to contact a physician: a MEWS score of 0 triggers new measurements every 24 hours, a score of 1 in 8–12 hours, a score of 2 every 4–8 hours and a score of 3–4 every 1–4 hours. A score of 4 or higher requires health care personnel to contact a physician. In TILT, the MEWS version used in the Hospital of Southern Norway and the municipalities in this study (TILT), oxygen saturation is also a part of the assessment but does not contribute to the score. A sudden drop in saturation (< 90 %) requires the health staff to contact a physician and indicates general concern for the person's condition [30].

There is a lack of studies that evaluate track-and-trigger systems like MEWS in community health care. However, many Norwegian municipalities have recently implemented MEWS and other EWS systems in home care and nursing homes, encouraged by the Norwegian patient safety programme [3]. Knowledge is needed on how these scoring systems impact the clinical reasoning and decision-making of RNs and GPs in community care. The overall purpose of this study is to describe RNs' and GPs' experiences with the EWS tool MEWS to support clinical reasoning and decision-making in working with the elderly who receive home care and suffer from acute functional decline. The two research questions are as follows:

- 1) Which strengths and limitations are identified by RNs and GPs related to the use of MEWS as a support of clinical reasoning and decision-making in home care?
- 2) Based on RNs' and GPs' experiences, what are the implications of using MEWS to assess elderly patients' acute functional decline in home care?

Method

Design, setting and recruitment

This is a qualitative interview study with a descriptive exploratory research design [31]. The study was conducted in a primary health care setting in Norway. Participants were recruited from one large (more than 20,000 inhabitants), three medium (5000–20,000 inhabitants) and three small (fewer than 5000 inhabitants) municipalities in southern Norway [34]. These municipalities were chosen for inclusion because they have all collaborated in MEWS training and implementation. GPs and RNs with experience using MEWS in clinical settings with elderly patients in home care were invited to participate.

The administrative leaders of the municipalities approved the RNs' participation in the interviews and directed the MEWS instructors in the home care teams to recruit RNs. The MEWS instructors recruited the RNs to ensure that they had experience using MEWS in clinical settings with elderly patients in home care. The first author contacted the district medical officers of the municipalities to obtain approval and contact information for current GPs who had experience using MEWS in clinical settings and cooperating with home care. Five GPs were recruited by a medical officer; other department managers in the health care service and three physicians were recruited by the first author via email and telephone.

No refusals to participate by RNs were reported by the MEWS instructors in the seven municipalities. GPs from each municipality participated in all interviews, except for one large municipality where only RNs were present. In another large municipality, three medical offices were contacted but had no GPs available to participate, with the justification that they either had no capacity to participate or no clinical experience with MEWS in clinical settings in home care.

Participants

Altogether, 44 health care personnel were included in this study: 36 RNs, and 8 physicians. All RNs participated in direct patient care, and all participating physicians worked as GPs, but four had additional functions in the municipal health service, such as supervisory doctors in nursing homes and municipal superiors. Participant characteristics are presented in Table 1.

Data collection

A dynamic interview guide with topics and questions related to the advantages and challenges of using MEWS in clinical practice was employed during all interviews. Semi-structured focus group interviews were conducted to explore issues and challenges regarding using MEWS in clinical practice from the participants' perspectives [32, 33]. Data collection started in September 2018 and was completed in November 2018.

Seven focus group interviews were conducted in the participant's workplace and lasted an average of 68 minutes (range 53–78 minutes). All interviews were audiotaped to ensure accuracy for transcription and analysis. All authors participated in the data collection. MK and LKB are experienced researchers with experience in focus group interviewing, while KJ is a PhD candidate who was less experienced in focus group interviews at the outset of the study. MK moderated the two first interviews, with KJ attending as co-moderator. KJ moderated the remaining five interviews, with LKB attending as co-moderator.

Ethical considerations

This study was approved by The Norwegian Regional Committees for Medical and Health Research Ethics (2018/469). All participants signed a consent form, assuring voluntary participation and confidentiality. All data are securely stored in the University of Oslo's Services for Sensitive Data.

Data analysis, coding and categorisation

All interviews were transcribed verbatim with the transcription software f4transkript [31]. The purpose of the present study is to describe the experiences of RNs and GPs in using MEWS with elderly patients in home care. In line with the study's purpose, the data were analysed using a basic thematic content analysis in an iterative process that moved between text, codes, categories and themes. The analysis was inspired by Green and Thorogood [32]. All transcripts were read by MJ, LKB and KJ to obtain an overview of the interviews. LKB and KJ coded the first interview together to identify codes and ensure consensus. Subsequently, all transcripts were imported into the qualitative analysis software Nvivo12 [33]. Furthermore, the second interview was coded by KJ and LKB separately. New and similar codes were discussed; the degree of agreement was assessed using Nvivo12, resulting in 95%–98% agreement. KJ coded the remaining five interviews. The first coding process resulted in a total of 114 codes that were identified as suitable for sorting the material to obtain an overview of the content of the interviews. All interviews were read again, and codes were grouped into similar content for 24 categories. Several codes were included in these main categories; examples are presented in Table 1. The categories were discussed by LKB and KJ before subsequent analysis was commenced. In the ensuing analysis, nine categories were found to be relevant to the study's research questions. Furthermore, two main themes emerged in the process of analysis: "MEWS as a supportive clinical decision-making-tool" and 'Adjusting the use of MEWS to non-institutional care settings'.

