



From medical language to medical coding

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The origin of Medical Coding

Among the many concerns of human beings, death has always been present through disease. There was not only evidence of its presence in Arts, thought artistic representations, but in writing. The need to communicate the cause of death is obvious in the Middle Ages. In 1348, Boccaccio in his book, *The Decameron*, refers to death caused by bubonic plague, called Black Death. Later in 1629, local Parish Clerks in various geographical areas of London collected the information concerning births and deaths in the parish and every December, each diocese made it public. These were known as «*The London Bills of Mortality*». They are the first known mortality statistics in the History of Medicine. These clerks lacked of any medical knowledge, deaths had descriptions like griping in the guts, teeth or eaten by lice.

Nosology arises as the branch of medicine that deals with classification of diseases

In 1665, John Graunt, a London merchant, published «Reflections on the weekly bills of mortality». Its central theme was that deaths from plague needed to be examined in the context of all the other causes of mortality in order to understand the effects of all diseases. The sixty disease categories in the Bills constitute the first systematic attempt to analyze the incidence of disease. Nosology arises as the branch of medicine that deals with classification of diseases.

During the eighteen century, additional classifications were authored by Linnaeus in Sweden (*Genera Morborum*, 1763), Bossier de Lacroix in France (*Nosologia Methodica*, 1785) and Cullen in Scotland (*Synopsis Nosologic Methodicae*, 1785).

The first medical statistician for the General Register Office of England, Dr. William Farr, revamped the Cullen disease classification to standardize the terminology and utilize the first primary disease instead of complications. Farr incorporated additional data, enabling reporting and analysis of factor such as occupation and its effect on cause of death.

The need for a uniform classification of causes of death was recognized at the International Statistical Congress convened in Brussels in 1853. From here came out the first of 138 diseases, which was adopted in 1864 and revised at four subsequent Congresses.

In 1839, the International Statistical Institute adopted a revised list of diseases prepared by Jacques Bertillon, chief statistician of the City of Paris. Known as the Bertillon Classification,

The Diseases and Casualties this Week.



jaundies	8
Impoſthume	10
Infants	26
Lethargy	1
Livergrown	2
Meagrome	1
Palſie	2
Plague	6988
Purples	7
Quinfic	1
Rickets	7
Riſing of the Lights	16
Rupture	1
Scowring	6
Small-Pox	2
Spotted Fever	157
Stilborn	11
Stone	2
Stopping of the ſtomach	8
Strangury	1
Surfeit	69
Teeth	138
Thruſh	3
Tiffick	6
Ulcer	5
Vomiting	1
Winde	3
Wormes	25

A Bortive	2
Aged	52
Apoplexie	1
Bleeding	1
Childbed	38
Chriſomes	28
Conſumption	106
Convulſion	81
Cough	1
Droptic	18
Drowned 2, one at St. Michael	
Queenhithe, and one at Step-	
ney	2
Feaver	364
Flux	1
Found dead in the ſtreet 3, one	
at St. Mary hill, and two at	
St. Botolph Biſhopsgate	3
Frighted	1
Gout	1
Griek	2
Gripping in the Guts	43

Chriſtined	Males — 79	Buried	Males — 4116
	Females — 88		Females — 4136
	In all — 167		In all — 8252

Plague—6988

Increased in the Burials this Week 756

Parishes clear of the Plague 12 Parishes Infected 118

The Aſize of Bread ſet forth by Order of the Lord Mayor and Courts of Aldermen, A penny Wheaten Loaf to contain Nine Ounces and a half, and three half-penny White Loaves the like weight.

The London Bills of Mortality 1665

A GENERAL BILL OF ALL THE CHRISTENINGS and BURIALS

From December 16, 1806, to December 13, 1807.
According to the Report made to the KING'S Most Excellent Majesty
By the Company of PARISH CLERKS of LONDON, &c.

