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National Early Warning Scores Following Emergency Hospital Transfer: Implications for Care Home Residents

Robert O. Barker MBBS, MPH^{a,b,*}, Catherine Atkin MBChB, MD^c,
Barbara Hanratty MBChB, MD^{a,b}, Andrew Kingston PhD^a, Tim Cooksley MBChB, FRCP^d,
Adam L. Gordon PhD MBChB^{e,f}, Mark Holland MBBS, MEd^g, Thomas Knight MBBS^{c,h},
Christian P. Subbe DM, FRCP^{i,j}, Daniel S. Lasserson MD, FRCP^{k,l}

^aPopulation Health Sciences Institute, Newcastle University, Newcastle, UK

^bNIHR Applied Research Collaboration North East and North Cumbria, Newcastle, UK

^cBirmingham Acute Care Research Group, University of Birmingham, Birmingham, UK

^dDepartment of Acute Medicine, Manchester University NHS Foundation Trust, Manchester, UK

^eUnit of Injury, Inflammation and Recovery Sciences, School of Medicine, University of Nottingham, Nottingham, UK

^fNIHR Applied Research Collaboration—East Midlands, Nottingham, UK

^gSchool of Clinical and Biomedical Sciences, Faculty of Health and Wellbeing, University of Bolton, Bolton, UK

^hDepartment of Acute Medicine, Sandwell and West Birmingham NHS, Birmingham, UK

ⁱSchool of Medical Sciences, Bangor University, Bangor, UK

^jDepartment of Acute Medicine, Ysbyty Gwynedd, Bangor, UK

^kDivision of Health Sciences, Warwick Medical School, University of Warwick, Coventry, UK

^lDivision of Acute General Medicine, Oxford University Hospitals NHS Foundation Trust, Oxford, UK

ABSTRACT

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Objective: Care home residents have high rates of hospital admission. The UK National Early Warning Score (NEWS2) standardizes the secondary care response to acute illness. However, the ability of NEWS2 to predict adverse health outcomes specifically for care home residents is unknown. This study explored the relationship between NEWS2 on admission to hospital and resident outcome 7 days later.

Design: Repeated cross-sectional study.

Setting and Participants: Data on UK care home residents admitted to 160 hospitals in two 24-hour periods (2019 and 2020).

Method: Chi-squared and Kruskal-Wallis tests, and multinomial regression were used to explore the association between low (score ≤ 2), intermediate (3–4), high (5–6), and critically high (≥ 7) NEWS2 on admission and each of the following: discharge on day of admission, admission and discharge within 7 days, prolonged hospital admission (>7 days), and death.

Results: From 665 resident admissions across 160 hospital sites, NEWS2 was low for 54%, intermediate for 18%, high for 13%, and critically high for 16%. The 7-day outcome was 10% same-day discharge, 47% admitted and subsequently discharged, 34% remained inpatients, and 8% died. There is a significant association between NEWS2 and these outcomes ($P < .001$). Compared with those with low NEWS2, residents with high and critically high NEWS2 had 3.6 and 9.5 times increased risk of prolonged hospitalization [relative risk ratio (RRR) 3.56; 95% CI 1.02–12.37; RRR 9.47; CI 2.20–40.67], respectively. The risk of death was approximately 14 times higher for residents with high NEWS2 (RRR 13.62; CI 3.17–58.49) and 54 times higher (RRR 53.50; CI 11.03–259.54) for critically high NEWS2.

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The authors declare no conflicts of interest.

* Address correspondence to Robert Barker, MBBS, MPH, Population Health Sciences Institute, Newcastle University, Level 2 Newcastle Biomedical Research Building, Campus for Ageing and Vitality, Newcastle upon Tyne NE4 5PL, UK.

E-mail address: robert.barker@newcastle.ac.uk (R.O. Barker).

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Conclusion and Implications: Higher NEWS2 measurements on admission are associated with an increased risk of hospitalization up to 7 days duration, prolonged admission, and mortality for care home residents. NEWS2 may have a role as an adjunct to acute care decision making for hospitalized residents.