Results

The present study shows that MEWS helped RNs in home care to concretise patient information, which could support their clinical reasoning and decision-making when vague and diffuse symptoms occur in elderly home care patients. RNs and GPs both thought MEWS was successfully implemented as an important shared interdisciplinary tool to assure comprehensive clinical assessment and communication of vital parameters. However, they also experienced difficulties in using MEWS with the elderly patient group and in complying with MEWS trigger recommendations and when to contact the medical service. In the following the findings are described in further detail.

Strengths of MEWS as a supportive clinical decision-making-tool

Assessing vital parameters is central to clinical reasoning and decision-making for health care personnel working with patients in unstable clinical conditions. The interviews with the RNs and GPs showed that MEWS had become an important tool in facilitating their clinical reasoning and decision-making when acute functional decline was detected in home care. MEWS was used as a support, along with several comprehensive assessments and considerations in home care. The following section presents the strengths identified by RNs and GPs related to using MEWS as a support in clinical reasoning and decision-making in home care.

Concretisation of vague and diffuse symptoms of acute illness

The RNs reported that they used MEWS when they detected newly emerging functional decline and vague, diffuse symptoms deviating from the patient's habitual condition and daily function. One RN described how she noticed functional decline in a patient:

'He was quite lucid, but his gait function was reduced. That was kind of how you noticed it'. (RN-4)

The RN had noticed a slightly change in the patient's gait function, which made her aware of the possibility of that the functional decline could be caused of acute illness. Another RN described that MEWS was used to concretize vague and diffuse symptoms in order to reason if the patient's condition objectively had deteriorated:

'I guess it's like...when you see the care recipient, and he doesn't behave like he normally does. Either you see that he is clammy or sweaty or that he says: "I'm not....there's something today...I don't know what it is, but I'm not like I usually am". Then we tend to do MEWS'. (RN-3)

The detection of symptoms and functional decline could be observed and reported by RNs or other health care staff, patients' relatives or patients themselves. The RNs communicated that they were using their clinical gaze which, in these situations, was a cognitive process that supported RNs in reasoning about the situation and in making decisions about whether patients were in their habitual condition.

The RNs also emphasised the importance of listening to what patients told them about their chief complaint in combination with the clinical gaze, obtaining the medical history and trying to identify the cause of the functional decline. One RN explained that she identified functional decline when patients themselves expressed irregular symptoms:

'I have experienced it twice at work, where the patients in their habitual state could complain about symptoms like "feeling weak and unwell." And MEWS showed that both had very low blood pressure! And to be honest, I don't think we would have detected it otherwise'. (RN-18)

The concretisation of vague and diffuse clinical symptoms supported this RN's clinical reasoning, so clinical information could then be reported to the GP. Minor deviations in vital parameters that lead to hypo- or hypertension, or tachycardia or bradycardia, could be detected with MEWS in some cases. Furthermore, more severe deviations like dehydration, infection and sepsis could also be detected. RNs in all municipalities provided examples of cases in which MEWS had helped them detect sepsis. They noted that sepsis develops rapidly in elderly patients and found it difficult to recognise with only the clinical gaze and no objective measurements. Furthermore, RNs were also aware that vital parameters can rapidly deteriorate in elderly patients, and parameters within normal MEWS reference values could be abnormal for an elderly home care patient.

MEWS supported RNs and GPs in their clinical reasoning and decision-making by concretising vague and diffuse symptoms. However, this underlines the importance of using a combination of the objective measurements in MEWS, the clinical gaze and judgement in clinical reasoning and decision-making with this group of patients.

MEWS baseline measurements in support of clinical judgment

The RNs explained that all home care teams in the municipalities under study were intended to have habitual vital parameters documented in all home care patients' electronic records. Some home care teams routinely conferred with the GP after they had performed MEWS baseline measures to ensure that vital signs, which were often outside the cut-off scores, were considered normal for the individual. Conferring with the GP was especially common for patients with congestive heart failure, chronic obstructive pulmonary disease (COPD) and other chronic disorders that habitually caused vital parameters outside the frame of reference. This practice made RNs more confident in assessing the MEWS scores because it supported their reasoning about causes of acute functional decline:

'You have to consider what's causing it if there is a change in a MEWS score'. (RN-33)

RNs often described performing additional examinations like C-reactive protein tests and urine samples before contacting the GP in order to be proactive and to provide as much information as possible to find the cause of the change in vital parameters. They also checked MEWS scores in patients' habitual states to assess the severity of physical changes.

Knowing the patients emerged as a common theme in all interviews with both RNs and GPs. The full sense of 'knowing the patients' includes detailed knowledge about how they managed daily functional activities and their diagnoses, including MEWS scores and vital parameters in their habitual state. One RN explained that knowing the patient was important to understanding the clinical situation and making proper decisions:

'A lot of our patients have dementia, and they are often unable to express symptoms; you just really have to know your patients in order to assess if it's normal or not'. (RN-3)

The RNs' knowledge of their patients' habitual state was important for them to be able to recognise new symptoms and determine whether it was necessary to make further clinical assessments or contact the medical services.

