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TITLE PAGE

TITLE OF THE ARTICLE

Level of accuracy of diagnoses recorded in discharge summaries: a cohort study in three respiratory wards.

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ABSTRACT

Rationale: One of the key functions of the discharge summary is to convey accurate diagnostic description of patients. Inaccurate or missing diagnoses may result in a false clinical picture, inappropriate management, poor quality of care and a higher risk of re-admission. While several studies have investigated the presence or absence of diagnoses within discharge summaries, there are very few published studies assessing the accuracy of these diagnoses. The aim of this study was to measure the accuracy of diagnoses recorded in sample summaries, and to determine if it was correlated with the type of diagnoses (e.g. “respiratory” diagnoses), the number of diagnoses or the length of patient stay.

Methods: A prospective cohort study was conducted in 3 respiratory wards in a large UK NHS Teaching Hospital. We determined the reference list of diagnoses (the closest to the true state of the patient based on consultant knowledge, patient records, and laboratory investigations) for comparison with the diagnoses recorded in a discharge summary. To enable objective comparison, all patient diagnoses were encoded using a standardized terminology (ICD-10). Inaccuracy of the primary diagnosis alone and all diagnoses in discharge summaries was measured, and then correlated with type of diseases, number of diagnoses and length of patient stay.

Results: 107 of 110 consecutive discharge summaries were analyzed. The mean inaccuracy rate per discharge summary was 55% [95% CI 52 to 58%]. Primary diagnoses were wrong, inaccurate, missing or mis-recorded as a secondary diagnosis in half the summaries. The inaccuracy rate was correlated with the type of disease but not with number of diagnoses nor length of patient stay.

Conclusion: Our study showed that diagnoses were not accurately recorded in discharge summaries, highlighting the need to measure and improve discharge summary quality.

MAIN TEXT

INTRODUCTION

The discharge summary is an important communication tool for promoting the quality, safety and continuity of care [1,2]. It enables the efficient transfer of information between health care professionals in primary and secondary care settings [3,4], and forms part of the permanent patient record [4]. One of the key functions of the discharge summary is to convey accurate diagnostic information by identifying the primary reason for admission (primary diagnosis), and other relevant diagnoses including co-morbidities (secondary diagnoses). Inaccurate or missing diagnoses may result in a false clinical picture, inappropriate management [5], poor quality of care [5] and a higher risk of re-admission [6]. Inaccuracies in the list of diagnoses recorded in a discharge summary will also have wider impact on key processes including clinical coding [7,8], research [7], surveillance [9,10], clinical audit [7], quality improvement and financial remuneration of the hospital [7].

Despite abundant literature [5,11–13] highlighting the importance of accurate and complete diagnosis capture, diagnoses are often missing in discharge summaries. A review of the literature by Kripalani et al. [5] found that diagnoses were recorded in only 17.5% and 28% of discharge summaries respectively. While several studies have investigated the presence or absence of diagnoses [5,12,14–16], there are very few published studies assessing the accuracy of diagnoses within discharge summaries.

The aim of this article is therefore to measure the accuracy of diagnoses recorded in a sample of discharge summaries, and to determine if this was correlated with the type of diagnoses (e.g. “respiratory” diagnoses), the number of diagnoses or the length of patient stay.

METHODS

To evaluate the accuracy of discharge summary diagnoses, we designed the following 5-step method (Figure 1):

- Step 1: Patient selection
- Step 2: Determination of the reference list of diagnoses for each patient
- Step 3: Determination of the list of diagnoses recorded in discharge summary for each patient
- Step 4: Comparison of the list of discharge summary diagnoses versus the reference list of diagnoses for each patient
- Step 5: Calculating the inaccuracy rate of diagnoses recorded in the discharge summaries

To allow objective comparison of the list of discharge summary diagnoses versus the reference list of diagnoses for each patient, we choose to standardize the medical vocabulary using a medical terminology. Each diagnosis was translated into an encoded diagnosis according to ICD 10 terminology, the most widely used medical terminology to code diagnoses [17]. Encoded diagnoses in ICD 10 begin with a letter followed by alphanumeric characters (e.g. J15.7 "Pneumonia due to Mycoplasma pneumoniae"). Each diagnosis was coded with the greatest possible level of accuracy, i.e. using the third, fourth or fifth character.

Step 1: Patient selection

We selected all consecutive adult patients discharged from three respiratory wards at St James's University Hospital Leeds, in March 2015. Exclusion criteria included a non-respiratory primary diagnosis or a missing discharge summary from the case notes.

