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Observational analysis of documentation burden and data duplication in trauma patient pathways at a major trauma centre

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ABSTRACT

Objectives Trauma patients require extensive documentation across paper and electronic modalities. The objectives of this study were (1) to assess the documentation burden for trauma patients by contrasting entries against predetermined key information elements, dubbed 'data entry points' (DEPs) of a thorough trauma clerking, and by evaluating completeness of entries; and (2) to assess documentation for repetition using a Likert scale and through identification of copied data elements.

Methods A 1-month retrospective observational pilot study analysing documentation within the first 24 hours of a patient's presentation to a major trauma centre. Documentation was analysed across three platforms: paper notes, electronic health record (EHR) and patient organisation system (POS) entries. Entries were assessed against predetermined DEPs, for completeness, for directly copied elements and for uniqueness (using a Likert scale).

Results 30 patients were identified. The mean completeness of a clerking on paper, EHR and POS was 79%, 70% and 62%, respectively. Mean completeness decreased temporally down to 41% by the second ward round. The mean proportion of documented DEPs on paper, EHR and POS entries was 47%, 49% and 35%, respectively. 77% of POS entries contained copied elements, with a low level of uniqueness of 1.3/5.

Discussion Our results show evidence of high documentation burden with unnecessary repetition of data entry in the management of trauma patients.

Conclusion This pilot study of trauma patient documentation demonstrates multiple inefficiencies and a marked administrative burden, further compounded by the need to document across multiple platforms, which may lead to eventual patient safety concerns.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Electronic health records can improve patient experiences and care quality; however, they may also paradoxically increase the administrative burden on healthcare staff if too many non-interoperable systems are employed. There is a need to assess this technological landscape and act accordingly.

WHAT THIS STUDY ADDS

⇒ Multiple modalities of data entry led to inefficiencies, data duplication and a marked administrative burden on healthcare staff.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ It is important that policymakers consider expanding on recommendations regarding electronic health record implementation and operation, so that issues in data validity and information duplication within patient care documentation can be minimised.

BACKGROUND

Major trauma can be defined as one or more injuries that can be life threatening or result in disability,[1] and are often complex and complicated by the lack of a clear history, requiring multidisciplinary team input to maximise patient outcomes. Additionally, major trauma is the leading cause of death in those under 45 and can cost between £3.3 and £3.7 billion in lost economic output every year.[1] Therefore, it is important that major trauma is managed effectively and that concise and accurate documentation is kept to improve patient outcomes. However, missed injuries and delayed diagnoses are commonplace among trauma patients.[2 3]

Documentation in medical practice has advanced greatly in recent years. In fact, 87% of clinicians in the UK use an electronic health record (EHR) regularly in some capacity,[4] with use further encouraged by the National Health Service (NHS) Long Term Plan.[2] Medical documentation can broadly be classified into paper records and EHRs. WHO defines an EHR as a 'real-time, patient-centred record[s] that provides immediate and secure information to authorised users… typically contain[ing] a patient's medical history, diagnosis and treatment, medications, allergies, immunization, as well as radiology images and laboratory results'.[5] In recent years, there has been a rise in a new type of software distinct but complementary to the EHR, patient organisation systems (POS). A POS is an electronic system that stores only brief clinical details specific to a patient's current admission, effectively acting as an electronic patient list

Figure 1 The typical sequence of documentation of a trauma patient at the authors' institution. EHR, electronic health record; POS, patient organisation system.

(or 'whiteboard') mainly used to organise and prioritise patient information and coordinate referrals into and between departments.

The use of electronic record systems can improve patient experiences, care quality and physician interactions with medical records; for example, by improving access to records, simplifying appointment and investigation management, improving efficiency, facilitating research with electronic auditing capabilities, improving patient data safety and much more. However, while electronic systems were created to improve patient outcomes, difficulties with integration within and across organisations, a lack of technical infrastructure, issues with implementation and resistance from clinical users or patients are but a few of the challenges faced in practice.[6] This can result in some organisations using multiple electronic systems, with limited interoperability, that perform specialised functions, alongside paper records when required to fill in any gaps of functionality. This can inevitably lead to inaccuracies in data entry, lost or missing data, duplication of data and data entry fatigue.

