The implementation of the National Early Warning Score in UK care homes: a qualitative evaluation

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Abstract

Background: The National Early Warning Score (NEWS) is a tool for identifying and responding to acute illness. When used in care homes, staff measure residents' vital signs and record them on a tablet computer, which calculates a NEWS to share with health services. This article outlines an evaluation of NEWS implementation in care homes across one Clinical Commissioning Group area in northern England.

Aim: To identify challenges to implementation of NEWS in care homes.

Design and Setting: A qualitative analysis of interviews conducted with 15 staff members from six care homes, five health professionals, and one Clinical Commissioning Group employee.

Method: Interviews were intended to capture people's attitudes and experiences of using the intervention. Following an inductive thematic analysis, data were considered deductively against Normalisation Process Theory constructs to identify the challenges and successes of implementing NEWS in care homes.

Results: Care home staff and other stakeholders acknowledged that NEWS could enhance the response to acute illness, improve communication with the NHS and increase confidence of care home staff. However the implementation did not account for the complexity of either the intervention or the care home setting. Challenges to engagement included competing priorities, insufficient training, and shortcomings in communication.

Conclusion: This evaluation highlights the need to involve care home staff and the primary care services that support them in the development and implementation of interventions in care homes. The appropriateness and value of NEWS within non-acute settings requires ongoing monitoring.

Keywords: early warning score; implementation science; nursing homes; qualitative research; residential facilities.

How this fits in

Despite limited evidence for its feasibility and practicality NEWS is being implemented into community settings such as care homes and primary care. This evaluation of an implementation of NEWS in care homes in northern England adds to the growing debate on the use of NEWS in non-

acute settings. Findings indicate that the implementation of NEWS in complex community settings such as care homes requires diligent and thoughtful planning. Communication with care home staff and health professionals such as community nurses and GPs should be ongoing during intervention development and implementation.

INTRODUCTION

Care home residents are community dwelling NHS patients with complex needs. Cognitive impairment and dementia, disability, frailty, multiple long-term conditions and polypharmacy are common (1). Many are unable to communicate their needs and their mood may fluctuate (2,3). The nature of paid care work in care homes is challenging. Staff are liable to stress and burnout, contributing to high staff turnover within the sector (2,4–6). Concerns have been raised about the quality of healthcare in care homes (7). Residents have 40-50% more emergency admissions and accident and emergency attendances than the general population aged ≥75 years (8), half of which may be avoidable (9). Overt signs of deterioration among older adults are often absent, making the identification and management of acute illness in residents challenging. Care home staff play a key role in identifying changes in residents' health, but many have limited or no healthcare experience (10,11). This presents barriers to communicating concerns to health professionals. Enhancing the ability of care home staff to recognise, respond to and communicate concerns could improve triage and reduce avoidable hospital admission.

The intervention

The National Early Warning Score (NEWS) is a tool for identifying and responding to acute deterioration. It can provide a common language to communicate about acute illness. To calculate a NEWS, vital signs are recorded (respiratory rate; oxygen saturation; temperature; systolic blood pressure; pulse rate; level of consciousness/confusion) and given a score. The resulting NEWS is an aggregate score based on these vital signs. Clinical risk thresholds and associated responses have been attached to different scores.

NEWS was developed for use in UK hospitals. Its use has spread into primary care and community settings, despite limited evidence on the appropriacy and effectiveness of NEWS outside of the acute sector (12,13). The Royal College of Physicians supported the development of NEWS, and advocates its use in pre-hospital assessment of acutely unwell patients to improve triage (14). Research published in 2018 suggested that using NEWS outside of hospitals has potential, but the capacity for this varies between settings (13). Concerns have been raised about the suitability NEWS with patients with complex comorbidities (15,16). Implementation of NEWS into care homes is already underway across multiple sites in the UK (17,18). Data were published in 2019 on expected values of NEWS in care home residents (19).

This article outlines the findings from the qualitative component of an evaluation of an implementation of NEWS into care homes in a Clinical Commissioning Group (CCG) area within northern England. The evaluation was independent from the implementation process, seeking to assess whether the implementation was successful and provide recommendations for improvement.

This implementation of NEWS into care homes, supported by the local Clinical Commissioning Group (CCG), involved 47 care homes within the CCG's remit. NEWS was briefly implemented within seven homes before being implemented across the remaining 40 care homes. External training was delivered by the CCG to a selection of staff from each care home. This covered the theory behind the NEWS, how to take vital signs and entering data into a bespoke tablet computer to generate a NEWS. Trained staff were tasked with training colleagues. The CCG provided ongoing technological support and top-up training.

Care home staff were required to take monthly vital signs measurements to maintain baseline NEWS readings for each resident. NEWS measurement was also undertaken if staff suspected a resident was unwell. Data were entered into the tablet computer. The tablet provided staff with specified responses to the NEWS, ranging from guidance to repeat NEWS within a certain time frame, to seeking emergency medical help. Data was designed to be shared with health professionals, such as GPs, community nurses, NHS 111, and urgent care services, to inform triage and decision making. The introduction of NEWS into the care home setting is a complex intervention, defined as '*interventions that comprise multiple interacting components, although additional dimensions of complexity include the difficulty of their implementation and the number of organisational levels they target'* (20,21).

At the time of the evaluation NEWS implementation had been ongoing for 24 months; support staff consisted of one, non-clinical CCG employee; and one third of care homes within the CCG's remit were regularly measuring NEWS.

This article describes an evaluation of the implementation of NEWS into care homes in this area which aimed to identify factors that inhibited and enabled successful implementation, and ways in which the implementation could be improved.

METHOD

Qualitative interviews were conducted with stakeholders in addition to quantitative analysis of NEWS recordings from the 47 care homes over 24 months, published elsewhere (19), and a survey sent to care homes in the area (see Supplementary Table 1 and Supplementary Box 1 for details).

