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Hospital overcrowding and care of stroke patients: Irish national audit of stroke

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Abstract

Introduction Hospital overcrowding where patient admissions exceed capacity is associated with worse outcomes in Emergency Department. Developments in emergency stroke care have been associated with improvements in stroke outcome but are dependent on effective, organised care. We examined if overcrowding in the hospital system was associated with negative changes in stroke outcome.

Methods Data on overcrowding were obtained from the Irish Nurses and Midwives Organisation (INMO) 'Trolley Count' database recording the number of patients cared for on trolleys/chairs in all acute hospitals each midnight. These were compared with quarterly data from the Irish National Audit of Stroke from 2013 to 2021 inclusive. Variables analysed were inpatient mortality rate, thrombolysis rate for ischaemic stroke, median door to needle time and median length of stay.

Results 579449 patient episodes were recorded by Trolley Watch over the period, (Quarterly Median 16719.5, range 3389–27015). Average Quarterly Thrombolysis rate was 11.3% (sd 1.3%) Median Quarterly Inpatient Mortality rate was 11.8% (Range 8.9–14.0%). Median Quarterly Length of stay was 9 days (8–11 days). Median quarterly door to needle was 65 min (45–80 min). Q1 was typically the worst for overcrowding with on average 19777 incidences (sd 4786). This was significantly higher than for Q2 (mean 13540 (sd 4785) $p=0.005$ t-test) and for Q3 (mean 14542 (sd 4753) $p=0.03$). No significant correlation was found between quarterly Trolley watch episodes and inpatient mortality ($r=0.084$, $p=0.63$), median length of stay $r=-0.15$, $p=0.37$) or thrombolysis rate ($r=0.089$ $p=0.61$). There was an unexpected significant negative correlation between trolley watch data and median door to needle time ($r=-0.36$, $p=0.03$).

Conclusion Despite increasing hospital overcrowding, stroke services still managed to preserve standard of care. We could find no association between levels of overcrowding and deterioration in selected indices of patient care.

Keywords Hospital Overcrowding, Acute stroke, Emergency Medicine, Epidemiology, Outcome, Stroke treatment

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Background

Hospital overcrowding where the number of patients admitted to hospital exceeds hospital capacity is an issue in many countries [1–3]. It is recognised that overcrowding, particularly in the Emergency Department can result in worsening outcomes for patients [4]. Hospital overcrowding has been an issue in Ireland for more than two decades [5, 6] but the problem has increased in recent years with reduced numbers of hospital beds available through bed closures [7, 8], an enlarging and ageing population, increased strain on primary care services and increased demand for care in the community [9].

Over the last three decades, organised stroke care has been associated with a reduction in death and long term disability in affected patients [10]. However effective stroke care involves the delivery of time sensitive interventions, such as thrombolysis, and appropriate, timely management in specialist Stroke Units [11]. This care is often highly protocolized and accordingly it is possible that overcrowding may be associated with deteriorating indices of care quality in stroke if it impedes structured care. We examined Irish national data on Hospital overcrowding and stroke care for a 9 year period to determine if there was an association.

Methods

Data on overcrowding was accessed from the Trolley Watch Database of the Irish Nurses and Midwives Organisation (INMO). This data collection process was begun in 2004 and is acknowledged by the Government as the most accurate index of overcrowding as it considers both additional patients in Emergency Departments and elsewhere in the Hospital. Trolley watch ‘counts the number of patients who have been admitted to acute hospitals, but who are waiting for a free bed. These patients are often being treated on trolleys in corridors, but they may also be on chairs, in waiting rooms, or simply wherever there’s space [12]’. Data is collected at 8:00am each morning by nursing staff independently of the Health Service. Thus the Trolley watch figure for a period represents a good measure of overall hospital overcrowding.

