Cross-Border Challenges in Informatics with a Focus on Disease Surveillance and Utilising Big-Data 59
L. Stoicu-Tivadar et al. (Eds.)

doi:10.3233/978-1-61499-389-6-59

The Israel National Hospital Discharge Register: an Essential Component of Data Driven Healthcare

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Abstract. The Israel National Hospital Discharge Register (INHDR) is an essential section of healthcare data. It includes record for each admission to hospital wards during the last twenty years, and the data are increasing by digitally updated information from hospitals on continually a monthly or quarterly basis. The register contains encrypted patient identity number, admission number, demographic and geographic data, hospitalization data, diagnoses, procedures and accounting data. The goal of the register is to measure medical and surgical services in hospitals, to compare hospital activity among regions, gender and age and population groups within the country and among other countries, to analyse the difference between periods. This large-scale hospital data helps in planning of the hospital services, analysing the health status of the population, disease and injury surveillance, and helps in performance of quality indicators. It assists decision makers at the Ministry of Health (MOH) in their daily and on-going missions.

Keywords. Hospital discharges, Hospital quality indicators, Information-driven healthcare, Big data.

Introduction

As standard healthcare moves to Evidence-Based Medicine (EBM) or Information-Driven Healthcare and to Patient-Centred Medicine (PCM) the concept of 4P Medicine - Preventive, Personalized, Predictive and Participatory is emerging [1]. The ultimate goal is to enable a more predictive, individualized, economical and safer healthcare by shifting from the evaluation of medical interventions in the average patient to the identification of the best intervention for each individual patient.

1. The Big Data Problem

To achieve the goals there is a need for the smart use of the ever-increasing amount of data available, both structured and unstructured, from multiple sources, and for tools for analysing the continual data streams produced for and by patients at every point of

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care. This is referred to as the "big data" problem [2]. Big data should reduce the statistical errors, reduce the risks of mistakes driven from inter- and intra-seasonal and yearly fluctuations, identify rare healthcare phenomena, and allow for the discovery of patterns within smaller and smaller subgroups of patients and resulting in better predictions.

2. Israeli National Register

The key component of this work is the Israeli National Hospital Discharge Register (INHDR). The goal of this database is to measure hospital activity, to analyse trends and directions, and to document and quantify medical and surgical services etc. This capability gives the repository a great value in assisting decision makers at the Ministry of Health (MOH) in their daily missions. The repository is used regularly for policymaking and for the planning of services within the healthcare system. These large-scale hospital data sets are at the heart of the diagnostic and forecasting systems that make predictions regarding health status and outcomes for individuals and populations.

The INHDR is a 40GB database and is an output of the increasing use of electronic medical records systems (EMR) at hospitals. Maintaining an INHDR at the national level, with a high coverage rate, is a strategic issue for data-driven healthcare.

Hospital discharge data are a key element in solving many issues, among them are the following [3]:

- Healthcare Planning,
- Quality Assessment and Performance Improvement,
- Health Services and Health Policy Research,
- Injury Surveillance and Prevention,
- Disease Surveillance and Disease Registries Item.

Situated at the Israeli MOH, the enormous database is continually updated with hospitals providing the information digitally on a monthly or quarterly basis. All acute care hospitals (public and private) are included in the INHDR, as well as some of the psychiatric and long-term care facilities. The database contains records of each individual admission. Patient identity numbers are encrypted to allow follow-up studies while preventing identification of individuals and in order to protect the privacy of the patient. The database includes demographic and hospitalization data, as follows:

- Demographic data include age, gender, city code, as well as the patient's HMO,
- Hospitalization data include general information such as the type of admission (elective or urgent) and the type of discharge (home, transfer to other facility, left against medical advice, or died),
- Detailed information on the departmental level such as the date of admission and discharge from each department,
- Diagnoses listed and procedures performed in each department are coded according to the ICD9-CM,
- Accounting information for each hospitalization is provided - the payer as well as the tariffs charged for the hospitalization.

