



Data Elements in Inpatient Databases to Enhance Safety & Health Outcomes Research

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BACKGROUND

The type of health services rendered to inpatients (INPT) differs from those to outpatients; IV drug administration, major surgeries, and ICU stays are unique such services that change hourly or daily. Access to INPT data provides details of acute care often on conditions specific to INPT settings.

OBJECTIVE

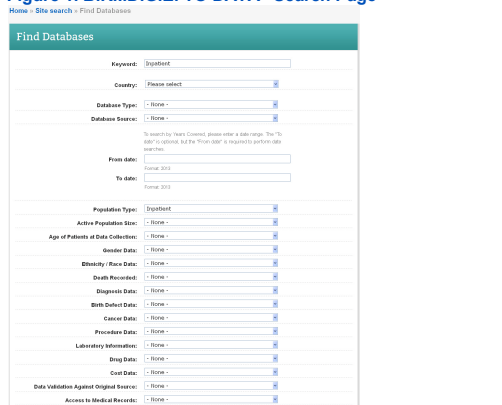
To profile categories and specific elements of INPT data and compare them with data in outpatient databases.

METHODS

Databases (DB) with INPT data were identified by reviewing population healthcare DB profiles in B.R.I.D.G.E TO DATA® (www.bridgetodata.org), an online resource with 220 population healthcare DB profiles worldwide (as of July 29, 2013).

A search using the criteria Population Type = 'Inpatient' and keyword term 'Inpatient' was conducted in B.R.I.D.G.E. to identify DBs with inpatient population/patient types (Figure 1). The search results were manually reviewed for inclusions/exclusions in the final data set.

Figure 1. B.R.I.D.G.E. TO DATA® Search Page



Inclusions: Databases with data at minimum on inpatient population or other populations that also include inpatients were retained. DBs with data obtainable via linkage or special request were also retained for analysis.

Exclusions: Spontaneous reporting systems (SRS) were excluded due to no denominator data and high variability in data quality. DBs without diagnosis, drug or procedure data were excluded.

The remainder were assessed for demographic & clinical data elements.

RESULTS – Part 1

- A total of 135 (61%) out of 220 DBs profiled in B.R.I.D.G.E. had INPT data.
- Excluded from the 135 INPT DBs were 13 (10%) SRS, and 44 (33%) DBs missing diagnosis, drug or procedure data.
- The remaining 78 (58%) INPT DBs consisted of (non-mutually exclusive): Longitudinal DBs - 45, National Surveillance Systems - 2, Cross-sectional DBs - 12, Hospital Discharge DBs - 2, and Registries - 25.

Data attributes specific to INPT DBs profiled in B.R.I.D.G.E. are presented in Table 1.

Table 1. Examples of inpatient data attributes

INPT DB Attributes	Examples from B.R.I.D.G.E.
Hospital Stay	Admission, Type (e.g., emergency, urgent, newborn), Discharge, Length of stay, Facility info, Billing period, Acute & Non-acute care
Demographic	Age, Gender, Ethnicity, Geographic
Physician	Attending/Operating Physician Identifier
Service category	Medical, Surgical, Pediatric, Obstetrical, Nursery, Psychiatric
Unique events	Births, APGAR, Deaths
Physical Exam	Biometric, Heart rate, BP, Cognitive, Functional status
Cost	Billing, Total charges, Type of payment, Insurance coverage/Reimbursement
Diagnosis (Dx)	Admitting Dx code, Principal Dx code, Other Dx codes, Medical history & Comorbidities, Accident-related info, Dx dates, Physician notes
Medication	Special use (anesthesia, IV antibiotics, chemioimmunotherapy, vaccinations, hormone treatment, post-transplant, dialysis-related), Date/Time of administration, Dispensing data, Brand/Generics, Formulation, Dosage, Strength, Route, Prescription/OTC, Drugs prescribed at discharge, Pre- and Post-op regimens
Procedures	Procedure dates/time, Anesthesia, Breathing support, Inhaled NO, Dialysis, Chemotherapy, IV medication, Oxygen therapy, Radiation, Transfusions, Drug/alcohol treatment, Respiratory, Physical therapy, Lactation consult
Surgical procedures	Major & Minor Surgeries
Special care	ICU, NICU, Cardiac/Stroke unit, Continuation (ancillary service, e.g., nursing home), Hospice care, Nursing rehab
Laboratory	Lab physician ID, Precollection info, Lab type, Sample receive date, Result value vs. Normal value, Analyzed date, Previous results, Diagnostic tests, Chemistry, Hematology, Urine analysis, Coagulation, Bloodbank, Anatomic pathology, Microbiology (cultures, virology, susceptibilities), Immunology-Serology, Flow cytometry, Radiology/imaging reports, ECG, Post-mortem reports