The GPs also noted the importance of RNs' knowledge of patients' habitual states when they assessed MEWS scores and symptoms of acute functional decline. This knowledge of the patients appeared to have strengthened the cooperation regarding decision-making about whether to start or defer medical treatment or whether the patient should be admitted to hospital.

The RNs also highlighted the importance of providing 'additional information' when acute functional decline occurred. MEWS scores and parameters in both the habitual state and acute situation were important, but additional information was needed to assess the severity of a patient's condition; thus, objective measurements alone could not support health care personnel in clinical reasoning and decision-making processes.

Improvement of interdisciplinary clinical communication

GPs and RNs cooperate to give patients in home care appropriate medical treatment. The main form of communication between RNs and GPs is telephone or electronic messages. In order to promote efficiency and quality in this work, both GPs and RNs emphasised the importance of concise and clear communication and noted that MEWS facilitated that.

One GP reported that he received more specific referrals and more complete and objective information from the RNs after MEWS was implemented:

'A lot of the work is already done when we communicate with the nurses now. Before MEWS, there were a lot of telephone calls and pulses were not taken, or the respiratory rate...so this has eased our job when we assess by telephone. It has especially eased my workday'. (GP-36)

The quality of information made GP's decisions more effective and GPs could assess inquiries by telephone or electronic messages. This expanded the GP's ability to treat patients in general as they had less need to visit the patients in the home. Another GP points out that RNs presented more relevant information after MEWS was implemented:

'Really, before MEWS... I could ask the nurse...what is the respiratory rate? It really didn't happen. It didn't happen before...or...I didn't get the answer to these questions. It's something that has happened after implementing MEWS. I don't think the nurses took the

respiratory rate. They would say, “shortness of breath” or “no shortness of breath” or “the patient is breathing fast”. (GP-3)

According to both GPs, and RNs, MEWS has given the RNs an increased awareness of the need to perform vital measurements and communicate both objective and subjective data. The improved accuracy in medical communication between GPs and RNs appeals to the GPs and creates a more equal role in the collaboration, which also made the GPs work more efficiently. The RNs also reported that their observational skills had improved and that they now assessed all parameters more comprehensively than they had before MEWS was implemented.

One GP had the impression that interdisciplinary cooperation had become more proactive after the introduction of MEWS, which could prevent unnecessary adverse events:

‘I think it is easier now to make assessments early in the process. It has changed the course of treatment for the patients. We can initiate medical help early, or we can say no, it’s safe to wait. You might avoid unnecessary hospital admissions, for example’. (GP-14)

The implementation of MEWS had improved health personnel’s ability to carry out appropriate medical reasoning and make better decisions for patients. MEWS supported interdisciplinary communication in clinical reasoning and decision-making, which in turn led to a general improvement of clinical practice, according to both RNs and GPs.

Limitations of MEWS in non-institutional care settings

MEWS has become an important clinical decision-making tool in home care, and, as detailed above, its implementation improved collaboration between RNs and GPs in their clinical practice. However, implementing MEWS, which was developed for use in hospital settings, in a non-institutional care setting, entails clinical and contextual challenges. In the following section, we present the experiences of RN and GPs regarding the limitations of using MEWS to assess elderly patients with acute functional decline in home care.

Adjustments of MEWS reference values to fit the patient group

The RNs and GPs emphasised that geriatric patients had many chronic diseases that often cause diffuse and vague symptoms and deviations from habitual state vital parameters. The lack of non-adjusted reference values in the MEWS with geriatric patients was clearly identified as a limitation by an RN:

‘We work a lot with geriatric patients, and I think that MEWS is not adapted to geriatric patients. It’s kind of like it would be suitable for me if I’m hospitalised’. (RN-4)

RNs found that they rarely could relate to the normal MEWS reference values because elderly patients’ reference values – even in their habitual state – often deviated from those values. RNs constantly had to assess and differentiate between normal or abnormal vital parameters by disregarding the normal MEWS reference values.

In particular, RNs and GPs in all municipalities identified a challenge with reference values for the respiratory rate. One RN emphasised that most patients had a higher respiratory rate than MEWS reference values indicated as normal:

‘I think that the respiratory rate score is very low; it’s for a healthy person, and we really have none of those’. (RN-2)

The RNs could not trust the MEWS reference values of respiratory rate, and resulted in uncertainty and ambiguity rather than support in clinical reasoning and decision-making. Another RN further emphasized that she was often in fear of making incorrect decisions when assessing a patient whom she did not know or could not physically see:

‘We are very often asked to assess MEWS scores performed by skilled workers, and let’s say they report a score of 1 because of elevated respiratory rate....Well, I sometimes fear that I overlook a MEWS score that I should really react to’. (RN-4)

The MEWS reference values of normal respiratory rate could, according to the RNs, lead to a lack of responsiveness on their part; some even feared that they would not detect and react to early signs of clinical deterioration because their experience had taught them that the majority of elderly patients had a respiratory rate above 14, which is considered abnormal according to MEWS. The reference values for blood pressure were also cited as too broad; the same was true of the reference values for temperature, which in elderly persons can be falsely low due to medication use. The normal MEWS reference values for temperature can camouflage fever

and a delayed physiological response in geriatric patients. The health care personnel were obliged to carry out comprehensive clinical reasoning and make decisions while interpreting measurements with a tool that was perceived as not suited to the patient group in particular.