Participants and recruitment

The evaluation concerned care homes, and health services that support them, within a CCG area in Northern England. Care home staff, NHS health professionals and CCG staff were recruited using purposive and convenience sampling. The research team were supplied with data from the CCG indicating whether the care homes were currently measuring NEWS, if they had started and then stopped, or never started. These data were used to place the care homes into three categories of engaged, inconsistent and not engaged. This informed purposive sampling, aiming to support the inclusion of care homes from each category.

Care home managers were approached via email, with an attached information sheet. Reminders were sent a week later, followed up with phone calls. Time(s) for the researcher to visit a home and conduct interviews with staff were confirmed with managers. Health professionals were identified

with support from the CCG and invited by email and follow up telephone calls. Telephone interviews were offered.

Data collection

Data collection occurred between May and August 2018. Written informed consent was obtained prior to data collection. Semi-structured interviews were conducted to enhance understanding of the implementation process, reasons for good or poor engagement, and important contextual factors. The majority of interviews were held face-to-face, some interviews were held via telephone and one via an emailed set of open-ended questions. Face-to-face interviews with care home staff were typically conducted in care homes. Topic guides provided focus and structure to the interviews. The semi-structured approach allowed the researcher to explore any unexpected responses and topics. Interviews lasted between 15 and 35 minutes, and were audio-recorded. Field notes supported analysis.

Data analysis

Recordings were transcribed verbatim, anonymised and transferred into NVivo (version 11) software to supporting management and retrieval of data. Data analysis followed the principles of thematic analysis (22), providing an interpretive exploration of the experiences, attitudes and beliefs of different stakeholder groups. One researcher reviewed and coded all transcripts providing them with an in-depth understanding of the data. The remaining authors independently coded a sample of the transcripts. Emerging codes and themes were discussed as a team. This coding framework was used to analyse all transcripts. This process was iterative.

Normalization Process Theory (NPT) identifies and describes mechanisms that promote and inhibit the implementation, engagement with, and integration of complex health interventions (23). There are four constructs within NPT, each containing four components capturing the individual and collective work involved in changing practice (see Supplementary Table 2 for details). NPT provided a framework for exploring the challenges and successes of the implementation. Findings from the thematic analysis were reconsidered, deductively, against NPT constructs in order to explore the engagement with, and acceptance and integration of the intervention. Four authors conducted this analysis.

RESULTS

Participants

In total, 21 interviews were conducted. Fifteen care home staff participated, across six homes (see Supplementary Table 3 for details). Two homes were inconsistent in their use of NEWS, while the remaining four were engaged. Two homes that were not engaging with NEWS did respond, but declined to participate. A variety of staff were interviewed; eight carers/senior carers, one registered nurse, six managers/ deputy managers. Fourteen interviews were conducted face-to-face within care homes and one was held over the phone. Interviews were one-on-one bar two that were dyadic (two participants interacting in response to open-ended questions).

Six interviews were conducted with health professionals: one GP who managed a practice (see Supplementary Box 2 for further details), three Older Person Specialist Nurses, one nurse from a 24 hour care service and a CCG employee involved in intervention support. Specialist Nurses visit care homes regularly, providing brief education to staff and healthcare to residents, acting as a link

between the care homes and external services, aiming to prevent avoidable hospital admissions. The 24 hour care service provided short term, responsive, multidisciplinary health and social care in the community, including to care homes. Due to their interaction with multiple care homes, these interviewees had a broad overview of how care homes interacted with NEWS.

Key themes

Three key themes were identified: acknowledging and exploiting the benefits of NEWS; inhibitors to engagement and integration; and shortfalls in communication.

Acknowledging and exploiting the benefits of NEWS

Care home staff recognised the potential advantages of NEWS, with some expressing a sense of empowerment. Having a NEWS measurement to hand often, though not always, enabled staff to communicate more effectively with external healthcare services, with a view to avoiding unnecessary hospital admissions. Using the tablet to input and calculate NEWS was viewed as straightforward.

> *it does give you the backup when you're ringing for professional help …they, kind of, listen a bit more.* (Dyadic interview, deputy managers, DM1, care home 4)

> *it doesn't have to be a nurse or a senior nursing staff, it can be a carer who can do it … it makes me feel important when I've got that little case there [containing NEWS equipment].* (Carer, care home 1)

Inhibitors to engagement and integration

The data provided by the CCG indicated that only one-third of care homes were regularly measuring NEWS. Measuring vital signs, particularly respiratory rate, posed a challenge for some care home staff, resulting in inaccurate or absent readings being used to generate a NEWS. There was a perception amongst health professionals, that care home staff sometimes took observations at inappropriate times or failed to account for variables that could result in an inaccurate reading (for example, a resident's nail varnish interfering with pulse oximetry). Health professionals believed that some homes were struggling with basic elements of care, such as hydration, making the introduction of NEWS potentially inappropriate.

> *sometimes get the oxygen saturations and heart rate around the wrong way … And that is reading off the actual pulse oximeter… Or they won't actually take the full score, or the score will be inaccurate because they haven't done a respiratory rate.* (Nurse, 24 hour care service)

> *I cover nine homes and I could probably straightaway think* [specific care homes] *are doing well with it… But, that's the minority. The rest are either struggling or paying lip service … sometimes I think "would I even want them to be worrying about the NEWS scores, would I actually want them to be worrying about more basic: have they given them a drink; have they made sure that they've been up to the toilet?"* (Specialist nurse 2)

With their broad view across multiple homes, health professionals were aware of regular changes in management and high staff turnover, leading to inconsistency in training and skill level across care homes. Differing levels of knowledge and skill also existed within care homes, with night staff and

agency workers often having less extensive training or lower expectations of responsibility than day staff. This lack of continuity meant that not all staff were aware of or trained in NEWS, creating extra work and frustration for health professionals. This was problematic as the 24 hour care service viewed the sharing of a NEWS as a requirement when care homes requested assistance.