Data on Stroke care and outcomes were taken from the Irish National Audit of Stroke care (INAS) [13]. This database was established in 2012 as the Irish National Stroke Register but was adopted as a formal audit by the National Office of Clinical Audit in 2018 and all data has subsequently been reviewed and cleaned using NOCA processes. INAS usually presents data in respect of patients’ date of discharge but for the purpose of this evaluation we instead analysed it according to admission date. Data were analysed for three month periods Quarter 1 (Q1) January-March, Quarter 2 (Q2) April to June, Quarter 3 (Q3) July to September and Quarter 4 (Q4) October to December for the complete years 2013

to 2021. The following performance indicators were analysed from the audit; percentage of patients admitted to a stroke unit; thrombolysis rate for ischaemic stroke and median door to needle time for thrombolysed patients. Outcome data evaluated were for inpatient mortality and median length of stay. We use the terms trolley count or trolley numbers to delineate all patients admitted to hospitals without an identified bed available measured at 8:00am each morning. Whilst these patients are most frequently kept on hospital trolleys in emergency departments they may also include some patients cared for in other temporary situations e.g. on chairs on waiting rooms or additional trolleys on wards.

Data were tabulated using Excel and analysed using proprietary statistics software. INMO Trolley watch data is publicly available online and the Governance Committee of INAS permitted use of the Stroke data, which is also publicly available on application. Trolley numbers were correlated against stroke indices for each of the 36 quarters and also individually for each quarter to look for seasonal effects. No patient identifiable data were used and approval by an ethics committee separate from the audit governance process was not required. Parametric data was evaluated using student t-tests, and correlation analyses. Proportional data was analysed using Chi Square analysis.

Results

Over the 9-year period (36 quarters), 579,449 episodes were recorded by the Trolley Watch process (Fig. 1). Some individuals who spend more than 24 h waiting for admission to a bed may be recorded as more than one episode. Over the period from 2013 to 2019 the number of trolley episodes increased before experiencing a significant reduction in 2020 probably related to reduced emergency attendances during the initial months of the COVID-19 pandemic. In 2021 the trolley count increased, but not to pre pandemic levels (Fig. 1). The median quarterly trolley count over the period was 16719.5 (Interquartile range 11989–19442). The worst quarter identified was Q4 2019 with 24,853 incidences and the best was Q2 2020, corresponding with the start of the Covid-19 pandemic, with 3389 incidences. Q1 was typically the worst for overcrowding with on average 19,777 incidences (sd 4786). This was significantly higher than for Q2 (mean 13540 (sd 4785) $p=0.005$ t-test) and for Q3 (mean 14542 (sd 4753) $p=0.03$) but not Q4 (mean 16524 (sd 5081) $p=0.18$). There were no statistically significant differences in numbers of trolley episodes between other quarters.

Over the 9 years stroke admissions to hospitals participating in the audit identified by the Hospital Inpatient Enquiry (HIPE) increased from 4727 to 5789 (22.5%), Over the period there were 35,050 admissions with

