Frequency of hospital-acquired pneumonia in electronic and paper-based patient record

Jürgen STAUSBERG a,1, Abdelouahid AZAOUAGH b

a Medical Faculty, University of Duisburg-Essen, Germany
b Medizinische Klinik I, Sankt Marien-Hospital Mülheim a.d. Ruhr, Germany

Abstract. Aim of the study was to check the validity of the electronic patient record for hospital-acquired pneumonia and to estimate its reliability. Reviewing 23,356 inpatients with admission from the 1st April 2005 and discharge up to the 30th September 2005 we identified 211 cases with hospital-acquired pneumonia in the electronic patient record whereof 70 cases taken at random were included in the validation. A second random sample of 130 cases under risk was used to calculate its completeness. For hospital-acquired pneumonia, the latest version of the definition of the Centers for Disease Control and Prevention (CDC) was applied. In 64.3 % of the cases hospital-acquired pneumonia was confirmed in the paper-based patient record (45 cases, 95%-confidence interval 51.9 % - 75.4 %). Beside 10 cases with pneumonia already existing with admission 15 cases remain where even pneumonia could not be confirmed in the paper-based patient record. Completeness was calculated as 42.9 %. Estimation for the University Clinics Essen revealed a true rate of hospital-acquired pneumonia of 1.32 % (308 of 23,356). The estimated true rate was higher than the measured rate of 0.90 % (211 of 23,356) which is covered, nevertheless, from the 95%-confidence interval. Data from the electronic patient record seem to be sufficient to forecast the true rate of hospital-acquired pneumonia, for example, for questions of infectious disease epidemiology. However, it is not sufficient enough for special claims of the supervision, clinical hygiene and prevention for which an optimization of the data quality is required.

Keywords. Centers for disease control and prevention, computerized patient records, hospital, incidence, nosocomial infections, paper-based patient record, pneumonia, routine data

Introduction

Pneumonia is one of the most frequent hospital-acquired infections and an important issue of patient safety [1]. It occurs at least 48 hours after admission to a hospital or 14 days after discharge. Main risk factors of hospital-acquired pneumonia are tracheal intubation, restricted consciousness, chronic lung disease, abdominal or thoracic operation, aspiration of fluid, and an age of more than 70 years [2]. The most important risk factor is a mechanical ventilation of more than 1 day at an intensive care unit.

1 Corresponding Author: Jürgen Stausberg, MD, PhD, Kordulastr. 13, D-45131 Essen, Germany; E-mail: stausberg@ekmed.de.
Hospital-acquired pneumonias carry harm for patients and an economical burden for the health care system. A continuously surveillance is a main mean in its prevention. Prevention is considered as the most effective procedure to reduce the mortality related to hospital-acquired pneumonia. About one third of hospital-acquired pneumonias are regarded as preventable [3].

The use of routine data available in an electronic patient record (EPR) has got great attention in quality control and surveillance [4]. It could be shown that the secondary use of routine data is one possibility to improve quality of care through the introduction of information and communication technologies in health care [5]. Regular feedback can support a weakness analysis [6]; a timely notion of adverse events can trigger protocol guided actions [7]. Nevertheless, the quality of data recorded electronically in parallel to a paper-based patient record is discussed controversially [8]. One can assume that the data are tailored to the tasks supported by each type of record, e. g. legal issues with the paper-based type and reimbursement with the electronic type. In case of functional overlap it might be the user who decides about the particular type of record used for the storage of a single item.

In the University Clinics of Essen patient safety is an issue of high priority, e. g. in the field of pressure ulcer [9]. Focusing on hospital-acquired pneumonia the question rose, whether the quality of the data available in the EPR is sufficient enough to estimate the frequency of hospital-acquired pneumonia. In the following we will introduce the study design and its results.