> *One of my homes has had a different manager every year. The turnaround can be very rapid… it causes a lot of unrest amongst everybody … some of the homes haven't got stability…* (Specialist nurse 3)

> *Information is not consistent. Changes in staff does not help.* (GP)

> *But I think when you have got agency staff, who - sometimes they don't even know that the equipment exists - I think that's where sometimes you get some of the problems. Especially if they cover, kind of, nightshifts and weekends*. (Specialist nurse 1)

Care home staff viewed their work as valuable, demanding and often unpredictable, which health professionals also recognised. This unpredictability was positioned as a potential barrier to utilising NEWS. The residents were at the centre of this complexity, with high level of dependency and cognitive impairment, which could result in residents becoming agitated by NEWS equipment. Thus, staff sometimes faced a choice between not obtaining a NEWS and causing distress.

> *…staff who are in the homes on minimum wage and we are expecting them to do more within their role and within a short space of time, when possibly the residents could all be high with anxiety one day and there could be chaos in that period of time that won't allow them to engage more with other residents.* (Nurse, 24 hour care service)

> **Researcher***: So, what were your initial thoughts about* [NEWS]*?*
> **Specialist nurse 2:** *… I thought it was a very good idea at the time and I suppose that my thoughts have possibly changed over a period of time. I now can understand the intricacies and the difficulties that* [care home staff]… *come across.*

> **Deputy manager (DM)2:** *… with it being predominantly dementia, there are a few that won't tolerate it or get frightened by the blood pressure usually, isn't it, the machine?*
> **DM1:** *Yes.*
> **DM2***: So that will be documented and risk assessed and there'll be something in place to say that, you know, we're not going to cause them distress with that if they're not tolerating it*. (Dyadic interview, deputy managers, care home 4)

Care home work was viewed as undervalued, because of its demanding nature and low pay. Asking care home staff to do more complex work like the NEWS was, at times, framed as problematic, and likely to compromise the time carers had with individual residents. Finally, the technology could also cause a barrier to using the NEWS equipment, with care homes typically citing failures with WiFi connections and tablets not charging.

Shortfalls in communication

A key purpose of NEWS was to improve communication between care homes and the NHS. The data suggest that this was not fully achieved, partially due to suboptimal training. Training delivered to care home staff covered the theory behind NEWS and practical experience of taking vital signs with

colleagues. Yet the training was perceived as being aimed at the wrong level; too high in the eyes of one of the health professionals and insufficient in the eyes of some care staff, failing to prepare staff adequately for the challenges of taking vital signs from residents.

> **Researcher:** *What kind of training did you receive around* [NEWS]
> **Carer:** *Very low … if they [fellow care home staff] had additional training or more quality of training, they may feel more amenable to actually engaging with it.* (Carer, care home 3)

Consequently, health professionals reported inconsistencies in how and when NEWS equipment was being used, with some homes only using it to take observations without calculating a NEWS, and others only using the equipment now and again, thus failing to maintain monthly readings. As such, the key purpose of the intervention appeared to have been lost.

In addition to problems with the training, the support being provided to care homes was limited, with one non-clinical CCG employee providing technical support across all 47 care homes. The clinical support care homes received was described as impromptu, such as when a health professional was on site or available on the phone. This resulted in unscheduled additional work for these health professionals. Care home staff were typically not given a strong foundation for engaging with the NEWS, and often lacked adequate longer-term support.

> *… respiratory rate, I have often talked through it on the phone; "I want you to count for a minute, I want you to count how much their chest rises and falls". Just so we can get a value* … (Nurse, 24 hour care service)

Knowledge of the intervention was variable. Some voiced frustrations at NHS services not always being aware of the NEWS or that it was being used in care homes. Care home staff and a specialist nurse also reported that services did not always listen to, or take account of the knowledge and views of care home staff with regard to their residents.

> … [care home] *had a little bit of a concern, done* [resident's] *readings, and their readings have been really out of sync, but … normal* [for the resident]*. But, looking at the* [resident] *themselves, they weren't that concerned for admission. But, based on those readings, the … service haven't gone out to check them, they have just said, "You need an ambulance." … I don't think they particularly did, and if* [the service] *had gone out to see them, then maybe that could have been avoided. … I don't think it's so much that the readings haven't been correct; I think it's more that they don't listen to the staff so much about what the patient's 'normal' is.* (Specialist nurse 2)

> *… if we have to ring for paramedics or 999, the triage can be just horrific.... they'll say "what's the NEWS?"… And I think receptionists at GPs … you would ring and say "we've done a NEWS score" and they'd be like "what does that mean?"* (Dyadic interview, deputy managers, DM2, care home 4)

Representatives from care homes were not included in meetings held by the CCG about the ongoing implementation. Views of care home staff were reported second hand, which meant that people at the frontline of the implementation were not directly involved in discussions on how it could be improved.

Findings Against NPT Constructs

Findings were considered against NPT constructs to identify where the implementation faced barriers and where improvements could be made (see Supplementary Table 3 for details).

The concept behind NEWS was appreciated, the potential benefits of NEWS were understood, and NEWS was perceived as a legitimate part of care home work by health professionals and care home staff alike. This suggests an intellectual level of coherence, cognitive participation and collective action. Some care home staff described the benefits of NEWS and confidence gained from providing objective data to external services. Positive remarks typically came from, or concerned, care homes with a long standing manager and staff, suggesting that homes with a stable staff base may be better suited to this complex intervention.