In home care, RNs have the greatest responsibility for all patients. A dilemma could arise if other workers – skilled or unskilled – needed more competence to interpret a MEWS score when patients had symptoms of acute functional decline. This clinical dilemma would escalate if an RN did not know the patient or could not prioritise seeing the patient. In these situations, MEWS did not support health care personnel in their clinical reasoning or decision-making, because the reference values were not sufficiently tailored to the elderly in home care. The non-adjusted reference values were highlighted by RNs in all interviews as a significant limitation that could lead to uncertainty in the clinical reasoning and decision-making processes.

Adjustment of MEWS trigger recommendations to the home care setting

The MEWS trigger recommendations were described by RNs as challenging to comply with in the home care context. Unlike a hospital setting, home care nurses do not see their patients around the clock; nor do they have immediate access to medical services in the event of acute illness.

RNs indicated that it was not always feasible to follow the MEWS trigger recommendations in home care because of geographical distance and work lists with limited flexibility. One RN described the great distances involved in the southern Norway home care context and how it becomes impractical to comply with MEWS trigger recommendations:

'To achieve continuity all the time...it's fine if they live close to the base, but if the patient lives far away, for example, a 40-minute drive, and you are supposed to perform a MEWS again 2 hours later'. (RN-2)

RNs made decisions regarding how and when to follow up after taking a MEWS measurement based on their clinical reasoning, often by consulting other colleagues and, if possible, by consulting with other health professionals for an interdisciplinary assessment. Another RN explained that, although the MEWS trigger recommendations were not routinely followed, comprehensive reasoning was safely adjusted to each patient's situation:

'It should be said that we are not that structured when it comes to the follow-up intervals. But sure, we do our own reasoning, even if it's a score of 3 or 2'. (RN-44)

RNs in home care were forced to make decisions that were in line with MEWS trigger recommendations. However, another RN found that the colour codes organised the assessments and that follow-up intervals were actually systematised:

'But what I think is OK with the colour codes in the MEWS card is that it tells me if it's a yellow score, the patient should be followed up in a certain period of time. If it's a score of 4, we contact a physician. We can sometimes wonder whether we should contact the physician, but when it's a score of 4, we do contact the physician'. (RN-26)

The RN used colour codes to visualise the severity of each patient's health condition and found that MEWS provided concrete guidelines in clinical reasoning and decision-making.

According to several RNs and GPs, a MEWS score of 0 was easy to assess, because they considered the clinical situation to be stable and normal, but they were aware of the prospect of making incorrect decisions. One RN described the constant possibility of making the wrong decision by relying solely on objective parameters:

'There is a risk of blindly trusting the measurements and not interpreting the clinical situation. [MEWS] is a starting point, but there can be serious misjudgements'. (RN-44)

A MEWS score of 1–3 also resulted in a dilemma for further clinical reasoning and decision-making, especially if the health care provider did not know the patient or have access to electronic patient records with the habitual vital parameters. A MEWS score higher than 3 or the presence of clinical indications for acute illness were situations that RNs and GPs found easy to assess because they reasoned the situation to be severe. If RNs considered the situation to be unstable and new MEWS measurements had to be done beyond the planned work, priority was given to new measurements, and they organised doing the follow-ups. They also considered other factors, such as whether the patient lived alone, the patient's distance from the home care base and whether it was

close to a weekend, when the GP office was likely to be closed for several days during the reasoning and decision-making process. If the MEWS score or the patient's clinical condition indicated frequent measurements because of an unstable health condition or if the patient had deteriorated significantly, the RNs often reasoned that it was not prudent to keep them at home. These situations often led RNs to contact the GP or the after-hours emergency service, and the patient was often admitted to a higher level of care, such as a nursing home, the municipal emergency care unit or the hospital. MEWS trigger recommendations did not appear as a support for RNs in clinical reasoning and decision-making.

Both strengths and limitations of using MEWS emerged from the experiences of RNs and GPs in home care. Although MEWS supported health care personnel in many clinical situations, the unadjusted reference values and trigger recommendations in MEWS indicated that a EWS tool designed for hospital practice, like MEWS, cannot and should not be easily transferred to community care settings without adjustments.

Discussion

The present study describes the experiences of RNs and GPs with MEWS in the community care setting. In the following, we discuss the strengths and limitations identified in this study that have implications for using MEWS as a support in clinical reasoning and decision-making in home care.

The implementation of MEWS has improved practice

According to the participants in this study, MEWS has strengthened the collaboration and communication between health care personnel in general and RNs and GPs in particular. The present study supports findings from earlier studies in other contexts [20, 23, 26], in which the use of EWS systems to communicate objective findings improved communication between health professionals.