**Material and Methods**

We included inpatients admitted from 1st April 2005 and discharged not later than 30th September 2005. The definition for hospital-acquired pneumonia in the electronically available routine data was as follows: a code for pneumonia from the German adaptation of the ICD-10 (ICD-10-GM 2005) **AND NOT** a code for pneumonia as admission and/or principal diagnosis. The period prevalence rate was then calculated as number of inpatients with hospital-acquired pneumonia as numerator and the total number of included inpatients as denominator. For the paper-based patient record we used the definition of the Centers for Disease Control and Prevention (CDC) [10]. The estimation of the true period prevalence rate is based on a combination of a) the period prevalence rate from the EPR adjusted for length of stay, b) the correctness of the EPR adjusted for length of stay and c) the completeness of the EPR. For the completeness we calculated the 95 %-confidence interval. The paper-based patient record was used as gold standard. Correctness and completeness were calculated as proposed by Hogan and Wagner [11].

For the calculation of correctness we took a random sample of inpatients with a hospital-acquired pneumonia in the EPR. Because we wanted to detect a difference of 20 % for correctness with an a priori figure of 80 %, sample size calculation leads to 70 inpatients (α-error 0.05, β-error 0.1). A priori we expected a completeness of 50 % and a true rate of hospital-acquired pneumonia of 20 % in a population at risk with a length of stay from at least 15 days and discharge from the Department of Anesthesiology, Department for Bone Marrow Transplantation, and the Center of Internal Medicine. The sample size calculation leads to 130 inpatients (α-error 0.05, β-error 0.1). Due to 6 inpatients present in both samples, 194 paper-based patient records remain for retrospective review concerning the presence of a hospital-acquired pneumonia.
according to the CDC-criteria. The analysis of the paper-based patient records was done without notion of the EPR-status. All records could be retrieved.

The EPR at the University Clinics of Essen is used in parallel to the paper-based one. It includes for example lab results, radiology reports, and clinical data needed for reimbursement with the German diagnosis related groups. For the latter, diagnoses and procedures are coded with legislatively obliged classifications by physicians and/or documentation specialists. The paper-based patient record is still the legislative obliged archive of all relevant data. Due to missing mobile computers it is used at the point of care as well. Therefore, electronically generated data like lab results are printed out and stored in the paper-based record.

Results

From the sample of 70 inpatients, 45 hospital-acquired pneumonias were confirmed in the paper-based patient record. The correctness is 64.3 %. This is significantly lower than the expected rate of 80 % (p=0.002). 10 inpatients presented pneumonia already at the time of admission, in 15 inpatients pneumonia could not be confirmed at all in the paper-based patient record.

Within the high risk sample of 130 inpatients we identified 28 with hospital-acquired pneumonia. From these, 12 were already identified in the EPR. The completeness is 42.9 % (95 %-confidence interval 24.5 % - 62.8 %). Thus, completeness confirmed the expected range.

The estimation of the true period prevalence rate is shown in table 1. First, we calculated the correctness for each group of length of stay. Then, we estimated the number of inpatients for each group by multiplying the number of inpatients identified in the EPR with the correctness figure (i.e. for group 1: 41 inpatients x 0.083 = 3.4 real cases). The resulting number of 132 inpatients (rounded) is combined with a completeness of 42.9 % (95 %-confidence interval 24.5 % - 62.8 %) leading to 308 (210 - 539) true inpatients suffering from a hospital-acquired pneumonia, i.e. a true period prevalence rate of 1.32 % (0.90 % - 2.31 %).