NEWS faced many real world barriers in its implementation in all NPT constructs. NEWS equipment was commonly not used as intended, vital signs could be taken at inappropriate times or inaccurately, undermining coherence and cognitive participation. Both appropriateness of the training and the legitimacy of care home staff taking vital signs observations was questioned. Not all staff were trained in NEWS causing a barrier to collective action. According to participants, NHS staff were not all aware of NEWS, some had not incorporated it into their triage protocol, and failed to acknowledge that care home staff had a unique understanding of their residents. This hinders collective action and suggests a lack of coherence and cognitive participation among such services. Specialist nurses were not formally involved in providing support to care home staff in regard to NEWS again impeding the integration of NEWS across the aforementioned constructs.

A considerable barrier to engagement with, and integration of, NEWS is based in coherence and reflexive monitoring. Firstly, the initial implementation occurred over a large number of homes over a short period of time, providing limited time for sense-making work. In addition, key frontline stakeholders, such as care home staff and Specialist Nurses, were absent from implementation meetings reducing the capacity for their concerns to be voiced and discussed with those responsible for the ongoing implementation. These issues created a fragmented form of implementation that created a barrier to sense-making and action, as well as reflexive learning and adaptation.

DISCUSSION

Summary

This study presents novel data on the implementation of NEWS in care homes. Stakeholders acknowledged that NEWS could enhance the response to acute illness in residents, improve communication and increase confidence of care home staff. However, only one-third of care homes used NEWS regularly. Considering the findings against NPT constructs showed that this implementation did not allow the time or support for sense-making or relational work to underpin the implementation. The capacity and capability of individual care homes to incorporate NEWS into existing practice was not assessed. There was limited involvement from care home staff and key health professionals in the development of the intervention and reflections on the ongoing implementation. This reduced the possibility of real world challenges and complexities of the care home setting being heard and addressed. There was insufficient support and training for care homes and their staff. Key staff were trained in NEWS outside of their care homes, rather than all staff receiving training within care homes. Such training may not provide the best preparation for the

challenges of taking measurements within the care home, with residents who may be unwell, uncooperative or agitated. The difficulty of measuring vital signs was not fully appreciated. Taking clinical observations is not necessarily straightforward or a quickly developed skill, which is particularly relevant to carers without healthcare training. The measurement of respiratory rate, for example, is known to be problematic, even for those with healthcare training (24,25) particularly when there are pressures (26). The complexity of the care home setting and the intervention itself was not well accounted for, resulting in barriers to successful implementation.

Strengths and limitations

A strength of this study was the qualitative approach used to gain an in depth understanding of the shortcomings and successes of an implementation of NEWS in the care home setting from the perspective of staff in care homes and community services. Considering the findings against NPT constructs provided a clear outline of these successes and shortcomings. Interviewees were drawn from only six care homes and unengaged care homes did not participate.

Comparison with existing literature

There is a growing trend towards using NEWS in community settings. Evidence suggests that the transition of NEWS into such settings is not without problems, including acceptance in the setting, perceived appropriateness for certain patient groups, and uncertainty over its ability to support decision-making and communication between services (13,27). Concerns have also been expressed about the potential for NEWS to 'creep' into primary care without a sound evidence base or sufficient validation (28). Increasing time and procedural burdens on care staff could have a debilitating impact on staff wellbeing and care practises (29,30). Continued rollout of NEWS into care homes, without rigorous evidence to suggest practicality and appropriacy, could compromise staff wellbeing and the provision of person-centred care.

This evaluation highlights the need for interventions implemented into care homes to address the 'whole home' accounting for environment, culture and care practices (29). Implementation could have sought advice and guidance from networks such as Enabling Research in Care Homes, (31) developed and supported by the National Institute for Health Research, to aid recognition of the unique set of competing priorities and challenges faced by care homes. In 2016, a realist review exposed the importance of joint working between care home staff and health professionals in order for health care interventions to become viewed as legitimate and established into care home practice (32). In order for NEWS to be implemented effectively health professionals such as GPs and community nurses need to work with care home staff and appreciate the knowledge, skills and concerns of care home staff in regard to the health and care of residents.

IMPLICATIONS FOR RESEARCH AND PRACTICE

According to the Royal College of Physicians, NEWS is not a standalone assessment and '*any concern about a patient's clinical condition should prompt an urgent clinical review, irrespective of the NEWS'* (14). Care home staff typically lack healthcare experience but are well placed to recognise 'soft signs' of deterioration such as a change in mobility, behaviour or appetite. While NEWS can support objective communication, concerns voiced by care home should not be disregarded.

Care homes are challenging environments for intervention implementation, as highlighted elsewhere (33,34). This complexity should be accounted for by involving care home staff and health professionals in development and implementation, avoiding a top-down approach and enabling the concerns of such stakeholders to be acknowledged and addressed. The readiness of individual care

homes to adopt complex interventions should be assessed to avoid compromising existing care practices.

Exploring the perceptions of primary care and ambulance service staff who receive information about NEWS from care homes would be an important component of future work.

ADDITIONAL INFORMATION

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Ethical approval

The Faculty of Medical Sciences Research Ethics Committee, part of Newcastle University's Research Ethics Committee approved this study (reference number 1505/4648). This study is classified as a service evaluation, and did not identify patients via the NHS. Further ethical approvals were not required. We complied with Caldicott principles, the Data Protection Act (1998) and The General Data Protection Regulation 2016/679.

Provenance

Freely submitted; externally peer reviewed.

Competing interests

The authors have declared no completing interests.

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References

1. Gordon AL, Franklin M, Bradshaw L, Logan P, Elliott R, Gladman JRF. Health status of UK care home residents: a cohort study. Age Ageing. 2013/07/17 ed. 2014 Jan;43(1):97–103.