Patients subjected to major trauma often require input from multiple specialties along a complex and lengthy clinical pathway. As such, accurate, robust and complete data are vital to ensure both quality and efficient patient care. At the author's major trauma centre in central London, a trauma patient will have documentation recorded across all three platforms. The trauma documentation pathway (figure 1) begins with a paper proforma identifying key Advanced Trauma Life Support (ATLS) components, filled in by the trauma team leader contemporaneously on patient arrival to the department, noting the time of arrival. After initial resuscitation, a full clerking is taken which is entered directly into the EHR. The same clinician then enters a snapshot of similar information into the POS, which organises patients for the daily trauma team meeting. The authors hypothesise that multiple inefficiencies occur in the documentation of such trauma patients, causing inaccuracy, unnecessary data duplication and an excessive administrative burden. As such, the aims of this pilot study are (1) to assess the documentation burden for each trauma patient in the first 24 hours of admission, analysing predetermined key information elements, dubbed 'data entry points' (DEPs), of a thorough trauma clerking, and by evaluating completeness of entries, and (2) to examine each trauma patient's documentation in the first 24 hours of admission to assess the level of repetition of data using a subjective Likert scale and through objective identification of directly copy-pasted elements of data.

METHODS

Patient population

Through a POS, all major trauma patients presenting to a major trauma centre in central London over the month of February 2021 were identified. The inclusion criteria were the presence of a trauma call (either primary, or transfer from another institution) and an orthopaedic referral on the POS. The exclusion criteria were patients who were stepped down from major trauma status after initial assessment and patients with no orthopaedic injuries.

Available data

Documentation platforms included a paper accident and emergency (A&E) proforma, an EHR and a POS entry. The order in which data were input throughout the patient pathway is illustrated in figure 1. The POS entry was made at a time convenient to the clerking doctor, usually after initial EHR clerking.

To identify individual key information elements of a thorough clerking, specific DEPs were generated through consensus opinion by three authors through the assessment of a random sample of trauma patient documentation (see online supplemental appendix 1). The presence of these DEPs was measured across all pieces of documentation and expressed as mean values. Relevant notes were independently assessed by two authors for data 'completeness', 'uniqueness' and for the number of DEPs input, with discrepancies resolved by a third author consult. Data were collected up to the second ward round following the initial clerking (see figure 1) or when the patient was discharged, whichever was sooner. For the purposes of this pilot study, only the trauma-team-lead paper notes and orthopaedic documentation was analysed due to the paucity in involvement of other specialties in major trauma emergency calls.

Completeness was assessed by identifying recorded information relevant to eight components of a complete clerking: presenting complaint, history of presenting complaint, past medical history, drug history, allergies, social history, examination and plan. This was based on the Calgary-Cambridge model,[7] adapted to include elements required for a trauma history clerking. Family history was excluded as it was not relevant to the major trauma presentation. For this reason, only clerking entries were assessed for completeness, excluding the postclerking ward rounds (post-take ward round (PTWR), next ward round (NWR)). Descriptive statistics were used to analyse completeness which was expressed as a mean (SD).

Uniqueness was assessed using a Likert scale (1=no new information was added (all information was known prior) to 5=completely novel information (no prior known information present); online supplemental appendix 2) with data entries containing directly copy-pasted elements noted separately. Timestamps, indicating the time of submission of electronic patient documentation, were used where relevant to identify the original location of novel information. The paper A&E proforma and EHR clerking were the first two pieces of documentation, and done in parallel through different modalities, hence they were both unique and served as a baseline.

Statistical analysis was performed using SPSS V.27. The data were initially tested for normality using the Shapiro-Wilk test. Parametric data were analysed with t-tests and non-parametric paired data were analysed with Wilcoxon signed-rank test.

Patient and public involvement

There was no involvement from patients or the public in the production of this study.