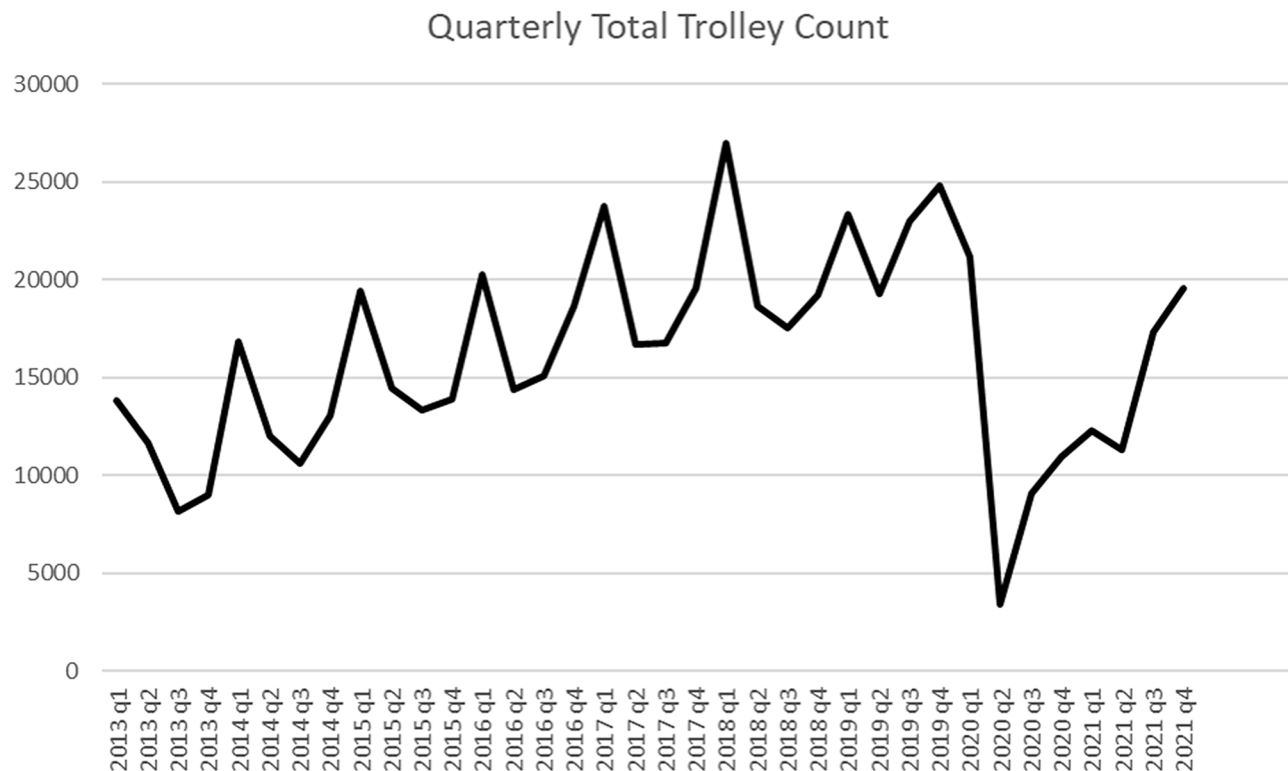


Fig. 1 Quarterly total trolley watch incidents 2013–2021

stroke identified by the audit. Average quarterly, unadjusted, inpatient mortality rate was 11.7% (sd 1.2%), average quarterly median length of stay was 9.25 days (sd 1.0 days) and average quarterly Stroke Unit admission rate was 69.3% (sd 3.7%). Average quarterly thrombolysis rate of subjects with ischaemic stroke was 11.3% (sd 1.3%) and average quarterly median door to needle time for thrombolysis was 65 min (sd 9.9 min) (Table 1).

No significant correlation was found between number of quarterly Trolley watch episodes and inpatient mortality ($r=0.084$, $p=0.63$), median quarterly length of stay $r=-0.15$, $p=0.37$) or thrombolysis rate ($r=0.089$ $p=0.61$). There was an unexpected significant negative correlation between trolley watch data and median quarterly door to needle time ($r=-0.36$, $p=0.03$).

Data was compared for the 9 quarters (upper quartile) with the highest trolley watch figures with the 9 quarters with the lowest figures (lower quartile). No significant difference was found for thrombolysis rate (10.7% vs. 11.0% Chi Sq 0.81 $p=0.37$), median door to needle time (58.5 min vs. 67.8 min $p=0.058$ t-test), Inpatient mortality (12% vs. 11.5%, Chi Sq 1.79 $p=0.18$) or mean quarterly median length of stay (8.8 vs. 9.4 days $p=0.18$ t-test). However, a higher proportion of patients were admitted to Stroke units during the quartiles with the highest number of trolley episodes (70.8% vs. 69.1% Chi Sq 5.87 $p=0.01$).

Discussion

We found no correlation between hospital overcrowding measured using the Trolley Watch process and measures suggesting deterioration of stroke care. Two positive correlations were found. An increase in admissions to stroke unit and reduction in Door to Needle time for thrombolysis correlated with increasing overcrowding.

This data was performed using two datasets developed to monitor patient care the INMO Trolley Watch process and the INAS Stroke Audit. In both cases the data is collected by clinical staff in the Hospitals independently of hospital management. This data is however collected primarily for quality improvement rather than formal research purposes. Accordingly, as no consent procedure is necessary to collect it, the data is more comprehensive than might be collected in an observational study. However, the data is collected anonymously and data for all potential factors or associated indices is not collected only that which is considered necessary to monitor care quality and performance. The INAS data is validated against routinely collected hospital coding data (HIPE) which uses ICD 10 classifications. The Trolley Watch data is collected by on duty nursing staff independent of Health Service management. There is no means of validating the numbers reported by Trolley Watch however the data is accepted by the Government and Health Service as the most accurate representative index of hospital