2. Scott A, Ryan A, James I, Mitchell EA. Perceptions and implications of violence from care home residents with dementia: a review and commentary. Int J Older People Nurs. 2011 Jun 1;6(2):110–22.

3. Holst A, Skär L. Formal caregivers' experiences of aggressive behaviour in older people living with dementia in nursing homes: A systematic review. Int J Older People Nurs. 2017 Dec 1;12(4):e12158.

4. Rapaport P, Livingston G, Hamilton O, Turner R, Stringer A, Robertson S, et al. How do care home staff understand, manage and respond to agitation in people with dementia? A qualitative study. BMJ Open. 2018 Jun 30;8(6):e022260–e022260.

5. Zimmerman S, Williams CS, Reed PS, Boustani M, Preisser JS, Heck E, et al. Attitudes, Stress, and Satisfaction of Staff Who Care for Residents With Dementia. The Gerontologist. 2005 Oct 1;45(suppl_1):96–105.

6. Vernooij-Dasssen MJ, Faber MJ, Olde Rikkert MG, Koopmans RT, van Achterberg T, Braat DD, et al. Dementia care and labour market: The role of job satisfaction. Aging Ment Health. 2009 May 1;13(3):383–90.

7. Tian Y, Dixon A, Gao H. Emergency hospital admissions for ambulatory care-sensitive conditions: identifying the potential for reductions. King's Fund; 2012.

8. Smith P, Sherlaw-Johnson C, Ariti C, Bardsley M. Quality Watch - Focus on: Admissions from Care Homes. London: Health Foundation and Nuffield Trust,; 2015.

9. Harrison JK, McKay IK, Grant P, Hannah J, Quinn TJ. Appropriateness of unscheduled hospital admissions from care homes. Clin Med Lond Engl. 2016 Apr;16(2):103–8.

10. Robbins I, Gordon A, Dyas J, Logan P, Gladman J. Explaining the barriers to and tensions in delivering effective healthcare in UK care homes: a qualitative study. BMJ Open. 2013 Jul 19;3(7):e003178.

11. Rycroft-Malone J, Burton C, Hall B, McCormack B, Nutley S, Seddon D, et al. Improving skills and care standards in the support workforce for older people: a realist review. BMJ Open. 2014 May 1;4(5):e005356.

12. Scott LJ, Redmond NM, Garrett J, Whiting P, Northstone K, Pullyblank A. Distributions of the National Early Warning Score (NEWS) across a healthcare system following a large-scale roll-out. Emerg Med J EMJ. 2019/03/06 ed. 2019 May;36(5):287–92.

13. Brangan E, Banks J, Brant H, Pullyblank 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 Oct 1;8(10):e022528.

14. National Early Warning Score (NEWS) 2 Standardising the assessment of acute-illness severity in the NHS. Royal College of Physicians,; 2017.

15. Grant S. Limitations of track and trigger systems and the National Early Warning Score. Part 1: areas of contention. Br J Nurs. 2018 Jun 12;27(11):624–31.

16. Grant S, Crimmons K. Limitations of track and trigger systems and the National Early Warning Score. Part 2: sensitivity versus specificity. Br J Nurs. 2018 Jun 28;27(12):705–10.

17. Hodgson P, Cook G, Thompson J, Abbott-Brailey H. Assessment and clinical decision making of the acutely ill older care home resident: Implementation of NEWS in Gateshead Care Homes. Northumbria University; 2017.

18. RESTORE2: Recognise early soft-signs, Take observations, Respond, Escalate [Internet]. West Hampshire Clinical Commissioning Group; 2019. Available from: https://westhampshireccg.nhs.uk/restore2/

19. Barker RO, Stocker R, Russell S, Roberts A, Kingston A, Adamson J, et al. Distribution of the National Early Warning Score (NEWS) in care home residents. Age Ageing. 2019 Dec 9;49(1):141–5.

20. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ. 2015 Mar 19;350:h1258–h1258.

21. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M, et al. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ. 2008 Sep 29;337:a1655–a1655.

22. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006 Jan 1;3(2):77–101.

23. Murray E, Treweek S, Pope C, MacFarlane A, Ballini L, Dowrick C, et al. Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. BMC Med. 2010 Oct 20;8(1):63.

24. Lovett PB, Buchwald JM, Stürmann K, Bijur P. The vexatious vital: Neither clinical measurements by nurses nor an electronic monitor provides accurate measurements of respiratory rate in triage. Ann Emerg Med. 2005 Jan 1;45(1):68–76.

25. Churpek MM, Yuen TC, Winslow C, Hall J, Edelson DP. Differences in vital signs between elderly and nonelderly patients prior to ward cardiac arrest. Crit Care Med. 2015 Apr;43(4):816–22.

26. Cardona-Morrell M, Prgomet M, Lake R, Nicholson M, Harrison R, Long J, et al. Vital signs monitoring and nurse–patient interaction: A qualitative observational study of hospital practice. Int J Nurs Stud. 2016 Apr 1;56:9–16.

27. McClelland G, Haworth D. A qualitative investigation into paramedics' thoughts about the introduction of the National Early Warning Score. Br Paramed J. 2016;1(1):9–14.

28. Mahase E. GPs warn over scoring system for calling ambulances for patients. BMJ. 2019 Oct 1;367:l5814.

29. Lawrence V, Fossey J, Ballard C, Ferreira N, Murray J. Helping staff to implement psychosocial interventions in care homes: augmenting existing practices and meeting needs for support. Int J Geriatr Psychiatry. 2016 Mar 1;31(3):284–93.

30. Backhouse T, Killett A, Penhale B, Gray R. The use of non-pharmacological interventions for dementia behaviours in care homes: findings from four in-depth, ethnographic case studies. Age Ageing. 2016 Nov 2;45(6):856–63.