RESULTS

Patient population

Thirty patients were identified, admitted between 1 and 26 February 2021, aged between 17 and 93 years ($\bar{x}$=51.8, SD=24.3). 66.7% were male. Paper clerkings were recorded for 29 patients, EHR clerkings were recorded for 28 patients and POS clerkings were recorded for 30 patients (see table 1).

Documentation burden

Following sample analysis, a maximum of 39 DEPs were identified (see online supplemental appendix 1). In paper clerkings, an average of 47% of all possible predetermined DEPs to establish were successfully identified at presentation. Successive EHR entries recorded decreasing DEP identification, establishing 49% (EHR clerking), 28% (PTWR) and 29% (NWR) of all DEPs. The POS clerking entries identified 35% of the predetermined DEPs. Notably, paper clerkings identified the highest number of 'presenting complaint'/'history of presenting complaint' DEPs (82%), but the lowest number of social history DEPs (4%). In successive postclerking EHR entries (PTWR, NWR), the percentage of DEPs identified within the 'presenting complaint'/'history of presenting complaint' and 'plan' was better preserved than in the 'past medical history', 'drug history and allergies' and 'social history'. There was a statistically significant difference between the level of identification of DEPs within the EHR and POS clerkings (49% vs 35%, p=0.005).

The paper clerking had the highest average completeness of 79% (SD=18%, n=29). The EHR clerking had a completeness of 70% (SD=29%, n=28). The POS had a completeness of 62% (SD=21%, n=30). The EHR PTWR and NWR reviews had the lowest completeness, with averages of 44% (SD=20%, n=29) and 41% (SD=21%, n=24), respectively. There was no statistically significant difference between the completeness of the EHR and POS entries (70% vs 62%, p=0.10).

Each patient required an average of 3 hours and 10 min from time of presentation to A&E, to the latest of either the initial EHR or POS clerking documentation submission time.

Data repetition

The paper clerking was the first piece of documentation completed for each trauma patient and hence was, by definition, completely unique. The EHR clerking was typically the first electronic entry and therefore had no directly copied elements. The POS clerking had an average uniqueness of 1.3/5 with 23/30 (77%) of entries containing directly copy-pasted elements. Subsequent postclerking EHR entries (PTWR and NWR) had a decreasing average uniqueness of 3.1/5 and 2.5/5. The number of postclerking EHR ward round entries with directly copied elements from prior documentation was 11/30 (37%) and 10/30 (33%) for the PTWR and NWR, respectively.

DISCUSSION

For each orthopaedic major trauma patient at the author's institution, data are recorded using paper notes, the EHR and the POS—three distinct formats of documentation. Our data illustrate a real-world issue of using multiple methods of data entry. Although the EHR and POS both required an initial clerking to be input, and the completeness between the two systems was not statistically different, the level of identification of DEPs between both

Table 1 Documentation completeness, uniqueness and composition (DEP percentage), classified by data entry format

Documentation platform	Entry type	n	Completeness (%)	DEPs identified (%)	Uniqueness (/5)	Entries containing directly copied elements (%)
Paper notes	Clerking	29	79	47	–	–
EHR	Clerking	28	70	49	–	–
	PTWR	29	44	28	3.1	37
	NWR	24	41	29	2.5	33
POS	Clerking	30	62	35	1.3	77

DEP, data entry point; EHR, electronic health record; NWR, next ward round; POS, patient organisation system; PTWR, post-take ward round.

was statistically different. This was an unexpected result as the POS should, in theory, contain the same information as both the EHR and paper clerkings. The significantly different degrees of DEP identification between the EHR and POS, coupled with the high level of directly copied data elements (77%) within the POS, inferred most data were copied and that not all data points were transferred. As both the EHR and POS require the same clerking to be entered, the inability to automatically transfer data across systems and requirement for manual data re-entry indicated an interface issue manifesting as lost information and/or an increased administrative burden.