Step 2: Determination of the reference list of diagnoses for each patient

To obtain a reference list of diagnoses for each patient that was as close as possible to the true state of the patient, we recruited the consultant responsible for that patient's care episode and a specialist respiratory coder. At point of the discharge, the consultant determined the reference diagnoses for the patient. He/she identified the primary diagnosis and any other diagnoses for each patient using his/her knowledge about the patient, the patient notes and the test results. The coder helped him/her to standardize diagnoses by translating them into ICD 10 codes (e.g. "Acute severe asthma" was translated in "J46 Status asthmaticus"). This resulted in a reference list of encoded diagnoses for each patient. Both consultant and coder were blinded to the content of the discharge summary during step 2.

Step 3: Determination of the list of diagnoses recorded in discharge summary for each patient

In our teaching hospital, discharge summaries are written in free text by junior doctors using a basic electronic template. To obtain the list of diagnoses recorded in the discharge summaries for each patient, we recruited a consultant naive to the clinical case and a specialist coder. At least 3 weeks after the discharge, they determined and coded the patient's discharge summary diagnoses together. This resulted in a list of encoded diagnoses recorded in the discharge summaries for each patient.

Both consultant and coder were blinded to the case notes during step 3.

To reduce bias, the discharge summary diagnoses were extracted: (i) by a consultant naïve to the case, to guarantee that the diagnoses were extracted from the discharge summary and not influenced by prior knowledge about the patient, (ii) by the same coder involved in the determination of the reference diagnoses, to guarantee that the translation of the diagnoses into

encoded diagnoses was consistent; (iv) at least three weeks after the determination of the reference list of diagnoses, to reduce memory effects in the coder.

Step 4: Comparison of the list of discharge summary diagnoses versus the reference list of diagnoses for each patient

For each patient, a third person not involved in the generation of the two diagnostic lists (RT) compared the encoded discharge summary diagnoses to the encoded reference list of diagnoses. We followed the ICD 10 structure, and thus distinguished exact ICD-10 diagnosis matches at 3 or 4 character levels from matches at block title level only or matches at clinical connection level only (i.e. medical meaning is similar but there is no code similarity). This matching process generated 5 well-defined accuracy categories:

- Accurate diagnosis: same ICD10 for at least the first 3 characters
- Partial inaccurate diagnosis: same ICD10 block titles only
- Serious inaccurate diagnosis: clinical similarity only
- Missing diagnosis: "reference" diagnosis not present in the discharge summary
- Wrong diagnosis: discharge summary diagnosis not present in the reference list of diagnoses for that patient

Examples of each category of accuracy are shown in Figure 2.

Step 5: Calculating the inaccuracy rate of diagnoses recorded in discharge summaries

The inaccuracy rate per discharge summary, *p*, was defined as follows:

$$p\% = \frac{\text{Partial inaccurate diagnoses} + \text{Serious inaccurate diagnoses} + \text{Missing diagnoses} + \text{Wrong diagnoses}}{\text{Same diagnoses} + \text{Partial inaccurate diagnoses} + \text{Serious inaccurate diagnoses} + \text{Missing diagnoses} + \text{Wrong diagnoses}}$$

The inaccuracy rate was measured separately for all diagnoses (i.e. primary and secondary diagnoses), and for the primary diagnosis alone. The percentage of discharge summaries containing less than half and greater than half of inaccurate diagnoses was also assessed.

The relationship between the inaccuracy rate and the type of diseases (e.g. respiratory disease) was studied. The type of diseases was determined according to the ICD 10 chapter. We carried out a Kruskall Wallis test for all types of disease including at least 50 diagnoses, excluding diseases where the number of diagnoses was too small.

The correlations between inaccuracy rate per discharge summary, number of diagnoses per stay and the length of patient stay were studied for each patient. Data was analysed using the Pearson correlation coefficient and Pearson correlation test. All results are presented with 95% confidence intervals. A p value of <0.05 was taken as significant (Software R version 3.2.2).

RESULTS

We were able to complete the described 5-step process in 107 (97%) of 110 discharge summaries (Figure 1). Thirty-two patients had already been excluded from the initial cohort because the discharge summaries were not completed or the primary diagnosis was not respiratory. Two patients were excluded due to a delay in receiving the notes and one due to a breech in the study protocol (the consultant and the coder focused on the wrong care episode).

1) Characteristics of the case study cohort

Median (range) patient age was 67 years [22-95]. 51% were female. Patients had a median (range) number of 12 reference diagnoses [2-34], and a median (range) length of stay of 6 days [<1-80].

2) Inaccuracy rate of diagnoses recorded in discharge summaries

For all diagnoses:

More than half of the discharge summary diagnoses were inaccurate in 67% [58 to 76%] of discharge summaries (Figure 3). The mean inaccuracy rate per discharge summary was 55% [52 to 58%] (Table 1). The majority of inaccurate diagnoses corresponded to missing diagnoses (41% [38 to 44%]). About 7% [5 to 9%] corresponded to diagnoses written in the discharge summary which were completely wrong. Other corresponded to partial or seriously inaccurate diagnoses.