31. NIHR. ENRICH (Enabling Research in Care Homes) [Internet]. [cited 2019 May 15]. Available from: http://www.enrich.nihr.ac.uk/

32. Goodman C, Dening T, Gordon AL, Davies SL, Meyer J, Martin FC, et al. Effective health care for older people living and dying in care homes: a realist review. BMC Health Serv Res. 2016 Jul 16;16(1):269.

33. Low L-F, Fletcher J, Goodenough B, Jeon Y-H, Etherton-Beer C, MacAndrew M, et al. A Systematic Review of Interventions to Change Staff Care Practices in Order to Improve Resident Outcomes in Nursing Homes. PloS One. 2015 Nov 11;10(11):e0140711–e0140711.

34. Smith R, Wood J, Jones F, Turner S, Hurley M. A qualitative study exploring therapists' experiences of implementing a complex intervention promoting meaningful activity for residents in care homes. Clin Rehabil. 2018 Dec 4;33(3):575–83.

Supplementary Materials

Additional Documentation S1: Topic Guides

Topic Guide: Care Home Staff views *Version 1. Date: 12.04.18*

Phase of the interview	Check list / Questions
Introduction	1. Introduce yourself as a researcher from Newcastle University and iterate the purpose of the study. 2. Offer the participant the opportunity to ask questions. 3. Remind the participant that all information remains confidential, and that they are free to stop the interview and withdraw at any time. 4. Obtain consent to proceed and to audio record the conversation – remember to ensure both copies of the consent form are signed and dated and give the participant their copy. 5. Ensure the participant is comfortable and commence the interview.
Rapport building	1. *So tell me a little about yourself?* Probes: How long have you worked in the care sector? How long have you worked in [Care home name]? What's it like working here? ○ Workload ○ Residents ○ Staff [**remind participant that the interview is confidential**] ○ Atmosphere
Core questions	*As I mentioned earlier, we're keen to learn your thoughts on the recording and sharing of data on resident's health.* **Could you tell me what you think about this?** 1. When did you first become aware this was going to be introduced here? • Who informed you? • Do you recall how they were described? 2. How did you feel about recording the health of residents in this way? 3. How about taking patient's blood pressure/breath count? 4. Were you familiar with tablet computers before they were used in [care home]? • Do you have any thoughts or feelings about such devices generally? 5. [if not already discussed] Did you receive any training? • What was this training like? • Did you have any questions for concerns? • Were these answered? 6. When do you take the readings? • Weekly? • When concerned about a patient? • *Why is this?* 7. Are you aware of whether residents and their families were informed about the introduction of the tablets? • Are you aware of their views about the tablets? 8. If you could change anything about how the tablets were first implemented, what would that be? • Could you explain that further? / Why do you feel that way?

	9. Has your opinion regarding recording data on resident's health changed over time? • Could you explain that further? / Why did you feel that way? 10. What impact, if any, has this had on your workload? • Could you explain that further? / Why did you feel that way? 11. What impact, if any, has it had on the care provided at [care home]? • Could you explain that further? / Why did you feel that way? 12. What has it been like sharing data with associated healthcare professionals outside of the care home? • Could you explain that further? / Why did you feel that way? 13. What are your thoughts on the use of National Early Warning Score (NEWS) within this intervention? 14. How about the Malnutrition Universal Screening Tool (MUST)? 11. And the Abbey Pain Score? 15. Is there anything else you would like to tell me about the care you provide here? • Could you explain that further? / Why do you feel that way?
Wrapping up	16. Is there anything else you'd like to add to what we have discussed? 17. Do you have any questions about what we have discussed?
Close	18. Thank the participant for their time.

Topic Guide*:* Healthcare Professionals views *Version 1. Date: 12.04.18*

Phase of the interview	**Check list / Questions**
Introduction	6. Introduce yourself as a researcher from Newcastle University and iterate the purpose of the study. 7. Offer the participant the opportunity to ask questions. 8. Remind the participant that all information remains confidential, and that they are free to stop the interview and withdraw at any time. 9. Obtain consent to proceed and to audio record the conversation 10. Ensure the participant is comfortable and commence the interview.
Rapport building	2. *So tell me a little about yourself?* Probes: How long have you worked in healthcare? • In this particular role? What's it like working in [place of work]? ○ Typical day ○ Workload ○ Types of cases ○ Staff [**remind participant that the interview is confidential**] ○ Atmosphere
Core questions	*As I mentioned earlier, we're keen to learn your thoughts on the tablet computers to record and share health data on the health of care home residents.* 19. When did you first become aware that the care homes were going to start using tablet computers to record and share data on the health of their residents? • Who informed you? • Do you recall how this intervention was described? • What were your initial thoughts about this intervention? ○ Have these thoughts changed? ○ Could you expand on that/explain further?

	20. Could you tell me how you usually communicate with other organisations outside of the NHS, like the care homes? • Barriers/facilitators to these communications? • How, if at all, has the digitisation of data sharing, and the use of tablet computers impacted upon this? • How about your workload? 21. If you could change anything about how this intervention was first implemented, what would that be? • Could you explain that further? / Why do you feel that way? 22. [If not answered by Q3] If you could change anything about the intervention as a whole, what would that be? • Could you explain that further? / Why do you feel that way? 23. What are your thoughts on the use of National Early Warning Score (NEWS) within this intervention? 24. How about the Malnutrition Universal Screening Tool (MUST)? 25. And the Abbey Pain Score?
	26. What impact, if any, do you think the intervention has had on the care provided in care homes? • Could you explain that further? / Why did you feel that way?
	27. Is there anything else you would like to tell me about the intervention? • Could you explain that further? / Why do you feel that way?
Wrapping up	28. Is there anything else you'd like to add to what we have discussed? 29. Do you have any questions about what we have discussed?
Close	30. Thank the participant for their time.