Studies performed in hospitals showed that RNs found it challenging to contact the physician when they were concerned about a patient based on their clinical intuition, but the EWS score was low [26]. In contrast to studies conducted in the hospital setting, no impeding hierarchical structure in communication between RNs and GPs was identified in our study. Furthermore, RNs found that their inquiries were taken seriously, while GPs indicated that they trusted the RNs' expertise in home care. The GPs noted the importance of integrating RNs' clinical knowledge and their concern regarding patients' state of health as an important part of the reasoning and decision-making process, even when vital parameters were normal. GPs received a complete set of objective vital parameters from RNs. These data, including the results of additional examinations and the patient's health history, improved the GPs' ability to work efficiently and make appropriate medical decisions for their patients. The present study supports findings from studies performed in other pre-hospital settings: RNs experienced that identification of potentially life-threatening conditions for elderly patients, such as infections and sepsis, were identified and treated earlier with EWS [29, 34].

The results of this study indicate that the implementation of MEWS contributed to improved practice as experienced by both RNs and GPs. Nevertheless, comprehensive clinical and contextual challenges with MEWS reference values and trigger recommendations were identified.

Challenges in using MEWS with geriatric home care patients

Several studies have highlighted challenges with using EWS systems in a variety of patient groups and pointed out the need to adjust EWS systems to ensure their proper use [20, 23-25]. In the present study, RNs and GPs reported that elderly patients in their habitual state frequently have vital sign values outside the MEWS reference values. All parameters and reference values in MEWS were discussed by RNs and GPs, and they agreed that the values were not adjusted for the majority of elderly patients in home care.

Normal respiratory rate values were found to be too sensitive for elderly patients in general and COPD and heart failure patients in particular. Normal values of systolic blood pressure were experienced as too broad, and MEWS did not trigger measures with significant drops or rises in patients' habitual values. Normal temperature values were too wide and not sensitive enough to enable early tracking of infections. Oxygen saturation did not generate scores in MEWS and did not take into account patients suffering from congestive heart failure or COPD. Newly emerged confusion did not generate points in determining the level of consciousness, which is a significant symptom and factor in raising concern for acute illness in elderly patients [7]. However, there are several EWS systems with reference values that could help overcome the challenges that RNs experienced when using MEWS with geriatric

patients. Brangan et al.'s (2018) use of NEWS takes chronic low oxygen saturation into account and, if the patient is receiving oxygen therapy, the respiratory rate reference values in NEWS are less sensitive than in MEWS [20].

The non-adjusted reference values challenged the RNs' interpretation of MEWS scores and led to ambiguity in clinical reasoning and decision-making; the nurses emphasised the possibility of errors in judgement regarding elderly patients' state of health if solely MEWS recommendations were followed.

Previous studies have emphasised that EWS systems are not superior to clinical judgement in detecting critical illness in hospital and pre-hospital settings [20, 24-28]. The present study shows that MEWS was used as an additional tool in – not a substitute for – the clinical reasoning and decision-making process. Furthermore, clinical reasoning and decision-making in geriatric home care patients requires comprehensive cognitive and non-cognitive skills [4, 5, 14].

Both RNs and GPs highlighted the importance of geriatric competence and knowing the patients' habitual-state physical and psychological functions in order to recognise any changes at an early stage. This specific clinical competence was crucial for the RNs in terms of detecting acute functional decline and for GPs and RNs in collaborating to make the appropriate clinical decisions for the patient. This ability appears to be closely related to organising for personnel continuity and the proper competences, which, in Norwegian home care, has been shown to be challenging [15, 16, 18]. However, in the present study, the RNs and GPs indicated that they knew their patients quite well.

RNs also reported challenges with compliance related to MEWS trigger recommendations in the context of home care. Studies have found issues with the use of EWS systems outside hospital settings and the need for adjustments related to different patient groups and contexts [20, 23-25]; these challenges were also identified in this study. The RNs stated that trigger recommendations in MEWS were difficult to comply with when working in home care. Unlike a hospital setting, neither RNs nor GPs see the home care patient around the clock. In home care, health care personnel see their patients on a wide variety of visit frequencies; they have limited flexibility in their work lists and often face long travel distances to reach a patient. The RNs reasoned and made individual and independent decisions about how follow-up could be handled properly. A MEWS score of 1–3 indicated frequent follow-ups or contacting the medical service, but the RNs made clear that these scores could be habitual state scores for many elderly patients and could thus represent false triggers, which could lead to a generalised culture of non-adherence to trigger recommendations in MEWS. The practise of non-adherence to EWS trigger recommendations is in keeping with a previous study in a hospital setting, which showed that nurses relied on their own clinical judgement to manage the patient rather than complying with the escalation protocol; they often viewed the EWS system as a task to be completed rather than a tool to support clinical decisions [24].

Furthermore, a MEWS score of 0 could also be abnormal for a patient with a high score in the habitual state, which would indicate more frequent measures or even the need for prompt medical supervision. If MEWS triggered frequent measures, such as every 1–4 hours, RNs reasoned that it was not prudent for the patient to stay at home and that a higher level of care or admission to the municipal emergency care unit or hospital was required. The present study found results similar to research performed in a community health care setting [20], where MEWS was also used as a support in decision-making regarding escalation of care.