Table 1 Trolley count and outcome data by quarter

Year	Quarter	Quarterly Total Trolley Count (N)	Thrombolysed Ischaemic Strokes (%)	Quarterly Median DTN (minutes)	Inpatient Mortality (%)	Median Length of Stay (days)	Admitted to stroke Unit (%)
2013	1	13,813	11.0%	76	12.0%	10	62.4%
2013	2	11,630	10.2%	70	12.9%	11	68.8%
2013	3	8161	10.5%	84	11.8%	11	64.0%
2013	4	8990	12.5%	73	12.8%	11	65.6%
2014	1	16,858	10.5%	73	11.7%	10	65.7%
2014	2	11,989	12.5%	79	11.7%	10	69.7%
2014	3	10,642	10.6%	80	12.3%	10	69.8%
2014	4	13,047	10.2%	75	13.2%	11	69.8%
2015	1	19,442	12.4%	70	12.5%	11	63.2%
2015	2	14,470	13.2%	71	11.3%	10	59.6%
2015	3	13,360	10.9%	71	13.5%	9	65.0%
2015	4	13,897	12.5%	77	12.5%	10	68.4%
2016	1	20,273	10.2%	66	11.8%	10	66.3%
2016	2	14,424	14.3%	79	11.5%	10	69.8%
2016	3	15,072	12.1%	71	11.4%	9	70.1%
2016	4	18,660	12.7%	68	13.3%	10	69.6%
2017	1	23,748	12.0%	60	13.4%	9	68.8%
2017	2	16,696	10.7%	58	13.3%	9	71.7%
2017	3	16,743	13.5%	62	12.5%	8	73.1%
2017	4	19,582	11.3%	69	14.0%	8	73.4%
2018	1	27,015	10.4%	57	11.4%	9	70.6%
2018	2	18,634	9.5%	63	10.3%	9	74.3%
2018	3	17,509	13.6%	66	10.2%	8	72.6%
2018	4	19,186	12.2%	45	11.6%	9	73.2%
2019	1	23,349	10.6%	61	12.1%	9	71.3%
2019	2	19,311	11.8%	56	10.9%	9	72.7%
2019	3	22,984	10.3%	59	9.3%	9	72.3%
2019	4	24,853	12.1%	54	12.4%	9	70.5%
2020	1	21,194	12.0%	52	12.0%	8	71.8%
2020	2	3389	11.8%	55	10.5%	8	71.4%
2020	3	9044	10.5%	60	10.6%	8	70.6%
2020	4	10,938	8.6%	55	11.4%	8	69.5%
2021	1	12,303	9.7%	51	10.9%	8	62.4%
2021	2	11,321	9.0%	56	9.2%	8	69.3%
2021	3	17,361	10.6%	56	8.9%	9	75.2%
2021	4	19,561	10.5%	50	11.4%	8	71.7%
Median		16719.5					
Average			11.3%	65	11.7%	9.25	69.3%
s.d.			1.3%	9.9	1.20%	1.0	3.7%

overcrowding in the country [14] as it includes both data from Emergency departments and elsewhere in the hospital. The Trolley Watch data is collected in 33 adult hospitals whereas the INAS data which only collects from 25 of these hospitals that admit more than 25 stroke patients per annum. However, these hospitals tend to be the largest and most subject to issues of overcrowding as they also operate Emergency Departments.

The number of hospitals included in INAS has increased over the study period [9], with increasing

organisation of services nationally, so we have represented outcomes as proportions rather than absolute numbers. Whilst no association was found between overcrowding and deterioration in stroke care we unexpectedly found two positive correlations however we feel that both are likely due to confounding factors. The apparent increase in the number of patients admitted to stroke units probably relates to an increase in the availability of specialist Stroke unit beds over the study period which corresponded with a general increase in overcrowding.

National Audits showed an increase in Stroke unit beds from 150 to 210 between 2015 and 2021. Similarly, the correlation with reducing Door to Needle time for thrombolysis may be explained by the implementation during the period of a national quality improvement project [15] to reduce Door to Decision time for potential thrombectomy patients.