At St. Andrew in Barbican	64	At St. George in the East	41	At St. Margaret in New Fish Street	4	At St. Michael in Cross Street	2
At St. Andrew in Holborn	64	At St. James in the Park	41	At St. Martin in Vintry	4	At St. Michael in Queenhithe	2
At St. Andrew in St. Dunstons	64	At St. John in the Fields	41	At St. Martin in the Church	4	At St. Michael in St. Dunstons	2
At St. Andrew in St. Giles	64	At St. John in the Old Jewry	41	At St. Martin in the Fields	4	At St. Michael in St. Dunstons	2
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At St. Andrew in St. Giles	64	At St. John in the Old Jewry	41	At St. Martin in the Fields	4	At St. Michael in St. Dunstons	2

THE DISEASES and CASUALTIES this YEAR.

A Bortive and Sore-throat	48	Diarrhoea	79	Mortification	210	Itch by Mad Dogs	2
A Bortive	57	Dropsy	10	Paralysis	107	Itch by Mad Dogs	2
Aged	142	Fever of all kinds	403	Palpitation of the Heart	10	Itch by Mad Dogs	2
Apoplexy and Strokes	1	Fibula	1	Pneumony	31	Itch by Mad Dogs	2
Althema and Pinkish	53	French Pox	26	Quandy	4	Itch by Mad Dogs	2
Andridles	2	Gout	21	Rheumatism	10	Itch by Mad Dogs	2
Blind	1	Gravel, Stone, Strangury	10	Rising of the Lights	10	Itch by Mad Dogs	2
Bleeding	2	Grief	10	Small Pox	129	Itch by Mad Dogs	2
Burdens and Repress	1	Gravel, Stone, Strangury	10	Sore Throat	10	Itch by Mad Dogs	2
Cancer	81	Inflammation, Hoar-	10	Sores and Ulcers	10	Itch by Mad Dogs	2
Canker	2	in the Head and Water	10	St. Anthony's Fire	10	Itch by Mad Dogs	2
Chicken Pox	1	Jamies	10	St. Vitus's Dance	10	Itch by Mad Dogs	2
Childbed	184	Law Lock'd	10	Thrush	10	Itch by Mad Dogs	2
Colds	12	Leishery	10	Ulcers in the Stomach	10	Itch by Mad Dogs	2
Colic, Griek, &c.	14	Lethargy	10	Worms	10	Itch by Mad Dogs	2
Conſumption	299	Livergrown	10			Itch by Mad Dogs	2
Convulſions	299	Livergrown	10			Itch by Mad Dogs	2
Cough and Hooping Cough	479	Lomatick	10			Itch by Mad Dogs	2
Croup	57	Madder	10			Itch by Mad Dogs	2
Diphtheria	1	Middle-age	10			Itch by Mad Dogs	2

Chriſtined { Males — 4612 } In all 4612
 { Females — 966 } { } In all 966

Buried { Males — 9126 } In all 9126
 { Females — 9044 } { } In all 9044

Whereof have died,
Under Two Years of Age 1441 Tenure of Thirty 1466 Fifty and above — 1222
From Two Years of Age — 752 From Forty and above — 1072 From Sixty and above — 419
From Tenure — 49 From Fifty and above — 419

Increased in the Burials this Year 396

* There has been found in the City of London and County of Surrey 12, of which Number (12 only) have been reported to be Buried in fact within the Bills of Mortality.

Printed by ANN REEVES, Printer to the Company of PARISH CLERKS, St. John's Square, Chancery.

it was the first standard system implemented internationally. The American Public Health Association recommended its use in the United States, Canada and Mexico by 1898. 26 countries adopted the Bertillon Classification in 1900 which had subsequent revisions through 1920.

After Bertillon's death in 1922, interest grew in using the classification to categorize, not only causes of mortality, but also causes of morbidity. Morbidity refers to a health state or the incidence of a disease in a population. As early as 1928, The Health Organization of the League of Nations published a study defining how the death classifications scheme would need to be expanded to accommodate disease tabulation.

In short, any disease, symptom, sign or medical or surgical procedure can be identified by codes, thus providing data storage, safe data transfer and statistics.

Codes, language and content

Medical language is one of the least known languages among the world population. Only medical and healthcare staffs are familiar with this specific jargon of the human body. For us doctors, it is much easier to talk to patients in these terms to properly express situations that have no clear translation into popular wording.

What matters is not the information itself but what we can do with it: key words to identify texts, numeric data to enable big statistical analysis to improve management, payments, performance or any work-in-process, in short «*Big Data*».