The identified challenges with reference values and trigger recommendations implies the need for adjustments of MEWS if it is to be used in the non-institutional care setting of home care with elderly patients. The adjustments are important for health personnel in the community health care service to experience sufficient support with MEWS in their clinical practice in order to make appropriate and sound decisions with acute illness in elderly home care patients.

Methodological considerations

The design of this study implies that a number of criteria have to be addressed to ensure the trustworthiness of the findings reported in this paper [32]. We have aimed for transparency, which relates to the explicitness of the method used and how clearly this is outlined through detailed descriptions of the process of analysis [32]. The process is outlined in this paper by giving several examples of coding the interviews, categorisations and main themes (Table 2). We recognise that we as researchers are part of the process of producing the data and interpreting their meanings. Our pre-understanding and experiences as health care personnel and researchers influenced the perception and interpretation of the data in this study. However, the rich examples of quotes in this paper emphasise the aim of transparency and support our interpretations of the data.

The study included both RNs and GPs, and sampling was continued until information saturation was reached. Validity was enhanced by assuring variation in age and clinical experience, along with the representation of two health care professions and representation of all sizes of Norwegian municipalities. One limitation regarding validity was that nurses' assistants and unskilled workers were not included in this study. These groups could have contributed their experience with identifying acute functional decline, using and interpreting MEWS and sharing their experiences in collaboration with RNs in home care.

Conclusions

This study shows that MEWS supported RNs in conducting comprehensive clinical assessments and reasoning when acute functional decline was detected. Interdisciplinary communication and collaboration appeared to be strengthened by using MEWS, and the work of GPs was streamlined. However, several limitations were identified regarding the use of MEWS reference values with geriatric patients, which could lead to ambiguity and misjudging a patient's state of health. MEWS trigger recommendations were experienced as difficult and inappropriate to use in the context of home care. The study has thus identified the need for a modified, evidence-based EWS tool with reference values and trigger recommendations adjusted for geriatric patients in home care.

Abbreviations

MEWS: Modified Early Warning Score, TILT: Early Identification of Life-Threatening conditions, GP: General Practitioners, RN: Registered nurses, EWS: Early Warning Score, RSS: Rapid Response Systems, NEWS: National Early Warning Score,

Declarations

Ethics approval and consent to participate

This study was approved by The Norwegian Regional Committees for Medical and Health Research Ethics (2018/469). All participants signed a consent form, assuring voluntary participation and confidentiality.

Consent for publications

Not applicable.

Availability of data and materials

Datasets generated and analysed during the current study are not publicly available due to Norway's strict ethics regulations. Excerpts of the data material may be made available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was funded under the Public Sector PhD scheme by The Research Council of Norway (Project number 273141), the municipality of Tvedestrand and the Board of Directors of the Eastern Municipalities of Norway. The University of Oslo contributed research time and organisational support.

Authors' contributions

KJ and MK participated in the study conception and design. KJ, MK and LKB participated in interviews. KJ, MK and LKB analysed the data. KJ drafted the manuscript. MK and LKB critically reviewed the analyses and supplied comments on the manuscript. All authors have read and approved the final version of this manuscript.

Acknowledgements

We thank all RNs and GPs in the municipalities of southern Norway who contributed their time and insight by participating in this study.