Clearly the lack of an association between overcrowding and indices of stroke service performance is unexpected. We did not evaluate the overcrowding data against more subtle measures of quality of stroke unit care such as delay to admission or proportion of hospital stay spent in a stroke unit, but these measures are less convincingly associated with patient outcomes [16, 17]. Certainly we could find no association with length of hospital stay. Due to the anonymised nature of the data we were unable to identify separately the cohort who were not admitted to a stroke unit specifically due to overcrowding and specifically analyse them.

Pressure to make beds available in an overcrowded hospital may serve to shorten length of hospital stay but conversely shortage of facilities or resource to permit discharge e.g. off site rehabilitation or nursing facilities, may tend to extend mean length of stay and overcrowding [18]. In later years, introduction of Early Supported Discharge Services in some areas may have provided rehabilitation capacity to offset increasing admissions [19].

Ireland has experienced a worsening problem with hospital overcrowding since before the turn of the Century [5]. This has resulted from several factors including an ageing population [8], a shortage of primary care services in the community [20] and a comparative shortage of hospital beds exacerbated by the closure of a number of small hospitals and institutions in the 1980s and 1990s. Whilst the problem in Ireland is pronounced, the issue of overcrowding is now affecting many national health services to varying degrees due to demographic, organisational and financial changes [1–3].

Excessive patient numbers and overcrowding, particularly in the emergency Department, may potentially result in delay of recognition of stroke symptoms and subsequent management but in Ireland as part of agreed care pathways, patients with FAST positive strokes are triaged at Level 2 and often are managed by stroke specialists or teams who attend the ED specifically for this purpose. In doing so they may offset the competition for attention of prioritisation experience by Emergency department doctors and increase patient turnover and allow more rapid and appropriate intervention and care.

In recent studies, performance of the Irish centres in stroke care was fairly typical for comparable Western European Countries [21, 22]. More than two thirds of patients with a stroke are admitted to a stroke unit for care during their stay in hospital. Due to pressure

to avoid empty beds on wards, no unit in a recent audit reported the ability to leave a bed empty and available for potential stroke patients [23]. In most circumstances, stroke teams will have identified which patient could be discharged from the unit to permit admission of a new patient. This may result in delays to admission. No unit was capable of consistently meeting the national target of 90% stroke patients admitted. Theoretically it may be possible to meet this target by allowing affected some patients unacceptably short lengths of stay however the audit addresses this by requiring 90% of a stroke patients stay to be on a unit. Other measured quality measures including thrombolysis, door to needle time and length of stay are all comparable to other Western European countries but none, in our opinion, would be considered exceptional.

Conclusion: In the face of severe overcrowding, stroke services still managed to preserve a standard of care similar to international comparators [21, 22]. We could find no association between levels of overcrowding and deterioration in selected indices of patient care however this may be in some part due to specific increases in resources and training in stroke care over the study period. It is unclear, in the context of overstretched hospital services if it will be possible to achieve exceptional levels of care.

Abbreviations

HIPE	Hospital Inpatient Enquiry
INAS	Irish National Audit of Stroke
INMO	Irish Nurses and Midwives Organisation
NOCA	National Office for Clinical Audit
Q	Quarter
sd	Standard deviation

Acknowledgements

We would like to acknowledge the efforts of hospital stroke services and data collectors who have contributed to the database for the last decade.

Author contributions

JH conceived the study and wrote the first draft of the paper. JH and OB analysed the data. All authors, JH, JM, OB, RC and TC contributed to the content, reviewed and revised the paper.

Funding

The National Office for Clinical Audit and Irish National Audit of Stroke are public organisations and funded by government. There were no external sources of funding for this study.

Data availability

Data from the INMO Trolley watch process is freely available online from https://www.inmo.ie/Trolley_Ward_Watch. Data from INAS is published in annual reports available from the NOCA website and further data can be accessed through an access request made to NOCA through their web-portal. <https://www.noca.ie/about-noca/access-to-audit-data>.

Declarations

Ethics approval and consent to participate

Ethics approval was not required as we used anonymised publically available data. No patient/subject identifiable data were used in the study. Approval was granted by the Governance Committee of the Irish National Audit of Stroke.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

Received: 12 September 2023 / Accepted: 10 September 2024

Published online: 16 September 2024

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