RESULTS – Part 2

- Of the 45 longitudinal DBs, only 16 captured *daily* / *hourly* medical events, such as drugs, procedures, physical exams, disease severity, medical services (e.g., dialysis, oxygen therapy) and special care (e.g., hospice care, rehab).
- Treatment data often had time of drug administration, department-specific medications (e.g., IV drugs, anesthesia, chemo) and drugs prescribed at discharge.
- The other DBs with INPT data provided summaries of events, e.g., admission/discharge diagnoses, procedures.
- Lifestyle information was often available (54) but type of data varied. Access to medical records (27) or linkage to other DBs (44) was frequently possible.

Although we found that 70 DBs with INPT data also had outpatient data, the types and granularity of data differ markedly between inpatient and outpatient datasets (Tables 2 & 3), possibly due to differences in patient environment and patterns of care. Additionally, few had linkage between INPT and outpatient data for assessment of continuity of care.

Table 2. Comparison of Inpatient and Outpatient Data Features

	Outpatient	Inpatient
Sites Covered	Physician office, Care clinics, ER, Urgent care, Nursing home, Home healthcare, Outpatient hospitals, etc.	Acute Care Hospitals, including ICU, PICU, psychiatric units, some Long Term Care and Rehabilitation units
Visit time	Visit date (session time usually not included) and ranges 0-1 day	Admission & Discharge date/time (i.e., Length of stay recorded or can be calculated) and ranges 1+ days
Demographic	Age/DOB, Gender, Postal code, Marital status, etc.	Age/DOB, Gender, Postal code, Marital status, etc.
Physical exam	Varies, usually if at physician's office	Yes, usually at admission and variably, vital signs over hospitalization; Detailed exam
Procedures	Clinic procedures (e.g., CPT in the US) Minimally invasive surgeries	Hospital procedure codes (HCPCS or ICD in the US) Major surgeries
Medication	Prescription by GP or specialist; Filled at retail pharmacy Administered at home or outpatient clinic	Prescription by hospital HCP; Filled at hospital Administered in hospital (or at home if discharge prescription) Includes IV drugs & inhaled medications
Diagnoses	Diagnosis codes, e.g., ICD Adverse events	Diagnosis codes, e.g., ICD; Primary Diagnosis & Procedure codes are designated. Adverse events Hospital-related codes, e.g., DRG All physician & nurses notes
Lab Tests	Test, Result (variably table of normal value ranges), Date	Test, Result (variably: table of normal value ranges), Date/Time (ordered, received, analyzed), previous results, etc.
Time course	Daily (MDS) to several months	Hourly to daily
Mortality	Yes, regardless of setting	Only if occurring at hospital
Cost	Billing, Reimbursement, Co-pay, Drug costs	Billing, Payer type, AWP, Total charges (sometimes by service/department), Prescription costs, Billing description, etc.

Each of the 75 data fields used in structured profiles in B.R.I.D.G.E. can be compared side-by-side to identify DBs with the most appropriate data elements captured within a DB (Table 3).