3. Examples of applications using the INHDR

3.1. Example for quality of healthcare and injury surveillance projects: Lower limb amputation rates among diabetics

The MOH undertakes data linkage projects to monitor the quality of healthcare in Israel in order to determine health policy in specific areas. These projects include processing and evaluating changes of post-operative clinical complications, re-admission and mortality. The projects are on-going in several areas such as colon surgeries, craniotomies, fractures of neck of femur and other indicators.

The Organization Economic Countries Development (OECD) and universal quality institutions consider non-traumatic lower limb amputation among patients with diabetes as a measure of quality of care. While this indicator uses inpatient data, the focus is on measuring the quality of non-hospital primary care.

Mortality and morbidity rates of diabetes have been decreasing over the past decade. Is the rate of amputation decreasing as well? Are there differences in the rate of amputation among different ethnic groups or in different geographic areas? These are the research questions.

The study is based on the INHDR in the MOH. During the study, we identified specific and age adjusted rates of diabetic inpatients that underwent lower limb amputation during the last decade.

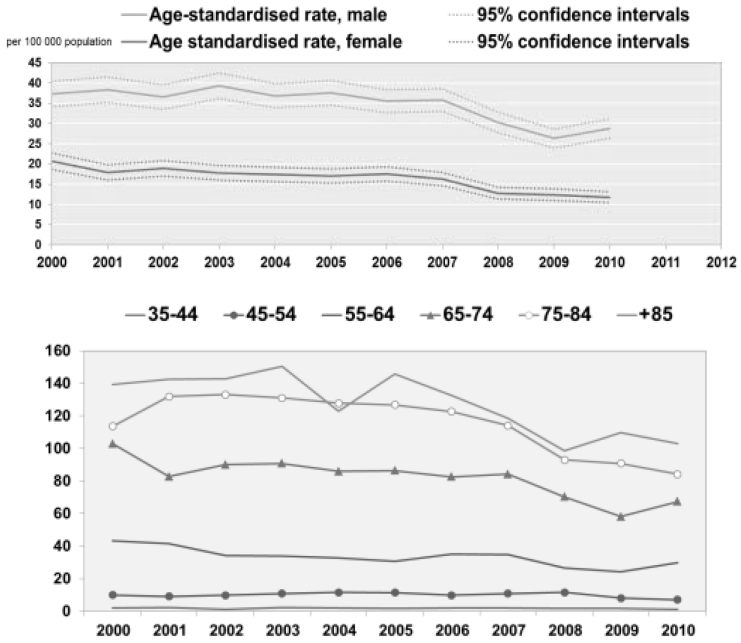

Figure 1 & 2. Lower Extremity Amputations in Diabetic Patients Rates per 100,000 persons.

Our findings show a steady decrease in the rates over the last 4 years. In addition, the age of the population undergoing amputation is steadily rising. This may reflect an improvement in diabetic care in the community and the utilization of a

multidisciplinary approach when treating diabetic foot ulcers. There remains a large variance in the rates between population groups and different geographical areas within Israel.

As a conclusion we find these findings to raise the question whether this has to do with the quality of healthcare in these areas, i.e. the standard of care and access to care, or rather to the characteristics of the population in these areas, i.e. genetic heritage, diet, exercise, socioeconomic status and culture.

3.2. Example of use of the HDR for quality assessment and performance improvement: Readmissions to Internal Medicine Departments [4]

Hospital overcrowding is high in acute care departments in Israel compared with OECD countries, and overcrowding in internal medicine departments is particularly high. Research objective was to study the trends in readmission rates in internal medicine departments and to predict the risk factors for readmission.

The research is based on the INHDR. We analysed discharges from internal medicine departments that were admitted for at least two nights. Readmission was defined as overnight emergency admission within 30 days, with stays in internal medicine or ICU departments. Trends by demographic, hospitalization and morbidity characteristics are displayed. A multivariate regression analysis determined the risk factors for readmission adjusting for age, gender, surgical procedure, LOS, emergency, admission, diagnoses, and admission to ICU.