For primary diagnosis:

The inaccuracy rate for primary diagnoses was 46% (Table 2). The majority of primary diagnoses were partially inaccurate (e.g. “asthma” instead of “near fatal asthma”) or seriously inaccurate (e.g. ”haemoptysis” instead of “community acquired pneumoniae”) and/or due to incorrect position (i.e. the primary diagnosis was considered to be a secondary diagnosis in the reference list). 5% [1 to 9%] of discharge summary primary diagnoses were completely wrong (e.g. “chronic obstructive pulmonary disease” was recorded when it was absent clinically).

4) Correlation of the inaccuracy rate of recorded diagnoses per summary with the type of disease

The inaccuracy rate was significantly correlated with the type of diseases (p=0.004, Figure 4). Diagnoses associated with respiratory, neoplastic, psychiatric and rheumatological diseases contained fewer inaccuracies than infectious diseases (e.g. 80% [64 to 96%] for infection vs 50% [36 to 65%] for respiratory).

5) Correlation of the inaccuracy rate of recorded diagnoses per discharge summary with the number of diagnoses

The inaccuracy rate in each summary was not correlated with the number of diagnoses per summary (p=0.83).

6) Correlation of the inaccuracy rate of recorded diagnoses per discharge summary with the length of stay

The diagnostic inaccuracy rate for each summary was not correlated with the patient's length of stay (p=0.27).

DISCUSSION

We assessed the inaccuracy rate of primary and secondary diagnoses in discharge summaries. Our results demonstrate that over 50% of all the diagnoses in discharge summaries were inaccurate, and that half of the primary diagnoses are also inaccurate, missing, wrong or considered as a secondary diagnosis. This inaccuracy rate was not correlated with the number of diagnoses or length of stay, but was correlated with the type of diseases. Diagnoses related to infectious diseases had the highest inaccuracy rate in our cohort.

Our study took into account the key methodological elements described by Hogan et al. [18] for studies designed to assess accuracy, using a prospective cohort design with consecutive cases to avoid sampling bias [18]. Only 2.7% of cases were unavailable for the final analysis. Further strengths of our study included determination of the patient's reference diagnoses blind to the discharge summary, and extraction of discharge summary diagnoses blind to the notes, to allow unbiased comparison by a third person not involved in the generation of the diagnosis list [18]. We also established a robust list of reference diagnoses by using the consultant responsible for the care episode, who was the person the most knowledgeable about the case [18], and a specialist coder. A further strength of our method is the encoding of diagnoses using ICD 10, allowing us to measure objectively the accuracy of discharge summary diagnoses. Indeed the use of medical terminologies [19] such as SNOMED CT or ICD 10 [17] standardises the medical vocabulary, so providing an objective approach to making a comparison and grading the level of accuracy on a 5-point scale; no other study has done this for the measurement of diagnostic accuracy.

In our study, bias could have been introduced by exposing physicians to the rather alien ICD 10 language. This disconnection between medical thinking and the terms used in terminologies [20] was reduced by supporting the physicians with the same specialist coder, to ensure reliable translation of medical diagnoses into encoding diagnoses. To avoid memory effects of the specialist coder, a period of wash out of at least 3 weeks was respected between the derivation of the both lists, and the discharge summary was anonymized. The study may have been limited by the fact we focused on accuracy of diagnoses and not impact of inaccuracy on clinical management. While a diagnosis of hypercholesterolemia would be very relevant to a patient with angina, it would have less acute impact on an individual with tonsillitis. Despite carrying out this study in a blind fashion, clinical teams may have become aware of the study through informal communication. This may have changed their behaviour towards writing discharge summaries [21], although every effort was taken to limit this potential bias. However, the high level of inaccurate diagnoses in discharge summaries suggests that junior doctors remained unaware of the study. The study cohort originated in a single busy acute speciality in a large UK teaching hospital, so results may not be generalizable to all specialities, or all hospitals. However, most patients had multiple diagnoses so are likely to reflect the case mix in general medicine. In our hospital, discharge summaries are written in free text by junior doctors without software support by using a basic electronic template, and at the time of discharge, whereas in other hospitals, they may be written or dictated by consultants following discharge when all tests results are available. To test the generality of our results, further cohort studies in other specialties and other hospitals are clearly needed.