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Care homes deliver care for residents living with complex care needs,^{1–4} representing a population with high rates of emergency transfer to hospital.⁵ Care home is an umbrella term for long-term care facilities with and without on-site nursing staff, termed nursing homes and residential homes respectively in the United Kingdom (UK).

Older adult residents often do not display overt signs of acute (short-duration) illness,⁶ otherwise termed deterioration. The trajectory of deterioration among care home residents may be unpredictable,⁷ posing challenges for health care teams in care home and hospital settings. The National Early Warning Score (NEWS2) is a “track and trigger” system used across UK hospitals to support clinical judgment in identifying patients at risk of further deterioration,⁸ in order to facilitate prompt and appropriate clinical responses. NEWS2 requires measurement of 6 parameters: temperature, pulse, systolic blood pressure, respiratory rate, oxygen saturation, and consciousness.⁸ The overall NEWS2 triggers a response, ranging from repeating observations within a specific time period, to initiating an emergency medical response.⁸

NEWS2 is advocated for use across the UK health care system,⁸ and is increasingly being adopted in care homes.^{9,10} The ability of NEWS2 to predict further deterioration and adverse health outcomes, such as death or critical care admission, is well-evidenced for hospital patients overall,^{8,11} but not specifically for care home residents. The evidence to support NEWS2 use in care homes is sparse.^{9,12} The value of NEWS2 may be dependent on the population to which it is applied^{13,14} and concerns have been expressed that it may be less applicable to care home residents because of their age, frailty, and multimorbidity,^{12,15} all of which may influence NEWS2 and its ability to identify residents at risk of adverse outcomes.

This study aimed to explore the ability of NEWS2, on emergency admission to hospital, to identify care home residents at risk of admission and discharge within 7 days, prolonged hospitalization (>7 days), and death (within 7 days).

Methods

The sample of care home residents was drawn from the Society for Acute Medicine Benchmarking Audit (SAMBA),^{16–19} a national audit (UK) of acute medical care. Participation is open to all hospitals receiving acutely unwell (non-elective, adult) medical patients, excluding non-acute and community hospitals.

Two waves of SAMBA data collection, each conducted over a 24-hour period, were analyzed: June 27, 2019,^{16,19} and January 30, 2020.¹⁷ Patients not living in care homes and those younger than 60 years were excluded. This defined the study population as older adults living in care homes who were admitted to hospital for acute care, either via the emergency department or directly to acute medical units.

The NEWS2 on arrival to hospital was categorized into 4 groups: low (NEWS2 0–2), intermediate (3–4), high (5–6), and critically high (≥ 7).⁹ The following outcomes were recorded.

- Same-day discharge (no overnight stay).
- Hospital admission followed by discharge within 7 days.
- Ongoing inpatient care at 7 days (ward-level/intensive care or readmission).
- Died within 7 days of admission.

STATA 15 was used to conduct the Kruskal-Wallis test to investigate the null hypothesis of no difference in median NEWS2 across outcome groups. Pearson's χ^2 was used to test the null hypothesis of no association between NEWS 2 category and resident outcome. Multinomial logistic regression modeled the relationship between NEWS2 category and outcome, using low NEWS2 and same-day discharge as reference categories, and adjusted for age, gender, and SAMBA wave. This dataset did not include contextual information about resident comorbidity, dependency, or frailty.

Results

Data from 676 acute hospital admissions across 160 UK hospital sites across 2 waves of SAMBA were analyzed. It is possible, but improbable, that this does not represent 676 unique residents; for the same resident to be represented twice, this would require the same individual to be admitted to hospital in the two 24-hour periods of data collection 6 months apart. Approximately 70% (486 of 676) of residents were older than 80; 70% were women.

A low level of missing data meant that NEWS2 and outcome data were available for 665 admissions out of the total of 676. Across 665 admissions, resident outcome 7 days after emergency presentation was as follows: 10% (69 of 665) same-day discharge, 47% (315 of 665) admitted and discharged within 7 days, 34% (229 of 665) remained inpatient, 8% (52 of 665) died (as displayed in Table 1). The median score on arrival at hospital was 2, range 0 to 18. The NEWS2 category for residents was as follows: 54% (356 of 665) low, 18% (121 of 665) intermediate, 13% (84 of 665) high, and 16% (104 of 665) critically high (Table 1). Therefore, most (72%) presented with a low/intermediate NEWS2, approximately one-third (28%) with a high or critically high NEWS2.