Table S1: Responses to the NoMAD survey instrument

When considering taking measurements and recording data on residents' health using a tablet computer	
General views	67% (28) felt that the intervention was worthwhile 88% (37) could see the potential value of the intervention
How does the intervention fit with current work?	81% (34) felt familiar with the intervention 83% (35) saw it as a normal part of their work 76% (32) felt that use of the tablets could be easily incorporated into their existing work 83 % (35) felt that it was a legitimate part of their role 100% (42) felt that it will become a normal part of their work in the future 86% (36) understood how it affected the nature of their own work 76% (32) felt that staff had a shared understanding of the purpose of the intervention 88% (37) were open to working in new ways with colleagues 88% (37) would continue to support use of the tablets to record data on residents' health 67% (28) valued the effect of the intervention on their own work 24% (10) felt that using the tablet computer to record data disrupts working relationships 69% (29) felt that they can modify how they work with the intervention
How does the intervention fit with current work?	65-74% • valued the effect of the intervention on their own work • felt that they can modify how they work with the intervention 75%+ • All the remaining statements including 'felt that using the tablet computer to record data does not disrupt working relationships' • These could be ordered, in ascending order of % response, or in an order that makes sense because it groups tasks.
Support and training	86% (36) judged that management adequately supported the intervention 81% (34) felt that sufficient training is provided to enable the staff to implement the intervention 86% (36) reported that work is allocated to people with the skills to use the equipment 67% (28) had confidence in other people's ability to use the tablet computers to record information 67% (28) felt that there were key people were driving the intervention and getting others involved. 90%(38) agreed that feedback can be used to improve the intervention in the future

Box S1: Survey instrument

The Normalisation MeAsure Development (NoMAD) [1] survey instrument was used to broaden the scope of the evaluation to include data from an increased number of care homes. The NoMAD is based on NPT and is designed to gauge the perspectives of people directly involved in the implementation of healthcare interventions. We used the NoMAD to a) to elicit care home staffs' views on how the intervention had impacted on their work and whether they believed it could form a routine part of their work; and b) to identify areas where the implementation could be improved. While the use of the NEWS is explicitly mentioned within the introduction the wording of survey questions typically emphasised the use of the tablet computer as opposed to NEWS.

Survey Distribution and analysis

Four paper copies of the survey with information sheets and pre-paid return envelopes, were sent to care home managers. Electronic copies were also sent by email. Managers were asked to distribute the survey to staff involved in the intervention. Information sheets detailed a) the purpose of the evaluation b) that participation was voluntary c) and that completion and return of the survey constituted consent. The survey questions invited responses on multi-point scales. Positive responses (agree and strongly agree) were aggregated.

Findings

Forty-two surveys were returned from 22 care homes. One of these homes had also participated in the qualitative component of the evaluation.

Twenty-one (50%) of responses came from carers, 19 (45%) from home managers/deputy managers, and two (5%) from registered nurses without managerial responsibilities. A small majority (57%) of respondents were directly involved in taking observations, with 43% overseeing such staff. The respondents' collective experience of care work was substantial, with 74% having worked in the care sector for 10 years or more, and 48% had been employed by their current care home for a similar time.

A majority of the respondents were supportive of the current and future use of the intervention. The areas where there were fewest positive responses were; sufficient training, confidence in others' ability, ease of incorporation into existing work and a shared understanding of the purpose of the intervention amongst staff. Further findings are detailed in Table S1.

References

1. Finch et al., 2013. Improving the normalization of complex interventions: measure development based on normalization process theory (NoMAD): study protocol. Implementation Science 2013, 8:43.

Box S2: Additional information on recruitment and data collection

The timescale for this evaluation was limited to four months. This limited the time available for recruitment and data collection.

The research team aimed to interview multiple GPs. However, GPs proved to be difficult to recruit being either non-responsive to requests or unavailable due to busy schedules or annual leave (recruitment and data occurred during summer months). GPs who did respond often felt that they were not familiar enough with the intervention, or that care home staff did not mention the NEWS when contacting them, again limiting participation of this group.

Exploring the views of primary care teams towards the use of NEWS in care homes would be a valuable piece of future research.

Table S2: Evaluation findings against NPT constructs

NPT Construct	Related Findings	
Coherence: The sense-making work that people do individually and collectively when they are faced with the problem of operationalizing some set of practices. Coherence includes: **Differentiation:** Understanding how a set of practices and their objects are different from each other. **Communal specification:** People working together to build a shared understanding of the aims, objectives, and expected benefits of a set of practices. **Individual specification:** Doing things that will assist understanding of specific tasks and responsibilities around a set of practice. **Internalization:** Understanding the value, benefits and importance of a set of practices.	**Evidence of Coherence:** • Staff within engaged homes recognised that NEWS differed from other care work, particularly in the taking of vital signs observations and sharing objective information.	**Evidence of a lack of Coherence:** • The majority of homes were not engaging regularly with the intervention (communal specification and internalization). • Vital signs observations could be taken in inappropriate contexts (e.g. noisy environments; after a resident had been active; using a pulse oximeter on a resident who is wearing nail varnish) and opportunistically (differentiation; internalisation). • Care homes varied in their use of the equipment, sometimes failing to utilise it as intended (communal specification). • Not all external services were aware of NEWS and some had not altered pre-existing triage protocol across stakeholder groups (communal specification) • NEWS implementation occurred over short space of time with a limited provision of support (limiting the potential for sense-making work).
Cognitive Participation: the relational work that people do to build and sustain a community of practice around a new technology or complex intervention. Cognitive Participation includes: **Initiation:** Key participants working to drive new practices them forward. **Enrolment:** The organization or reorganization of participants and others in order to collectively contribute to the work involved in new practices.	**Evidence of Cognitive Participation:** • Care homes that were perceived of as successful by CCG staff and health professionals were those with long-term managers and a core body of long serving staff.	**Evidence of a lack of Cognitive Participation:** • The majority of homes were not engaging regularly with the intervention. • Changes in management and high staff turnover as well as variation of staff skills within and across the care homes created barriers to initiation and enrolment. • NEWS related support provided to care homes from health professionals was impromptu as opposed to an integrated part of the intervention (activation and enrolment) • The legitimacy of staff taking vital signs observations was questioned. Care home staff and health professionals questioned taking vital signs