From Paper Medical Records to Electronic Health Record

In recent years, thanks to the widespread use of computer technology, a large amount of text information has been stored, written in normal language, unstructured, making analysis very complex or impossible in some cases, as expert system or analysis software do not understand it.



What is Big Data?

Every day, we create 2.5 quintillion bytes of data - so much that 90% of the data in the world today has been created in the last two years alone. This data comes from everywhere: sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and cell phone GPS signals to name a few. This data is **Big Data**.

Big Data spans three dimensions: Volume, Velocity and Variety.

Volume: Enterprises are awash with ever-growing data of all types, easily amassing terabytes -even petabytes- of information.

Velocity: Sometimes 2 minutes is too late. For time-sensitive processes such as catching fraud, Big Data must be used as it streams into your enterprise in order to maximise its value.

Variety: Big Data is any type of data - structured and unstructured data such as text, sensor data, audio, video, click streams, log files and more. New insights are found when analysing these data types together.

Big Data is more than simply a matter of size; it is an opportunity to find insights in new and emerging types of data and content, to make your business more agile, and to answer questions that were previously considered beyond your reach. Until now, there was no practical way to harvest this opportunity.

Source: IBM

<http://www-03.ibm.com/software/products/en/category/SWP10>



Patient's medical record is the main source of information, not only to know about the health state but to manage it. Doctors write their impressions and comments on patients in their own language, easy for them to understand, but hard for analysis on characteristics or condition present in their patients.

Critics of this paper model suggest that the available information may be incomplete, illegible, damaged by external elements such as water, food or fire. It may as well lack of confidentiality due to circulation from hand to hand, with the risk of losing any included document or lack of imaging due to the inability to store them in paper.

We must not forget that medical records are a scientific and legal document:

- ▶ Scientific as they collect information on the health state of the individual, providing relevant data having multiple applications.
- ▶ Legal in different areas as forensic, criminal arbitrage, bodily damage and personal insurance. Therefore, it must be true, clearly written, in chronological order, including relevant information such as physical exam, diagnose, therapy, complications, indications on lifestyle and expected developments.

Therefore, medical records should have information easy to retrieve.

Information systems

Information systems enter healthcare in the fifties developing medical software to help mainly the administration and finance department to translate medical procedures and bill them. This is one of the main reasons for the United States to develop the adapted ICD-8 and procedural terminology. The era of medical billing starts.

Medical coding and billing represent a key step in the healthcare industry. They are the link between healthcare and its economical



CPT or Current Procedure Terminology is widely used in insurance, mainly in English speaking countries. It is a set of codes developed and constantly maintained by the American Medical Association

value. Any type of care due to a disease is formulated into a series of codes showing the procedures used and their cost. This way a detailed invoice is issued, valid in both public and private/insurance environments.

The CPT or Current Procedure Terminology is a set of codes developed and constantly maintained by the American Medical Association, AMA. The code set describes medical, surgical, and diagnostic services and

is designed to communicate uniform information about medical services and procedures among physicians, coders, patients, accreditation organizations, and payers for administrative, financial, and analytical purposes. This unified coding enables standardization of administrative, financial and analytical tasks. CPT coding is widely used in insurance, mainly in English speaking countries. Some companies have developed their own coding as there was no approved code set.



Information systems enter healthcare in the fifties. The era of medical billing starts

Healthcare Information Management in Insurance

Insurance is based on risk factors analysis to develop different products. Information technologies help actuaries developing models using a great number of variables.

Diagnosis has a major role in medicine. Clinicians rely on it for analysis, decision-making and performance. Lately, the structure and formulation of diagnosis has undergone major changes to better meet its goal, particularly regarding data confidentiality, process and transmission. Part of the new challenges are related to the introduction of this International Classification of Diseases.

The health status of the individual is basic to determine the risk to insure. Health questionnaires are developed by insurers for the applicant to answer questions on their health.