The Relationship Between NEWS2 and Study Outcomes

Among 356 admissions with a low NEWS2, 15% (52 of 356) of residents were discharged on the same day, 48% (171 of 356) were admitted and discharged within 7 days, 34% (121 of 356) remained in hospital at 7 days, and 3% had died (12 of 356). The outcomes for the 121 intermediate scores were similar: 10% (12 of 121), 50% (61 of 121), 34% (41 of 121), and 6% (7 of 121), respectively. This is in contrast to the 104 admissions with a critically high NEWS2: 2% (2 of 104) same-day discharge, 34% (35 of 104) discharged within a week, 41% (43 of 104) remained in hospital, and 23% (24 of 104) had died (as displayed in Table 1). There is a significant association between NEWS2 category and resident outcome ($P < .001$).

The median NEWS2 was 1 for same-day discharge, 2 for discharge within 7 days and admission >7 days, and 6 for residents who died. Overall, the differences observed between the median NEWS2 across different outcome groups are significant ($P < .001$).

Multinomial Regression Model

Multinomial regression explored the relationship between NEWS2 category and unordered outcome categories (see methods and Table 2). In comparison with low NEWS2, residents with a high or critically high NEWS2 had approximately 3.6 times [relative risk ratio (RRR) 3.56; 95% CI 1.02–12.37] and 9.5 times (RRR 9.47; CI

Table 1
The Distribution of 7-Day Outcome for Care Home Residents According to NEWS2 Category

Resident Outcome	Number (%) of Residents According to NEWS2 Category				Total (%) for Outcome Category
	Low	Intermediate	High	Critically High	
Same-day discharge	52 (15)	12 (10)	3 (4)	2 (2)	69 (10)
Discharge within 7 days	171 (48)	61 (50)	48 (57)	35 (34)	315 (47)
Inpatient at 7 days	121 (34)	41 (34)	24 (29)	43 (41)	229 (34)
Death within 7 days	12 (3)	7 (6)	9 (11)	24 (23)	52 (8)
Total (%) in NEWS2 category	356 (54)	121 (18)	84 (13)	104 (16)	

2.20–40.67) increased risk of prolonged hospitalization, respectively (with reference to the same-day discharge). The risk of death in hospital within 7 days was approximately 14 (RRR 13.62; CI 3.17–58.49) and 54 (RRR 53.50; CI 11.03–259.54) times higher for residents with a high or critically high NEWS2, respectively.

In summary, the risk of hospitalization for up to 7 days, prolonged hospital admission, and death (compared with same-day discharge) is higher for residents with intermediate, high, or critically high NEWS2 (compared with the low NEWS2 category). Although the risk of these outcomes increases with progressively high NEWS2 category, statistically significant differences are observed only when comparing high and critically high NEWS2 (but not intermediate scores) with low NEWS2 categories.

Discussion

Higher NEWS2 measurements on emergency presentation to hospital are associated with an increased risk of admission for up to 7 days, prolonged hospitalization (>7 days), and mortality for care home residents. The main differences are observed for residents with high or critically high NEWS2 (with reference to the low NEWS2 category), with no (statistically) significant difference for intermediate readings. The findings suggest that, in conjunction with clinical judgment, the NEWS2 on arrival to hospital following emergency conveyance has a role for hospital teams in identifying residents who are at highest risk of further deterioration. This is especially pertinent for residents with the highest NEWS2 readings (≥ 5), who are the most likely to experience adverse health outcomes, and who require urgent decisions about what level of medical intervention is required and is consistent with their care preferences. It is possible that high (≥ 5) NEWS2 may help clinical teams to identify residents on arrival to hospital who may be experiencing an end-of-life event, to facilitate discussion with families and carers about treatment intensity and palliative care decisions. Our findings do not suggest that NEWS2 should replace clinical judgment or override residents' wishes, which are paramount.

