Review Article

A Comprehensive Overview of Drug Classification, Disease Coding, Drug Dictionaries of Drug and Information Resource

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ABSTRACT

An international standard for comparing drug use across nations is provided by the Anatomical Therapeutic & Chemical (ATC) system. It categorizes medications based on the chemical makeup, intended use, and mode of action. In addition, the International Classification of Diseases (ICD) is a diagnostic tool used in clinical practice, epidemiology, and health management. ICD encompasses symptoms, aberrant findings, complaints, social variables, and external sources of harm in addition to assigning codes to illnesses. When combined, ATC and ICD provide a single framework for classifying diseases and arranging pharmacological information in healthcare systems around the globe. Two crucial instruments for standardizing medication usage and nomenclature are the International Non-proprietary Name (INN) and the Defined Daily Dose (DDD). While INN guarantees that every medicine has a distinct, internationally recognized generic name, DDD offers a set unit to assess drug intake and compare usage across groups. When combined, they strengthen patient safety in healthcare systems, facilitate rational prescription, and increase communication. Because they offer a consistent method for documenting and analysing adverse medication responses, drug dictionaries and coding systems are crucial to pharmacovigilance. Consistent identification of medications, constituents, and side effects across international databases is made possible by tools like the WHO Drug Dictionary and MedDRA.

Keywords: ATC classification, ICD, DDD, INN, Drug Dictionaries coding in Pharmacovigilance and Drug Information Resource.

INTRODUCTION

A system of categories to which morbid entities are allocated based on predetermined criteria is known as a classification of illnesses. The ICD was created to make it possible for mortality and morbidity statistics to be systematically recorded, analyzed, interpreted, and compared. Gathered at various periods and in various nations or regions. The ICD is used to convert written diagnoses of illnesses and other health issues into an alphanumeric code that makes data storage, retrieval, and analysis simple.[1] A drug dictionary is a systematic reference that offers comprehensive details on medications in an orderly manner. To put it simply, it is a database or listing that contains vital information such as medicine names, ingredients, and classifications.

It facilitates the uniform identification, comparison, and analysis of medications by academics, medical personnel, and regulatory agencies.[2] a drug information resource is any reliable source that provides detailed and evidence-based information about medicines.it is a tool or database that helps you learn everything about a drug, such as its uses, dosage, side effects, interactions, precautions, and safety. These resources are used by doctors, pharmacists, researchers, and students to make safe and correct decisions about medicines.[3]

I. Anatomical, therapeutic, and chemical classification of drugs:

The categorization scheme known as Anatomical Therapeutic Chemicals (ATC) was created and One of the most used methods for categorizing medications is kept up to date by the World Health Organization Collaborating Center for Drug Statistics Methodology. It is crucial to research drug use worldwide. The medications are categorized into fourteen major groupings (the first level) with pharmacological/therapeutic subgroups (the second level) in this five-level structure. Chemical /pharmacological/ therapeutic subgroups make up the third and fourth levels, while the chemical substance makes up the fifth.[4]

Predicting a drug's ATC categorization is crucial since it improves our understanding of how medications function, including their chemical makeup, pharmacological effects, and therapeutic applications. This type of forecasting is also helpful in spotting potential adverse effects and discovering novel applications for currently available medications (a procedure called "drug repositioning"). Predicting ATC classifications for chemical compounds also aids in the creation of novel drugs, particularly when paired with contemporary virtual screening methods. Recently several computational methods have been proposed to predict ATC classification of drugs based on different data sources.[5] The NLSP is a newly proposed multilabel learning method and has achieved top performance in some predictive tasks. In this study, we adopted the data-driven NLSP method for prediction of ATC classes of a compound.[6]

Anatomical Therapeutic Chemical codes: -

It makes it simpler to arrange and evaluate medications consistently by giving each drug a distinct code based on its pharmacological characteristics and therapeutic purpose. The system has five hierarchical layers and a tree-like

topology. From a broad category to a very specialized categorization, each level offers increasingly particular information about the substance. To put it simply, it begins by determining the primary organ or system that the medication affects.