Table 3. Excerpt from B.R.I.D.G.E. TO DATA® Comparing Data Elements in 2 Inpatient Databases and 1 Outpatient Database

FIELD NAMES	PHARMIO Database Network (Netherlands)	Center Health Facts® Database (USA)	CSD Longitudinal Patient Database (France)
Region	50 regions within the Netherlands	Over 450 contributing facilities throughout USA	National representative (8 "INSEE" French regions)
Brief Database Description	The PHARMIO Database Network covers patient-centric longitudinal data for multiple settings of care, including acute hospital & GP diagnoses and procedures, inpatient and outpatient medication utilization, clinical lab, microbiology and pathology tests and results. Other data include oncology registry data, perinatal, renal disease, and respiratory data. Currently, data are collected from a population of ~9 million residents in the Netherlands and are representative of the Netherlands.	Center Health Facts® Database since 2000 captures de-identified longitudinal electronic health record (EHR) patient data. Health Facts collects clinical records with time-stamped & sequenced information on pharmacy, lab, admission and billing data from all patient care locations. The DB is designed to track physician's usage across diagnoses & major procedures, and by geographic region and hospital type. Researchers can determine practice patterns, treatments, and outcomes. The DB includes data on patient demographics, encounters, diagnoses, prescriptions, procedures, lab tests, locations of services/patients (e.g., clinic, ED, ICU), hospital info, and billing.	CSD has developed several longitudinal patient DBs since 1995, including one in France. Once-based GPs volunteer to download in the electronic DB anonymized patient-level information that is collected for purposes of patient management. Data reflect routine clinical practice in primary care. The patient population is representative of the French population according to age & sex distribution, as provided by National Statistic Authorities. Information is continually updated, permitting prospective investigations on newly marketed drugs as well as retrospective ortho-cardio-cancer pharmacovigilance studies.
Database Type	1) Longitudinal Population DB Drug & Diagnosis Data - Medical/Pharmacy Insurance Claims 2) Cross-sectional Population Data 3) Registry: Netherlands Perinatal Registry (PHARMIO-PFN) 4) Tissue/Blood and Genomic/Pharmacogenetic DB	Longitudinal Population Database Drug & Diagnosis Data - EMR Outpatient and Inpatient 1. Outpatient clinics associated with a hospital system: A patient can be tracked across outpatient, hospital, and ER visits. 2. Physician Offices not associated with a hospital system: A patient can be tracked across multiple visits to the same physician office.	Longitudinal Population Database Drug and Diagnosis Data - EMR Outpatient only
Years Covered	1987 - Present	January 1, 2000 - Present	1995 - Present
Patient Type	Inpatient and Outpatient (ER & hospital outpatients not covered)	Inpatient and Outpatient Emergency Room	Outpatient/Non-institutionalized
Active Population Size	1.1-9 Million. Population size differs per DB used within the network. E.g., outpatient pharmacy (5 M); GP (2 M); hospitalizations (16 M); pathology (16 M). DB can be linked on patient-level to create cohort of interest.	21 - 50 Million. As of Jan 2012, DB has 35,001,010 unique patients and 156,198,274 encounters (acute admissions, emergency & ambulatory visits)	1.3 Million
Percentage of Participants <18 years or >65 years	<18 = 16% >65 = 20% (As of 2011)	<18 years = 15% >65 = 20%	<18 years = 20% >65 years = 12.5%
Percentage of Males/Females	Males = 46.5% Females = 53.5% (As of 2011)	Males = 40% Females = 60%	Males = 47% Females = 53%
Death Recorded	Yes: Date of death is recorded for ~99% of the population	Yes: Information is recorded on in-hospital mortality & cause of death	No
Diagnosis Data	Yes Yes: All diagnoses made at the time of visit / discharge and comorbidities recorded during patient's inpatient stay	Yes: Temperature, Chief complaint, Respiratory rate, BP, Pain assessment, Symptoms, Weight	Yes Yes: ICD9/ICD10 for France, ICD9/ICD10 for US
Diagnosis Coded	ICD-9-CM, ICD-10 (since 2011 only), ICD9	Yes: Smoking history, alcohol use, substance abuse, tobacco smoke - available 2009 onward for a subset of institutions	CSD uses its own ICHSUS - mapped to CSD IP (French version of ICD)