Comparison With Other Work

Care home residents in this study have higher mortality rates across all NEWS2 categories compared with the total population in the corresponding SAMBA cohorts, 1.7% in 2019¹⁹ and 2.3% in 2020.¹⁷ This

is likely to reflect the high levels of frailty and multimorbidity^{1,3} in the care home population, leading to susceptibility to adverse outcomes. It is also possible, because frailty is associated with blunted homeostatic response, that residents are less likely to manifest physiological derangement during acute illness, meaning that even those with lower NEWS2 are at higher risk of deterioration than people with similar scores who do not live in a care home and are not as frail. This hypothesis would require empirical testing.

NEWS2 is increasingly being adopted in care homes across the United Kingdom.^{9,10} Previously published work demonstrated that only 7% of residents in care homes had a high or critically high NEWS2 at baseline, rising to 18% if care home staff were concerned about resident deterioration.⁹ The cohort of residents in this study have a higher proportion (28%) of high/critically high scores on admission to hospital. This indicates higher levels of physiological derangement in residents admitted to hospital than observed in care homes, and is an expected finding for residents requiring acute hospital care. One of the reasons that NEWS2 may perform differently in care home settings is because the prevalence of severe acute illness would be substantially lower than in hospital settings.¹² This is one of the reasons that specific validation in the care home setting is required.

The risk of mortality (23%) in this study was significantly higher for residents with critically high NEWS2 (≥ 7), compared with previously reported (30-day) mortality rates for adult patients across the age spectrum (13%).¹⁴ This suggests that the highest NEWS2 readings are associated with a particularly high risk of mortality for care home residents, compared with the general population.

Strengths and Limitations

To our knowledge, this is the first study to explore the association between NEWS2 on arrival at hospital and health outcomes in a large, nationally representative dataset. As participation in SAMBA is voluntary, there may be differences between participating and non-participating hospitals, although the size of the hospitals that participate is comparable to acute hospital services nationally,²⁰ and covers urban and rural locations across the UK.¹⁷

It is recognized that NEWS2 trajectory is particularly important,²¹ but neither subsequent nor baseline (when not acutely unwell) NEWS2 were available, with outcomes measured at 7 days in this study. It is important to acknowledge that NEWS2 is designed to identify people at imminent risk of deterioration, and loses discriminatory value over longer time periods.²²

Table 2
The Relative Risk Ratio (RRR) of 7-Day Outcomes Across Different NEWS2 Categories (Adjusted for the Effect of Age, Gender, and Wave)

Outcome Category (Reference Category is Same-Day Discharge)	RRR of Outcome at Each NEWS2 Category (CI)			
	Low (Reference Category)	Intermediate	High	Critically High
Overnight hospitalization and discharge within 7 days	—	1.53 (0.76–3.08)	5.00* (1.49–16.75)	5.41* (1.26–23.33)
Inpatient at 7 days (prolonged hospitalization)	—	1.46 (0.70–3.03)	3.56* (1.02–12.37)	9.47* (2.20–40.67)
Mortality within 7 days	—	2.43 (0.78–7.56)	13.62* (3.17–58.49)	53.50* (11.03–259.54)

The reference NEWS2 group was low and the reference outcome category was same-day discharge.

*Denotes statistical significance at the .05 level.

In this study, we had no access to contextual information such as resident preferences/frailty, community outcomes, or primary diagnosis. Frailty may be a more important variable than age when it comes to understanding the appropriateness of NEWS2 in vulnerable groups of older adults.

Estimates of relative risk for the least commonly observed outcomes (such as death) within the smallest NEWS2 categories (such as critically high), reached statistical significance, but are imprecise.

Implications for Future Research

Further research is required to evaluate the performance of the NEWS2 in care home residents, a population characterized by frailty and complex care needs,¹ to ascertain whether it enhances the delivery of resident-centered care.

The use of NEWS2 in care homes is becoming widespread despite a limited evidence base.^{9,12,23} Further research is required to establish the association between care home NEWS2 measures and (both primary and secondary care) health outcomes.

Conclusion and Implications

Higher NEWS2 measurements on emergency presentation to hospital are associated with an increased risk of hospitalization for up to 7 days, prolonged admission, and mortality for care home residents. NEWS2 may have a role as an adjunct to acute care decision making for hospitalized residents.

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