Coding of the disclosed conditions or procedures enables using data to/for:

- ▶ Study portfolio profiles, identifying which conditions or procedures are more common by sex, age, geographical distribution and lifestyle. For example: diabetic endemic populations.
- ▶ Product design to meet buyer's needs. For example, saving products vs. risk products or specific health insurance products for certain conditions.
- ▶ Cost analysis, studying the cost of medical tests required to have a diagnosis.
- ▶ Epidemiological studies to understand how diseases behave.
- ▶ Analysis of new diseases that formerly were not a threat for the individual or are caused by a change in lifestyle.



- ▶ Development of predictive models related to health which enables prediction of future behaviour. Mortality and morbidity related to lifestyle and economical status or other patterns of behaviour depending on the available information.

Management of health information in an economic environment

Decisions made by health administrators, either public or private, highly depend on the quality of the produced information, hence the importance of adequate completion of files and careful processing of information, verifying full covered service and minimizing mistakes in coding and data capture.

The lack of uniformity on code systems can cause the same condition to be encoded in different ways, modifying mortality statistics and hindering the cost analysis on diagnosis and treatment.

New management systems enable the integration of costs related to health care, hospital care, surgical procedures, diagnostic imaging and laboratory testing and are used both nationally and internationally.

In insurance, choosing the right coding systems will affect the use and application of the information.

- ▶ **Immediate payment of services.**
Insurer-hospital / health provider / physician.
 - ▶ **Claims payment to third parties.**
 - ▶ **Updating Health care cost.**
 - ▶ **Change in protocols.**
 - ▶ **Hospital inventory management.**
 - ▶ **Productivity ratios.**
-

Medical coding and billing represent a key step in healthcare. They are the link between healthcare and its economical value

There is a lack of uniformity in procedural terminology and medical coding

In some countries, such as the United States, physicians do not receive their fees from insurers if they do not send all required paperwork including medical and CPT codes.

Nowadays the use of on-line billing models is widespread. The chip card in healthcare identification cards has different functions:

- ▶ Report to clinics and physician that insured from a certain company is up to date with premium payments and /or has coverage for service.



Current Coding

1949 International Conference for the Sixth Decennial Revision of the World Health Organization, convened in Paris.

The «**International Classification of Disease, Injuries and Causes of Death**», called **ICD** (International Disease Classification) is created.

An extensive list of mortality and morbidity statistics was adopted and endorsed the international rules for selecting the underlying causes of death.

From now on, the use of ICD was extended to tabulation, registration and use of data for the planning and evaluation of Health Services.

The purpose of the IDC and the WHO is to promote the international agreement in the collection, classification, processing and presentation of mortality and morbidity statistics.

1900 ICD-1. The Unites States of America implemented ICD-1 in 1900.

1900-1968 ICD -2 to ICD -7. Successive revisions. It is used not only to classify the causes of death disease but to index diseases.

1968 ICD-8. The United Sates developed their own version called ICDA-8 or International Classification of Disease Adapted, due to disagreements with the international version.

1975 In parallel to ICD-9, the International Classification of Procedures in Medicine **ICPM** was developed and published in 1978. Divided into fascicles (bundles or groups of subjects), each issue contains procedures laboratory, radiology, surgery, therapies and diagnostic procedures. Many countries have adapted and translated some or all of the CIPM.

1976 ICD -9. The Ninth Revision was attended by delegations from 46 countries, who debated on a more detailed classification, required by those countries



using ICD for evaluation of medical care and for payment purposes. Its implementation was effective January 1, 1979.

The United States of America adopted a modified version called ICD-9-CM, International Classification of Diseases, Clinical Modification.

This **CIE-9-MC** has had many amendments over the years to adjust to changes in Healthcare Management, including codes for new diseases such as AIDS and related conditions, a tick-borne condition known as Lyme disease, Kaposi's sarcoma, toxic oil syndrome, HPV Human papillomavirus, morbid obesity, necrotizing fasciitis, toxic shock syndrome and SARS.

1983 **ICD-10.** The new revision was endorsed by the Forty-third World Health Assembly in May 1990.

The latest version came into use in 1994. The classification system allows more than 155,000 different codes and permits tracking of many new diagnoses and procedures.

2013 **CIE-11.** The World Health Organization is currently revising the latest version. The development is taking place on an internet-based workspace, called iCAT (Internet Collaborative Authoring Tool) Platform, somewhat similar to a wiki – yet it requires more structure and peer review process.