It then proceeds step-by-step to explain the medication's therapeutic goal, pharmacological properties, and precise chemical composition. The ATC system is very helpful for research, clinical practice, and other purposes since these five levels assist provide a clear and systematic manner to classify medications, as outlined in fundamental WHO studies and later methodological research, and healthcare policy.[7]

1St Level: The first level of the ATC code represents the 14 primary subgroups, which are indicated by a single letter such as "Antiparasitic products, insecticides, and repellents" (P), "Antiinfectives for systemic use" (J), "Nervous system" (N), "Respiratory system" (R), "Musculoskeletal system" (M), "Systemic hormonal preparations excluding sex hormones and insulins" (H), "Blood and blood-forming organs" (B), "Genito-urinary system and sex hormones" (G), "Sensory organs" (S), "Dermatologicals" (D), "Cardiovascular system" (C), "Alimentary tract and metabolism" (A), "Antineoplastic and immunomodulating agents" (L), and "Various" (V). For example, the ATC code for the drug verapamil at the first level is C.

2nd Level: The therapeutic group is denoted by the second level of the ATC class, which is indicated by two digits. For example, the ATC code for verapamil at the second level is C08.

3rd Level: The ATC code uses a letter to designate pharmacological/therapeutic categories. For example, the ATC code for verapamil at the third level is C08D.

4th Level: The pharmacological, therapeutic, and chemical subgroups are denoted by the fourth level of the ATC code, which is indicated by a letter. For example, the ATC code for verapamil at the fourth level is C08DA.

5th Level: The chemical substance is denoted by the fifth level of the ATC code, which is indicated by two digits. For example, the ATC code for verapamil at the fifth level is C08DA01.[8]

II. International classification of diseases:-

The WHO created the International Classification of Diseases (ICD) to aid in the recording, analysis, and comparison of data on illnesses and medical conditions among various populations and geographical areas. To put it simply, ICD creates standardized alphanumeric codes a string of letters and numbers from textual diagnoses. This greatly facilitates the correct storage, sharing, and analysis of medical data. ICD has evolved into a well-recognized system for categorizing illnesses. It is extensively utilized in public health reporting, medical billing, epidemiological research, and healthcare administration, assisting experts in monitoring illness trends and enhancing healthcare planning globally.[9]

ICD is used diagnostic tool that supports clinical practice, research, and health management. It is created and maintained by the World Health Organization, which leads international public health activities. ICD provides a standardized way to classify diseases and medical conditions. Medical diagnoses are converted into structured alphanumeric codes, which can include up to six characters and are frequently a combination of letters and numbers.[10]

These codes help categorize complex medical data into comprehensible groupings. ICD was first created to classify diseases, but it has since expanded to include a wide range of health-related information. It now encompasses not just diseases but also symptoms, abnormal outcomes, patient complaints, societal factors, and even outside causes of illness or injury. Each code enables related conditions to be grouped together by connecting a particular health issue to a more general category.[11]

History of ICD

The International List of Causes of Death was first published by the International Statistical Institute in 1893. Standardizing the recording of causes of death across nations was the primary objective at the time. This approach was updated several times to incorporate more precise and in-depth categories as medical understanding advanced. When the World Health Organization assumed control of ICD in 1948, it marked a significant turning point.

The WHO published the most recent edition, ICD-11, in 2019. It is entirely digital and made to satisfy contemporary healthcare demands, such as enhanced global health tracking and greater data exchange.[12]

Current versions of ICD (ICD-10 and ICD-11

Because it includes important facets of human health in an organized manner, ICD is also one of the three primary reference classification systems that the WHO has authorized for use in international health reporting. Adopted in May 1990, the tenth revision—officially In 1993, the International Statistical Classification of Diseases and Related Health Problems (ICD-10) was implemented.(ICD-10)—was put into effect in 1993.

For many years, it was extensively utilized in healthcare systems all over the world.[13] More recently, in May 2019, ICD-11 for Mortality and Morbidity Statistics (ICD-11 MMS), the 11th iteration, was approved. After ICD-10 had been in use for over thirty years, it formally went into effect on January 1, 2022. With enhanced digital capabilities and more precise, adaptable coding, ICD-11 was created to satisfy contemporary healthcare demands, flexible coding for today's medical and research environments.[14]

ICD versions: -

Table 1: ICD Versions Timeline

ICD Revision	Year Adopted / Conference	Year Came into Effect	Key Notes
ICD-1	1900	1900–1909	First international list (causes of death).
ICD-2	1909	1910–1920	Minor updates.
ICD-3	1920	1921–1929	Continued refinement.
ICD-4	1929	1930–1938	Expanded categories.
ICD-5	1938	1939–1948	Last pre-WHO version.
ICD-6	1948	1949–1957	First under WHO; included morbidity (diseases) + psychiatric section.
ICD-7	1955	1958–1967	Further updates on causes of death & illness.
ICD-8	1965	1968–1978	(ICDA-8 in some countries like US).
ICD-9	1975	1979–1998	Widely used; ICD-9-CM in US for clinical modification.
ICD-10	1990 (adopted by WHA)	1 Jan 1993	Major expansion (over 14,000 codes); still widely used globally. India primarily uses ICD-10 for morbidity reporting.
ICD-11	25 May 2019 (WHA72)	1 Jan 2022	Fully digital, semantic model, post-coordination, better for modern EHRs. Currently in effect globally; India is in transition phase from ICD-10 to ICD-11.