Each patient required a completed paper clerking, at least one initial clerking entry into the EHR and an orthopaedic referral clerking into the POS. This process, from the time of presentation to A&E, to the latest of either the entry into the POS or the EHR, took an average of 3 hours and 10 min to complete. While this time is heavily dependent on the nature of the patient's condition, other studies reported an equivalent pathway being completed in substantially less time.[8 9] This increased administrative burden can have wide-reaching implications for both the patient and the doctor. For example, such excessive administration can reduce patient contact and direct care time, reduce career satisfaction and morale and increase physician burnout.[10–13] Patient care quality may also be put at risk through, for example, data entry fatigue and the failure of multisystem interoperability, causing important pieces of information to be lost as it inputs across multiple systems.

The use of informatics in healthcare can be broadly classified into two distinct approaches: best of breed (BoB) and integrated.[14] The BoB approach is based on the utility of multiple interfacing systems from different suppliers, which contrasts with the integrated approach, in which the entire system is provided by a single software team. The BoB approach has been receding in favour of integrated EHRs over the past decade in English hospitals, with the integrated approach overtaking BoB in 2019. As of July 2020, 37% of acute English hospitals use BoB, 56% use integrated EHR and the remaining 7% use in-house EHR.[15] While it is reasonable to not expect integrated EHRs to perform specialist tasks (eg, medical imaging), the utilisation of a POS for a specific non-specialist task (eg, organising trauma patients) constitutes a shortcoming in a supposedly 'integrated' enterprise-wide single system. A core issue within the utilisation of multiple software packages and BoB approach is in interoperability, acknowledged in the NHS Long Term Plan and by NHS England.[16 17] The NHS Long Term Plan requires 'every technology supplier to the NHS to comply with published open standards to enable interoperability and continual improvement'.[16] In practice, the chief clinical information officer for Health and Care in England has outlined the following seven areas as a priority for developing interoperability: NHS number, medications, staff ID, dates and scheduling, basic observations, basic pathology and diagnostic coding. While this covers the necessities, it is a far cry from the requirements to develop a pragmatically functional interfacing system.

While prehospital documentation has been well optimised, taking the London Ambulance Service Patient Report Form as an example, once a patient arrives at the trauma department, documentation is less clearly defined. This lack of definition has bred innovation in trauma patient documentation (eg, POS) which, while admirable, can result in the aforementioned issues in interoperability and data fragmentation when used in conjunction with an inflexible EHR. This can impact on patient safety through missed, inappropriately duplicated or erroneous data entry, and can increase the administrative burden on staff having to enter data across multiple systems, further compounding patient safety concerns.

One method of circumventing the loss of information across different platforms, and improving interoperability, is with the use of standardised clinical coding. The development of the International Classification of Diseases 11th Revision (ICD-11) for diagnoses and problem lists represents a valiant unified effort in standardisation and acts as the Rosetta stone of healthcare. Even with the necessary tools within EHRs, the uptake of coded problem lists by clinicians remains imperfect. In the 2021 study by Poulos *et al*, it was found that a year after implementation of an EHR in an NHS trust, the structured problem list entry was poorly populated with almost 40% of notable diagnoses only mentioned in the free text portion of the notes.[18] The underpopulation of problem lists on EHRs has also been noted by multiple other authors.[19–21] This unfortunate reality is that even if a Rosetta stone for each aspect of medical record keeping is achieved, the uptake by clinicians may still pose a problem for true smart integration.

The NHS Long Term Plan stipulates both the use of 'intuitive tools' to reduce administrative burden on physicians by capturing patient data as a by-product of care, and the enforcement of strict technology standards to ensure interoperability.[16] However, the lack of a clear mandate on the number of interoperable systems healthcare staff must interact with, greatly limits any reduction in existing administrative burden, despite improvements in said interoperability. Conversely, simply creating a single integrated system that 'does it all' may not solve the issue of an excessive administrative burden. As remarked in *The New Yorker*,[11] Gawande observed a newly designed computer simulation program to be reported by its users as 'elegant and powerful'. However, as the software developed to new levels of complexity to serve a wider audience, tighter regulation was required, increasing the layers of bureaucracy, and resulting in a decreased level of usability across the whole program.