The WHO collaborates through this platform with all interested parties. The final new version is expected to be submitted for official endorsement by 2017.

The information in ICD-11 will be more structured, unlike version 10, which only refers to the name of the disease, now each disease will have specific definitions.

The ICD is translated into forty one languages and is available on-line.

The purpose of the International Classification of Diseases, ICD, and the WHO is to promote the international agreement in the collection, classification, processing and presentation of mortality and morbidity statistics

International Statistical Classification of Diseases and Related Health Problems 10th Revision

Chapter	Blocks	Title
I	A00–B99	Certain infectious and parasitic diseases.
II	C00–D48	Neoplasms.
III	D50–D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism.
IV	E00–E90	Endocrine, nutritional and metabolic diseases.
V	F00–F99	Mental and behavioural disorders.
VI	G00–G99	Diseases of the nervous system.
VII	H00–H59	Diseases of the eye and adnexa.
VIII	H60–H95	Diseases of the ear and mastoid process.
IX	I00–I99	Diseases of the circulatory system.
X	J00–J99	Diseases of the respiratory system.
XI	K00–K93	Diseases of the digestive system.
XII	L00–L99	Diseases of the skin and subcutaneous tissue.
XIII	M00–M99	Diseases of the musculoskeletal system and connective tissue.
XIV	N00–N99	Diseases of the genitourinary system.
XV	O00–O99	Pregnancy, childbirth and the puerperium.
XVI	P00–P96	Certain conditions originating in the perinatal period.
XVII	Q00–Q99	Congenital malformations, deformations and chromosomal abnormalities.
XVIII	R00–R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.
XIX	S00–T98	Injury, poisoning and certain other consequences of external causes.
XX	V01–Y98	External causes of morbidity and mortality.
XXI	Z00–Z99	Factors influencing health status and contact with health services.
XXII	U00–U99	Codes for special purposes.

In the IDC 11, there are currently 13 defined main parameters in the Content Model.

1. ICD Entity Title - Fully Specified Name.
2. Classification Properties - disease, disorder, injury, etc.
3. Textual Definitions - short standard description.
4. Terms - synonyms, other inclusion and exclusions.
5. Body System/Structure Description - anatomy and physiology.
6. Temporal Properties - acute, chronic or other.
7. Severity of Subtypes Properties - mild, moderate, severe, or other scales.
8. Manifestation Properties - signs, symptoms.
9. Causal Properties - aetiology: infectious, external cause, etc.
10. Functioning Properties - impact on daily life: activities and participation.
11. Specific Condition Properties - relates to pregnancy, etc.
12. Treatment Properties - specific treatment considerations: e.g. resistance.
13. Diagnostic Criteria - operational definitions for assessment.



- ▶ Accelerate invoicing through an on-line transaction so procedures are automatically written on company accounts.

Although this system has greatly improved invoicing, there is still a long way to go. There is a lack of uniformity in procedural terminology and medical coding.

As insurance companies include these concepts in their business models, products will be more competitive and allow a bespoke design according to end user needs.

Conclusions

Information technology has become an important part in the modern concept of Public Health and healthcare policy in each country. This resource can help healthcare institutions

to plan their strategies to promote health and communicate related key messages.

Applying information technology to Health Science enables:

- ▶ The use of expert systems as structuring knowledge models or educational models.
- ▶ The analysis of large amounts of data in an homogeneous and safe environmental way, useful to both public sector and insurance.
- ▶ Integration of further evidence, including both lab and imaging testing.
- ▶ Improving service delivery through a more efficient service and financial management.
- ▶ Development of mathematical models for physiopathological process to relate

In short, any disease, symptom, sign or medical or surgical procedure can be identified by codes, thus providing data storage, safe data transfer and statistics



parameters to a model and study the effect of modification of the existing variables.

- ▶ Medical training with simulators reproducing patient behaviour to allow learning patients care.
- ▶ The development of laboratory and high precision surgical techniques to analyze, remove or provide treatment in areas otherwise very difficult or impossible to access.

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There is a lack of uniformity in procedural terminology and medical coding