Results are the following. In 2011, there were 197 thousand hospitalizations discharged from internal medicine departments. The readmission rate was stable over the last decade, 19%-20%. The logistic model shows, patients with stays of 8 or more days have odds ratios (OR) to return within 30 days of 1.5 vs. patients with stays of 2-7 days. The risk for readmission increases with age (OR=1.7 for those aged 85 and over, 1.5 for those aged 75-84, and 1.4 for those aged 65-74, vs. those aged less than 65). Males have a higher risk (OR=1.2) vs. females. The OR for those with neoplasms was 1.7, with CHF was 1.5, and with renal failure 1.3 vs. those without these diseases.

As a conclusion, we can put that the rate of hospital readmissions in Israel was stable over the years. Health policy implications was to reduce the readmission rate through preventative treatment and continuity of care in the community, particularly for populations with co-morbidities to be coordinated with the health funds.

3.3. Example of use of the INHDR for Disease Surveillance: Kawasaki disease (KD) in Israel [5]

The study objective was to characterize the epidemiology and estimate the incidence of Kawasaki disease (KD) among children in Israel. By means of using the INHDR we investigated the epidemiologic features of KD among children less than 18 years of age between 1996 and 2009 in Israel. Incidence rates were calculated using the corresponding census data.

Results are the following. During 1996 through 2009, 685 children less than 18 years of age were hospitalized for KD in Israel. Eighty eight percent of these children were less than 5 years; the male/female ratio was 1.7 and most cases occurred in late winter-early spring. The overall incidence of KD was 6.4 per 100000 children less than 5 years of age. Since 2000, there was a gradual increase in KD incidence as well as an

increase in the ratio of KD-associated hospitalizations to all-cause hospitalizations. For male patients under one year of age, rates of KD have almost doubled: from 5.8 per 100000 cases in 1996-1998 to an average of 11.9 cases per 100000 in the following years (p=0.002). The overall proportion of patients with coronary artery aneurysm (CAA) as a secondary discharge diagnosis was 2.9%, with higher rates of CAA among patients <1 or >5 years of age and in male patients.

As a conclusion, we can put that major epidemiologic features of KD among Israeli children are similar to those reported for the Caucasian population in Europe and the USA. KD incidence increased over the study period, especially among males less than 1 year of age. Higher rates of CAA among children <1 or >5 years of age warrant a higher index of suspicion for KD in these age groups. Continued surveillance for further rise in KD incidence in Israel is required.

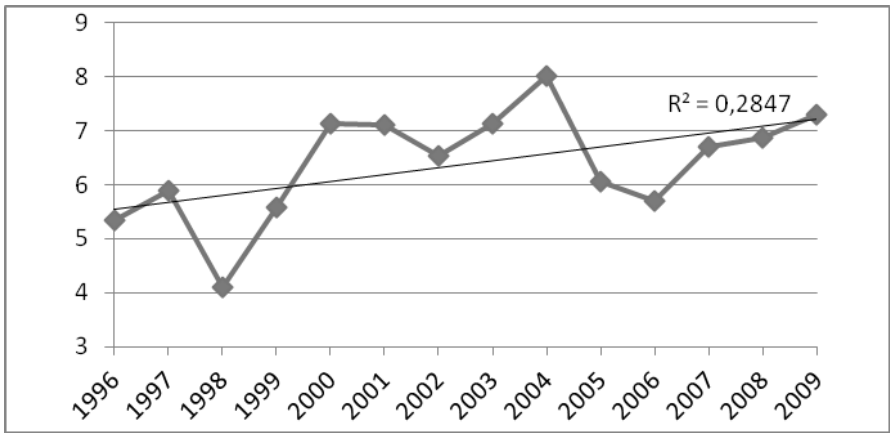

Figure 3. Annual incidence of KD in children < 5 years of age; rate per 100,000 children

4. Concluding remarks

This register is treasure of information that should be an essential component in all planning activities. The value of this treasure lies not with the cost of the register, but with its potential uses. Experiences at the Israeli Division of Health Information, with the INHDR show the usefulness of such a database for health research, especially during the lengthy period between the planning and implementation of a universal Electronic Health Record system.

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