References

1. The Ministry of health and care services: **White paper number 47. The Coordination Reform. Right treatment-at the right place-to the right time.** In. Oslo, Norway; ; 2009.
<https://www.regjeringen.no/contentassets/d4f0e16ad32e4bbd8d8ab5c21445a5dc/no/pdfs/stm200820090047000dddpdfs.pdf>
Accessed 20 oct 2019.
2. The Ministry of health care services: **Living all your life - A quality reform for the elderly.** In. Oslo, Norway; 2018.
<https://www.regjeringen.no/contentassets/196f99e63aa14f849c4e4b9b9906a3f8/no/pdfs/stm201720180015000dddpdfs.pdf>
Accessed 20 oct 2019.
3. The Norwegian Patient Safety Program, In safe hands 24/7. <https://www.pasientsikkerhetsprogrammet.no/om-oss/innsatsomr%C3%A5der/tidlig-oppdagelse-av-forverret-tilstand>. Accessed 16 oct 2019.
4. Bing-Jonsson P, Foss, C, Bjørk, I.T: **The competence gap in community care: Imbalance between expected and actual nursing staff competence.** *Nordic Journal of Nursing Research* 2015, **36**(1):11.
5. Næss G, Kirkevold, M, Hammer, W, Straand, J, Bruun Wyller, T: **Nursing care needs and services utilised by home-dwelling elderly with complex health problems: observational study.** *BMC Health Services Research* 2017, **17**(645):10.
6. Vegda K N, J X, Wang L, Tracy C.S, Moineddin R, Upshur R EG: **Trends in health services utilization, medication use, and health conditions among older adults: a 2-year retrospective chart review in a primary care practice.** *BMC Health Services Research* 2009, **9**(217):7.
7. Hébert R: **Functional decline in old age.** *Canadian Medical Association Journal* 1997, **157**(8):9.
8. Hsin-Ju Tang H-YJT, Fang-Wen Hu, Ching-Huey Chen: **Changes of geriatric syndromes in older adults survived from Intensive Care Unit.** *Geriatric Nursing* 2016, **Volume 38**(3):219-224.
9. Cigolle C, Langa, KM, Kabeto, MU, Tian, Z, Blaum, C S.: **Geriatric conditions and disability: the health and retirement study.(Author abstract)(Clinical report).** *Annals of Internal Medicine* 2007, **147**(3).
10. Anpalahan M, Gibson SJ: **Geriatric syndromes as predictors of adverse outcomes of hospitalization.** *Internal Medicine Journal* 2008, **38**(1):16-23.
11. Bell SP, Vasilevskis EE, Saraf AA, Jacobsen JML, Kripalani S, Mixon AS, Schnelle JF, Simmons SF: **Geriatric Syndromes in Hospitalized Older Adults Discharged to Skilled Nursing Facilities.** *Journal of the American Geriatrics Society* 2016, **64**(4):715-722.
12. Fox M, Persaud M, Maimets I, O'Brien K, Brooks D, Tregunno D, Schraa E;: **Effectiveness of Acute Geriatric Unit Care Using Acute Care for Elders Components: A Systematic Review and Meta-Analysis.** *The American Geriatrics Society* 2012, **60**(12):9.
13. Buurman B, Hoogerduijn, JG, de Haan, RJ, Abu-Hanna, A, Lagaay, AM, Verhaar, HJ, Schuurmans, MJ, Levi, M, de Rooij, SE: **Geriatric Conditions in Acutely Hospitalized Older Patients: Prevalence and One-Year Survival and Functional Decline (Geriatric Conditions: Prevalence and Outcomes).** *PLoS ONE* 2011, **6**(11).
14. Higgs J J, MA: **Clinical reasoning in the health professions.** London: Elsevier Health Sciences.; 2008.
15. The Norwegian Directorate of Health: **Professional training in the nursing and care services** In.; 2018.
<https://www.helsedirektoratet.no/statistikk/statistikk/kvalitetsindikatorer/kommunale-helse-og-omsorgstjenester/fagutdanning-i-pleie-og-omsorgstjenesten>. Accessed 20 Oct 2019.
16. Kattouw CE, Wiig, S: **The organisation of community nursing services may impact negatively on safety and the quality of care.** *Sykepleien Forskning* 2019(13):21.
17. The Ministry of health care services: **Regulations on quality in the nursing and care services for services provided by the Act of 19 November 1982 No. 66 on health services in the municipalities and by the Act of 13 December 1991 No. 81 on social services, etc.** In.; 2003. <https://lovdata.no/dokument/SF/forskrift/2003-06-27-792>. Accessed 20.Oct 2019.
18. Gjevjon ER, Eika, K.H, Romøren, T.I, Landmark, B.F: **Measuring interpersonal continuity in high-frequency home healthcare services.** *Journal of Advanced Nursing* 2014, **70**(3):11.
19. Dale B, Sævareid, H.I, Kirkevold, M, Söderhamn, O: **Formal and informal care in relation to activities of daily living and selfperceived health among older care-dependent individuals in Norway.** *International Journal of Older People Nursing* 2008, **3**(3):10.

20. Brangan E, Banks J, Brant H, Pullybank A, Le Roux H, Redwood, S: **Using the National Early Warning Score (NEWS) outside acute hospital settings: a qualitative study of staff experiences in the West of England.** *BMJ open* 2018, **8**(10):8.
21. Smith BME, Chiovaro, J.C, O'Neil, M, Kansagara, D, Quiñones, A.R, Freeman, M, Motu'apuaka, M.L, Slatore, C.G: **Early Warning System Scores for Clinical Deterioration in Hospitalized Patients: A Systematic Review.** *AnnalsATS* 2014, **11**(9):13.
22. Subbe CP, Kruger, M, Rutherford, P, Gemmel, L: **Validation of a modified Early Warning Score in medical admissions.** *Q J Med* 2001, **94**(10):6.
23. Downey CL, Tahir, W, Randell, R, Brownc, J.M, Jaynea, D.G: **Strengths and limitations of early warning scores: A systematic review and narrative synthesis.** *International Journal of Nursing Studies* 2017, **76**:14.
24. Foley C, Dowling, M: **How do nurses use the early warning score in their practice? A case study from an acute medical unit.** *Journal of Clinical Nursing* 2019, **28**(7-8):10.
25. Fox A, Elliot, N: **Early warning scores: A sign og deterioration in patients and systems.** *Nursing management* 2015, **22**(1):6.
26. Jensen JK, Skaar, R, Tveit, B: **The impact of Early Warning Score and Rapid Response Systems on nurses' competence: An integrative literature review and synthesis.** *J Clin Nurs* 2017, **27**(7-8):19.
27. Fullerton JN, Priceb, C.L, Silveya, N.E, Bracea, S.J, Perkins, G.D: **Is the Modified Early Warning Score (MEWS) superior to clinician judgement in detecting critical illness in the pre-hospital environment?** *Resuscitation* 2012, **83**(5):6.
28. Williams TA, Tohira, H, Finn, J, Perkins, G.D, Ho, K.M: **The ability of early warning scores (EWS) to detect critical illness in the prehospital setting: A systematic review.** *Recuscitation* 2016, **102**:8.
29. Patel R, Nugawela, M.D, Edwards, H.B, Richards, A, Le Roux, H, Pullyblank, A, Whiting, P: **Can early warning scores identify deteriorating patients in pre-hospital settings? A systematic review.** *Resuscitation* 2018, **132**:11.
30. Pedersen L: **Early identification of life-threatening conditions** In.: Hospital of Sourthern Norway 2014. <http://ss.prod.fpl.nhn.no/SiteCollectionDocuments/PWA/Pasientsikkertskonferansene/TILT%20-%20Line%20Pedersen.pdf>. Accessed 20 Oct 2019.
31. Autotranskription: **version 6.2.5 f4transkript** In. Edited by Dresing TPuDT. Germany: dr. dresing & pehl gmbH audiotranskription; 2018. <https://www.audiotranskription.de/>. Accessed 20 Ocy 2019.
32. Green J, Thorogood, N: **Qualitative methods for health research.** London: Sage; 2014.
33. QRS International: **Nvivo 12 for windows.** In.: OSR International; 2018. <https://www.qsrinternational.com/nvivo/nvivo-products/nvivo-12-plus>. Accessed 20 Oct 2019.
34. Skumsvoll KG, Mjøen, K.S: **Early identification of life- threatening conditions - Assessment tool in community care. [TILT-tidlig identifisering av livstruende tilstander -Vurderingsverktøy i kommunehelsetjenesten].** Department of Health and Nursing Science: University of Agder; 2015.