Physical Examination	Yes: BP, BMI, etc.	Yes: Time & type of procedure, location of services/patients (e.g., clinic, ICU), locations where medication & lab orders were placed	Yes: There are 124 procedure codes
Behavioral Data Elements	Yes: Smoking status, alcohol intake, diet and physical activity information are available via the GP database	Yes: Prescription of OTC drugs, vaccines, and provided, all time-stamped. There are ~4,000 drugs from pharmacy orders dispensed	Yes: ICD9/ICD10 for France, ICD9/ICD10 for US Yes: Information is available on drug regimen, route, dosage, frequency, manufacturer, and generic name
Procedure Data	Yes	Yes: Lab number; Device; Duration/route/quantity/time of medication administration (concentration, drug, brand); generic names; Start/stop dates; Route of administration; Dosage; SV/PL/VP; Patient; infusion rate; Ordering physician specialty; Type of clinical care provided	Yes: Reimbursement status of a drug is available; Patient status: fully/partially covered by Social Security (depending on type of illness)
Procedures Coded	CIV Codes	ICD-9	CSD uses its own ICHSUS
Laboratory Information	Yes: Clinical lab data and national pathology data are available. Lab tests can also be made available via GP DB and medical records.	Yes: Data on 1,888,833,664 lab test orders & results as of Jan 2012. Chemistry, Hematology, Urine analysis, Pathology, Microbiology (organism, specimen, etc.), Immunology, Serology, Flow cytometry, etc. Details on result, units, dates & times for lab order, received, performed, verified, canceled & completed, ordering physician specialty, type of clinical care provided	Yes: ATC/ANSM/AN for France, CIP code - unique identifier of all drugs on the French market
Drug Data	Yes	Yes: Additional information is available, such as regimen, route, dosage, manufacturer, days supply, generic, cost, KOMP number, and other drug label information	Yes: Prescription only, including class prescribed, molecule, product, dosage, potency, duration and quantity
Drug Coding System	ATC; ANSM/WHO; SNOMED CT® Clinical Terms (drug information only)	NDIC	Yes: Laboratory test results, CIP code - unique identifier of all drugs on the French market
Drug Additional Information	Yes: Additional information is available, such as regimen, route, dosage, manufacturer, days supply, generic, cost, KOMP number, and other drug label information	Yes: Lab number; Device; Duration/route/quantity/time of medication administration (concentration, drug, brand); generic names; Start/stop dates; Route of administration; Dosage; SV/PL/VP; Patient; infusion rate; Ordering physician specialty; Type of clinical care provided	Yes: Information is available on drug regimen, route, dosage, frequency, manufacturer, and generic name
Type of Cost Data	Yes: All costs for drugs, and some fee info on pharmacists & GP. etc. Hospital data are aggregated to include specialists, procedures & hospital (including bed type) fees. All costs are based on tariffs of the National Pricing Board (not patient-level).	Yes: Hospital charges from the DR-92 & CMS1500 billing. Charge data can be converted to costs through methodologies developed by Center.	Yes: Reimbursement status of a drug is available; Patient status: fully/partially covered by Social Security (depending on type of illness)

LIMITATIONS: This analysis was done using registries currently profiled within B.R.I.D.G.E. TO DATA®. More profiles of data sources are continually being added to this resource.

CONCLUSIONS

The pattern of hospital care is described by data elements unique to inpatient (INPT) settings. Select INPT DBs with daily clinical data offer valuable information on acute treatment, diagnostic tests, drugs, and procedures. Specifically, 61% (135/220) of the profiles in www.bridgetodata.org include data on an inpatient population. Most of the detailed daily medical events were best captured by INPT longitudinal DBs and registries. A comparison of outpatient and inpatient DBs showed that the type and granularity of data differed markedly due to differences in patterns of care in the two settings. This makes data linkages between outpatient and inpatient data challenging, as well as continuation of studies upon patient discharge. This study highlights the types and details of INPT data that can provide insight into safety and outcomes studies.

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