<table>
<thead>
<tr>
<th>Inpatients</th>
<th>Short stay (1-5 days)</th>
<th>Normal stay A (6-10 days)</th>
<th>Normal stay B (11-20 days)</th>
<th>Long stay (&gt; 20 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatients with hospital-acquired pneumonia EPR</td>
<td>41</td>
<td>29</td>
<td>51</td>
<td>90</td>
</tr>
<tr>
<td>EPR period prevalence rate</td>
<td>0.3 %</td>
<td>0.6 %</td>
<td>2.0 %</td>
<td>6.6 %</td>
</tr>
<tr>
<td>Random sample</td>
<td>12</td>
<td>9</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Confirmed in the paper-based patient record</td>
<td>1</td>
<td>3</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Correctness</td>
<td>8.3 %</td>
<td>33.3 %</td>
<td>76.2 %</td>
<td>89.3 %</td>
</tr>
<tr>
<td>Estimated true number of inpatients with hospital-acquired pneumonia</td>
<td>3.4</td>
<td>9.7</td>
<td>38.9</td>
<td>80.4</td>
</tr>
</tbody>
</table>
Discussion

In the case of hospital-acquired pneumonia, the EPR is a reliable estimation of the period prevalence rate in comparison with the paper-based patient record. False positives and false negatives countervail each other, so that the rate of 0.9 % from the EPR lies within the 95 %-confidence limits calculated for the true value of 1.32 % from the paper-based patient record. This supports the potential of the secondary usage of electronically available routine data, as recently pointed out by Einbinder and Bates [5]. They stated that “... the secondary use of clinical data - including structured documentation, unstructured narrative, laboratory results, and administrative data - may help drive measurement, improve quality, and help manage populations of patients, even when they are not face-to-face with a provider”. The estimated true rate of 1.32 % lies in the expected range of 0.5 % - 1.5 % published for acute hospital care [12]. The rate seems stable over time, taking into account the results from Leu et al. from 1989 with a period prevalence rate of 0.86 % [13]. External reference values are not available at the moment, because national as well as international quality indicator programs focus on appropriate treatment of pneumonia in outpatient care (cf. [14]). Nevertheless, the quality of data present at the University Clinics of Essen is sufficient for external quality control of hospital-acquired pneumonia as well.

In contrary, a correctness of 64.3 % and a completeness of 42.9 % underpin, that the ICD-10-coded diagnoses in the EPR at the University Clinics of Essen are not qualified for the daily support of patient care. The literature shows similar results. For example, Massanari et al. published a rate of 57.05 % of recorded nosocomial infections [15]. It seems realistic for Germany, that only half of the complications are at the moment coded in the electronically available routine data. Own experiences with other adverse events at the University Clinics of Essen are comparable, as in the case of pressure ulcer [16] and fall (unpublished). We argue that the insufficient completeness of adverse events in the EPR is to some extend caused by the minor role of the EPR at the point of care. As long as the control of the clinical processes is supported mainly by the paper-based patient record, the electronic one will not reach the necessary attention and consequently will lack in data quality. Additionally, our results confirm the conclusion of Mikkelsen and Aasly [17] that “parallel use of electronic and paper based patient records has resulted in inconsistencies” and “documentation is missing in both”. This is a late recognition of Burnum’s warning in 1989 [18], who argued that “medical record information has become less reliable than ever before despite the electronic information revolution in medical care ...”. Burnum presumed a decrease in confidentiality induced by the electronic storage of data. Mikkelsen and Aasly point to the need of a systematic life-cycle-management of the EPR and adequate data-quality procedures.

Especially for the comparison of clinical data for a single individual one must be aware of a couple of relevant methodological difficulties as uncertainty of clinical reasoning, ambiguities of the definition of hospital-acquired pneumonia, and a weak reliability in diagnosis coding with the ICD-10 [19]. But, substantial difficulties are not specifically relevant for the EPR, they are as well apparent in the paper-based patient record.

For the University Clinics of Essen, the EPR is a reliable source for the frequency of hospital-acquired pneumonia, but not suitable to drive the care for an individual patient, e. g. in accessing appropriate guidelines. This supports the notion that electronically available routine data could be used within quality control programs. But
as long as they are recorded in parallel to the paper-based patient record they could not be easily incorporated into the process of health care. Regarding hospital-acquired pneumonia, a more precise definition and a merging with other data sources as lab results and radiology reports will improve correctness and completeness for both issues.

References