Tables

Table 1: Characteristics of the sample

Variable	GP (n=8)	RN (n=36)	Total (n=44)
Age (mean (SD))	43,25 (5,94)	43,92 (13,26)	43.8 (12,2)
20-29			9 (20.5)
30-39			6 (13.6)
40-49			13 (29.5)
50-59			12 (27.3)
60-69			4 (9.1)
Clinical experience (mean (SD))	15,13 (6,33)	15,81 (10,89)	15,69 (10,16)
0-5	0	6 (17,14)	7 (15.9)
6-10	3 (37,5)	6 (17,14)	9 (20.5)
11-20	5 (62,5)	11 (31,42)	15 (34.1)
21-30	0	8 (22,85)	9 (20.5)
31-40	0	4 (11,42)	4 (9.1)
Medical specialization, Physicians			
General medicine	7 (87.5)		7 (87.5)
Internal medicine	2 (25.0)		2 (25.0)
Anesthesia	2 (25.0)		2 (25.0)
Continuing education, Nurses (n=9)			
Palliative care		4 (66.6)	4 (66.6)
Dementia care		1 (11.1)	1 (11.1)
Rehabilitation		1 (11.1)	1 (11.1)
Geriatric		1 (11.1)	1 (11.1)
Critical care		2 (22.2)	2 (22.2)

All values are n (%) unless otherwise specified.

Table 2: Examples of codes, categories, and main themes of the qualitative analysis

Transcribed text	Code	Category	Main theme
'I guess it's like...when you see the care recipient, and he doesn't behave like he normally does. Either you see that he is clammy or sweaty or that he says: "I'm not....there's something today...I don't know what it is, but I'm not like I usually am". Then we tend to do MEWS' (RN-3).	MEWS provides specific information	Change of practice after the introduction of MEWS	MEWS as a supportive clinical decision making-tool
'A lot of our patients have dementia, and they are often unable to express symptoms; you just really have to know your patients in order to assess if it's normal or not'. (RN-3) "I think it's something about that continuity and that home care nurses know the care recipients very well, and that is important. It is as important as well as an instrument like MEWS". (GP-6)	Nurses must be in contact with the patients to identify changes	Nurses and GPs have to know their patients	
"I think it is easier now [after the introduction of MEWS] to make assessments early in the process. It has changed the course of treatment for the patients. We can initiate medical help early, or we can say no, it's safe to wait. You might avoid unnecessary hospital admissions, for example" (GP-14).	MEWS can prevent unnecessary hospital admissions	Change of practice after the introduction of MEWS	
'We work a lot with geriatric patients, and I think that MEWS is not adapted to geriatric patients. It's kind of like it would be suitable for me if I'm hospitalised'. (RN 4) "There is a risk of blindly trusting the measurements and not interpreting the clinical situation. [MEWS] is a starting point, but there can be serious misjudgements. " (RN-44)	Patients have parameters outside the frame of reference in habitual state.	MEWS is not an appropriate tool for all patient groups	Adjusting to the use of MEWS to non-institutional care settings
'It should be said that we are not that structured when it comes to the follow-up intervals. But sure, we do our own reasoning, even if it's a score of 3 or 2'. (RN 44) «You know, coming back to the patient in two hours, and then a new MEWS in eight hours really, that's not how we work in home care" (RN-9).	MEWS trigger recommendations are not always relevant nor feasible		

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 <u>>4</u> , if oxygen saturation drops to <90 % with oxygen treatment and if you are concerned of the patients' 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 1

Modified Early Warning Score (MEWS)