Limitations and further work

This pilot study identified multiple issues in excessive documentation burden and electronic records interoperability, and the associated implications for the patient and physician. However, limitations of the study include

the small sample size which limited the statistical power of our analysis to the identification of trends, without further quantification. Further, while the issues of poor interoperability and data duplication are well documented, our single-centre analysis conducted over a 1-month period could not firmly conclude the generalisability of such issues' prevalence across multiple sites, or even within our single site over a prolonged period. Such limitations could be overcome with future work integrating multiple centres over a prolonged period, analysing an increased case load of patients, demonstrating an increased statistical power to pull firm conclusions.

Despite successfully demonstrating an excessive administrative burden and poor system interoperability in the trauma patient documentation journey, it is important to note such problems are yet wider spread and could benefit from further studies and interventions. For example, advanced interoperability could obviate the need to input full justifications for imaging and blood test requests by prepopulating certain details.

Expeditious reductions in data duplication and administrative burden may be gained with local quality improvement interventions that should focus on reducing data entry fatigue for the user. For example, organisations could use Ishikawa analysis (fishbone diagrams)[22] to identify areas of inefficiency in data entry and modify their patterns of practice to reduce data duplication.

CONCLUSIONS

This is the first study to map data entry burden of each patient. Inefficiencies in patient management software are commonplace and can lead to an increased administrative burden and eventual patient safety issues if data are, for example, inappropriately copied. Ideally, an initial clerking should be entirely unique (with all information novel and pertinent), complete (with all the elements of a complete clerking) and maintain adequate detail, containing all the relevant data points. In other words, all the information required to care for the patient safely and effectively is present in one place. However, patients often have more than one initial clerking, across multiple modalities, by multiple teams. This unnecessarily duplicates information, sometimes erroneously, with problems further compounded by the introduction of multiple poorly interoperable patient management systems.

Current National Institute for Health and Care Excellence major trauma guidance recommends recording a minimum standard of information (such as an ABCDE in the primary survey).[23] However, no such recommendation is made as to how best this information is recorded. Further, the NHS Long Term Plan mandates the use of, but does not restrict the number of, interoperable systems, which if in abundance can paradoxically increase the administrative burden on healthcare staff having to learn to operate multiple and distinct electronic systems. With changes to recommendations and a stricter mandate from senior advisory bodies, we believe issues in data validity and information duplication can be partially overcome, with wide-reaching positive implications, such as increased patient safety and a reduced physician burnout from data entry fatigue. However, while awaiting such regulatory change, local quality improvement interventions offer a chance to potentially reduce data duplication and administrative burden at a user level more promptly.

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Appendix 1

Predetermined Data Entry Points (DEPs)

Subheading	Data Entry Point (DEP)
Presenting Complaint History of Presenting Complaint Examination	Age
	Gender
	Date of injury
	Time of injury
	Type of injury
	Mechanism of injury
	Number of injuries
	Location of injuries
	Orientation (L/R)
	Haemodynamic status
	Neurovascular status
	CT scan (trauma series) mentioned/ordered
	Primary survey
	Cervical spine status mentioned
	Glasgow Coma Scale
Past Medical History	Past medical history
	Past surgical history
Drug History	Medications
	Allergies
	Tetanus status
Social History	Smoking status
	Alcohol
	Occupation
	Living situation
	Hand dominance
	Mobility aids
	Next of kin
Plan	Weight-bearing status
	Tetanus booster given?
	Antibiotics (if open fracture or wound only)
	Swabs of injury site (if open fracture or wound only)
	Intravenous fluids
	Analgesia
	Blood tests (ordered, mentioned)
	Venous thromboembolism status or plan
	Immediate management of injury e.g. cast
	Long term management of injury e.g. theatre or senior review
	Theatre scheduled
	Nil by mouth status

Appendix 2

Five-level Likert scale for uniqueness

Likert Scale	
1	no new information was added; all information was known prior
2	limited new information was added; a majority of information was known prior
3	a mix of new and known information
4	a substantial proportion of new information added; a minority of information was known prior
5	completely novel information, no prior known information present