Legitimation: The work of ensuring that other participants believe it is right for them to be involved, and that they can make a valid contribution to it. **Activation**: Collectively defining the actions and procedures needed to sustain a practice and to stay involved.		based on limited training while health professionals questioned the appropriacy of placing further demands and responsibility onto beleaguered and low paid care home staff.
Collective Action: the operational work that people do to enact a set of practices, whether these represent a new technology or complex healthcare intervention. Collective Action includes: **Interactional workability**: The interactional work that people do with each other, with artefacts, and with other elements of a set of practices, when they seek to operationalize them in everyday settings. **Relational integration:** The knowledge work that people do to build accountability and maintain confidence in a set of practices and in each other as they use them. **Skill set workability:** the allocation work that underpins the division of labour that is built up around a set of practices as they are operationalized in the real world. **Contextual Integration:** Resource work - managing a set of practices through the allocation of different kinds of resources and the execution of protocols, policies and procedures.	**Evidence of Collective Action:** • Care homes were provided with impromptu support by external health professionals • Care home staff supported colleagues with NEWS.	**Evidence of a lack of Collective Action**: • Care home staff described not being fully aware of all aspects of the intervention at the outset or being given inaccurate information (interactional workability) • Care home staff voiced frustrations at services not always being aware of the NEWS. Care home staff and one specialist nurse reported that services did not always listen to, or take account of the knowledge and views of care home staff in regard to their residents. Care home staff highlighted problems with equipment failures and instances of external services questioning accuracy of the NEWS equipment (relational integration; interactional workability). • Responsibility for using the NEWS equipment varied across the care homes, often with only certain members of staff being trained and tasked with using the equipment which opposed the view of some health professionals who assumed all staff were trained. • Health professionals questioned the ability of care home staff to take vital signs observations. Both health professionals and care home staff highlighted the challenges of undertaking vital signs observations within the care home setting, for example, a resident's not consenting or becoming distressed by NEWS equipment, noisy environments, competing priorities (skill set workability).

		• Care homes varied in their use of the equipment, sometimes failing to utilise it as intended (e.g. not calculating a NEWS; not maintaining monthly readings) and some services remained unaware of the NEWS intervention or had not amended processes to account for NEWS (contextual integration).
Reflexive Monitoring: is the appraisal work that people do to assess and understand the ways that a new set of practices affect them and others around them. Reflexive Monitoring includes: **Systematization**: The work of seeking to determine how effective and useful the intervention is for them and for others, and this involves the work of collecting information in a variety of ways, formally and informally. **Communal appraisal**: Participants working together - sometimes in formal collaboratives, sometimes in informal groups to evaluate the worth of a set of practices. **Individual appraisal:** participants individually appraising an intervention's effects on them and the contexts in which they are set - appraising not only the worth of the program, but also its impact on her/his other tasks**.** **Reconfiguration**: appraisal work by individuals or groups leading to attempts to redefine procedures or modify practices.	**Evidence of Reflexive Monitoring** • The CCG employee providing support to the care homes kept informal notes on the progress and challenges of and face by the care homes. These were feedback to the CCG in appraisal meetings • Care home staff described positive experiences of using NEWS and commented on improved communication with some services and increased confidence within such communications (individual appraisal).	**Evidence of a lack of Reflective Monitoring:** • Neither care home staff nor the external health professionals working directly with the care homes, were involved in appraisal meetings with the CCG. Concerns of care home staff were typically fed back to the CCG via a third party. As such they had no direct say in discussions on barriers to the implementation nor in discussing possible improvements (communal appraisal and reconfiguration). • Health professionals felt that some care homes faced difficulties with pre-existing care tasks and NEWS would be potentially inappropriate for such homes and some care home staff and health professionals commented on NEWS being time consuming, impacting on other work and reducing time spent with other residents. Providing care home staff with impromptu support with NEWS also added to health professional's workloads and caused frustration (individual appraisal).

Table S3: Care Home Participants

Care Home	No. of Interviewees	Job Role	Time in Current Post	Perceived Engagement with NEWS****
Care Home 1 Nursing 40+ beds	3	Nursing Assistant	9 years	Engaged
		Carer	18 years	
		Nurse	3 years *	
Care Home 2 Residential 50+ beds	3	Senior Carer	5 years	Inconsistent
		Senior Carer	15 years	
		Manager	3 years	
Care Home 3 Residential 25+beds	3	Senior Carer	5 months**	Inconsistent
		Manager	1 year***	
		Carer	2.5 years	
Care Home 4 Residential 30+ beds	2	Deputy Manager	15 years	Engaged
		Deputy Manager	10 years	
Care Home 5 Residential 25+ beds	3	Manager	25 years	Engaged
		Senior Carer	7 years	
		Carer	4 years	
Care home 6 Residential 20+beds	1	Deputy Manager	3 years	Engaged
Total	**15**			

* Worked as a nurse for 25 years
** 6 years as a senior carer elsewhere
*** Worked in the sector for 28 years
**** CCG perceptions of care home engagement