Our study focused on inaccuracy in diagnoses and not in other discharge summary components, such as procedures carried out, medication lists [12,16,22], investigation results [12,16] or follow up [12,16]. There are very few published studies assessing inaccuracy in primary and secondary diagnoses recorded in discharge summaries. Only limited information is available about the accuracy of final diagnoses showing inaccuracy occurring in 4.5% to 20% of discharge summaries [12,16,23,24]. However, these

studies are severely limited by the methodology used: (i) they focused only on final diagnosis, (ii) some of them focused on one type of diagnosis (e.g. delirium) [24,25]; (iii) the determination of reference patient diagnosis may cause bias (e.g. lack of blinded assessment) [12,16,23]; (iv) the comparison between reference diagnosis and discharge summary diagnosis was done by a person involved in the generation of the diagnosis lists from the discharge summary [12,16]; (v) the metrics and methods used to measure accuracy are not clearly described [12,16,23].

The high level of diagnostic inaccuracy in our study is likely to reflect lack of time and/or knowledge of junior doctors about the importance of specifying diagnoses to a high level of accuracy [26]. Even though the national college of physicians has proposed standards for discharge summaries [13], junior doctors still have no formal teaching on how to generate an accurate summary [26]. The process is often burdensome and is low priority for hectic front line clinicians. Delivering timely discharge summaries in the secondary care environment can be very time consuming, requiring approximately 10 +/- 3.5 hours per week for a junior doctor to complete the forms [27]. With high patient turnover and bed shortages, junior doctors are also under additional time pressure to deliver the summaries prior to patient discharge, as delays in delivering discharge summary to primary care may impact on community follow up and the quality of care [5,6,28,29]. This pressure on junior doctor time can be expensive [27] and may impact on safe clinical care and reduce the quality of the discharge summaries. With the implementation of shift patterns, junior doctors may also discharge and write summaries on patients whom they have not previously seen. While advances in information technology have been significant, there is an absence of effective and intuitive software to support them in marshalling the relevant information and helping them complete the summary.

CONCLUSION

The results of our cohort study highlight the need to improve the accuracy of discharge summary diagnoses in respiratory wards, even in a teaching hospital. Those responsible for the quality and

safety of discharge summaries elsewhere might simply assume that such quality issues do not apply to all categories of wards, and to all institutions, but it would be more rational to apply our method to assess the quality of discharge summaries in their own organisation. Assuming that our findings are replicated in other centres, future research should focus on education and assessing how best to help junior doctors to deliver high quality, accurate discharge summaries within a hectic clinical environment. One potential solution would be to involve junior doctors in this quality improvement activity by alerting them to the problem and asking them to propose solutions [30,31]. Another would be to electronically share diagnoses between specialties in an electronic patient record [32,33], avoiding duplication and allowing the creation of a more accurate in-depth record available at the time of discharge [34–36]. The introduction of templates [5,37] with speciality-specific drop-down menus of diagnoses and a simple hierarchy for less frequent conditions might also support junior doctors generating more accurate discharge summaries. These templates should be displayed in a usable interface to increase user satisfaction, confidence and stimulate better uptake [38].

DECLARATIONS

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ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

Not applicable. This study is part of service evaluation and audit. We have not collected extra data but assessed data collected as part of routine practice. This does not need ethics or patient consent.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIAL

The datasets generated and/or analysed during the current study are not publicly available due to use of these data for other research studies not yet published, but are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests

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AUTHORS' CONTRIBUTIONS

Design of the study protocol: RT

Setting up the study in hospital: RT, DP

Derivation of the gold standard: IC, PB, PW, KR, MC, DG

Extraction and coding of diagnoses from discharge summaries: IC, PW, MC, DG

Analysis of Data and statistical analysis: RT

Writing the manuscript: RT

Revising the manuscript critically: DP, JW

Adding relevant suggestions to improve the manuscript: IC, PB, PW, KR, MC, DG

Agreement for all aspects of the work and approval of the final version to be published: RT, DP, JW, IC, PB, PW, KR, MC, DG

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LEGENDS OF FIGURES

Figure 1: 5-step process for evaluating the accuracy of discharge summary diagnoses – For each patient, the reference list of diagnoses was compared with the list of diagnoses recorded in discharge summaries by a third person not involved in the generation of the lists. To allow for an objective comparison, all diagnoses were encoded using a standardized terminology (ICD10).

Figure 2: Comparison of the reference list of diagnoses versus the list of diagnoses recorded in the discharge summaries for each patient. All reference diagnoses were compared to all discharge summary diagnoses using a 5 grade scale to determine the level of accuracy.

Figure 3: Inaccuracy rate per discharge summary. Each vertical line represents one discharge summary. There was a greater than 50% inaccuracy rate in 67% [58 to 76%] of discharge summaries. None were fully accurate.

Figure 4: Correlation of the inaccuracy rate in recorded diagnoses per summary with the type of disease (p=0.004). "n" is the number of total diagnoses for the related ICD10 chapter. The inaccuracy rate was highest for infectious diagnoses, symptom and endocrinology diagnoses, and lowest for psychiatry, rheumatology, neoplasms and respiratory diagnoses.