ICD Codes (International Classification of Diseases Codes)

ICD codes are used for much more than only keeping track of illness and mortality rates. ICD coding, which was created by the World Health Organization, is now a crucial component of contemporary healthcare systems. These codes are now frequently used in hospital administration, healthcare planning, and billing and payment. They are used by hospitals to monitor patient workload, duration of stay, and treatment quality. ICD codes are also used by organizations like the Veterans Health Administration to organize healthcare services and distribute resources. ICD codes are an effective tool for enhancing overall health systems because they enable researchers and medical professionals to examine illness trends, treatment results, care quality, and healthcare expenditures.

Examples of ICD Codes:

J00 → Common cold, **E11** → Type 2 Diabetes, **I10** → Hypertension (High blood pressure)

A09 → Diarrhea and gastroenteritis, **B20** → HIV disease

Each ICD code corresponds to a particular disease or condition. This system makes it easier to store, share, and analyze health information globally, improving healthcare planning and treatment.[15]

III. Defined Daily Dose (DDD)

For a medication taken for its primary indication in adults, the DDD is the presumed daily maintenance dosage. Although the Defined Daily Dose (DDD) is a common unit of measurement for medication intake, it may not necessarily correspond to the precise dosage that patients are prescribed. In actual practice, dosages might change based on a number of variables, including patient response, age, body weight, and the severity of the illness. There is only one DDD allocated for each medication (ATC code) and mode of administration. Typically, this figure is an average based on statistics from many nations. As a result, the DDD may occasionally indicate a dose that is not typically utilized in actual therapy and may even deviate from routinely given doses.[16] A common way to gauge how much of a medication is consumed in a community is to utilize the Defined Daily Dose (DDD). The World Health Organization defines DDD as the estimated average daily maintenance dosage of a medicine when used for its principal purpose in adults. It's important to keep in mind that actual doses may vary based on the patient's requirements, therefore DDD may not always match the prescription dose (PDD).

. Nevertheless, because it offers a reliable method of comparing drug consumption, DDD is frequently employed in pharmacoepidemiology research.[17]

For example, DDD helps in comparing treatment costs, analysing patient adherence to medications, estimating disease prevalence, and evaluating whether drug supplies are adequate.

IV. International Non-proprietary Names for Drugs:

The active ingredient of a medication is assigned a unique, internationally recognized designation known as a WHO International Non-proprietary designation (INN). It has been appointed by the World Health Organization to ensure precise and consistent medicine. Identity on a global scale. Because they enable safe prescribing practices, INNs are essential, efficient drug monitoring (pharmacovigilance), and simple international identification of medications. In contrast to manufacturers' brand or trade names, which might change from location to location, an INN is consistent across the world. The final marketed product is not given these designations; only the active component is. While distinct prefixes aid in differentiating each medication, INNs

sometimes share common suffixes (referred to as stems) to suggest comparable chemical structures or pharmacological activities. INNs are also often used in pharmacy and medical education, and programs like the "School of INN" aid professionals and students in comprehending medication naming systems.[18-20]

V. Drug dictionaries and coding pharmacovigilance

It is particularly challenging to maintain and keep correct drug information in databases due to the vast number of medications that are now accessible. Each medication may have several brand names, manufacturers, and classifications in addition to varying dosages, forms, and administration methods. This intricacy makes it difficult to organize medication information. To address this, several common classification schemes have been created to maintain the data's organization and usability.[21]

There are so many medicines available today that managing their information can be quite challenging. Each drug may come in different forms, doses, routes of use, brand names, and manufacturers, which makes the data complex and difficult to organize. To make this easier, standard classification systems have been developed to arrange drug information in a clear and systematic way.[22] There are several standard medical coding dictionaries available. Some commonly used ones include:

1. COSTART (Coding Symbols for Thesaurus of Adverse Reaction Terms)
2. ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification)
3. MedDRA (Medical Dictionary for Regulatory Activities)
4. WHO-ART (World Health Organization Adverse Reaction Terminology)
5. WHO Drug Dictionary Enhanced

1. COSTART (Coding Symbols for Thesaurus of Adverse Reaction Terms)

An early method for categorizing and coding adverse medication responses was called COSTART. During clinical trials and medication safety studies, it assisted researchers in routinely documenting and reporting adverse events. It made data entry more consistent and simpler to evaluate by offering a defined set of terminology.[23] All reported adverse drug experiences (ADEs), including reports from various nations, were coded using COSTART nomenclature. The original reported words (raw descriptions) were transformed into standardized COSTART terms with the use of a printed lexicon, improving data consistency. A experimental effort examined the possibility of automating this operation in 1987. The algorithm translated 500 new phrases with around 73% accuracy using strategies including a hashing search strategy, a synonym dictionary, and historical coding data. Although helpful, this was still lower than manual coding, which achieved about 88% accuracy.[24]

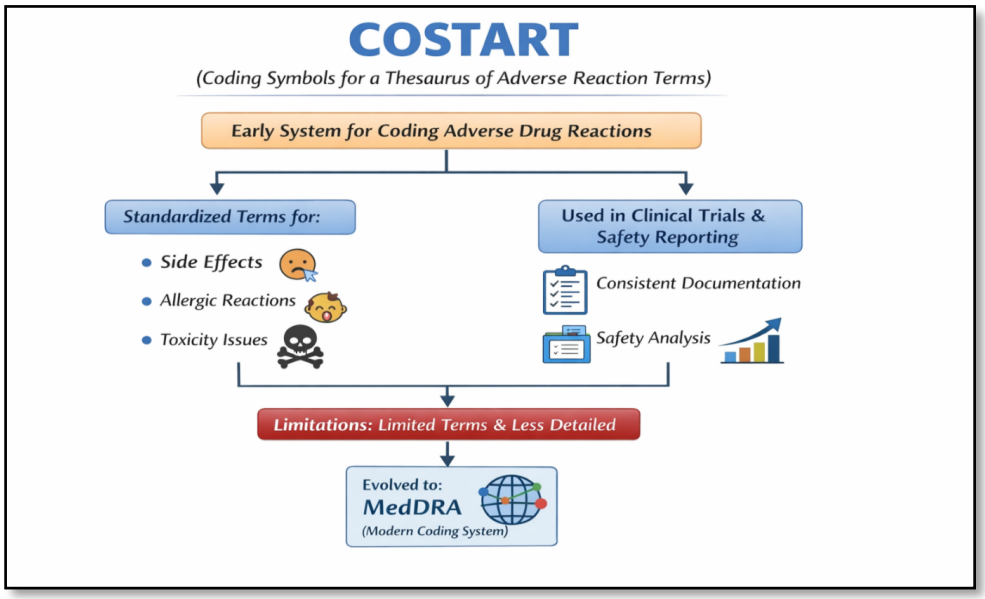

Figure 1: COSTART Coding Symbols

2. ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification)

Developed under the auspices of the World Health Organization, the ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification) is a classification system used in healthcare to document comprehensive patient data. Diagnosis codes, procedure codes, and external cause codes (E-codes) are its three primary categories of codes. While E-codes explain potential causes, diagnosis codes define the patient's state. For instance, if a medication causes a rash in a patient, one code would describe the rash, and another (E-code) would identify the medication as the reason. ICD-9-CM codes are helpful for tracking patient safety and healthcare outcomes

because they are very successful in identifying adverse events (AEs), particularly those connected to medical devices, according to studies.[25]

3. MedDRA (Medical Dictionary for Regulatory Activities)

Adverse events and other drug-related information may be reported clearly and consistently using MedDRA, a widely recognized standardized medical terminology. By assisting researchers and regulators in efficiently monitoring medication safety, it plays a significant part in pharmacovigilance. MedDRA, which was created in the 1990s by the International Council for Harmonization and is kept up to date by the Maintenance and Support Services Organization, is extensively utilized in drug safety monitoring, clinical trials, and regulatory filings. Worldwide, academic institutions, pharmaceutical corporations, research groups, and regulatory bodies utilize it. MedDRA guarantees that adverse event data is uniform, similar, and simple to comprehend across various nations and healthcare systems by offering a single language.[26]

Structure of MedDRA

MedDRA is involved in five hierarchical levels, each providing more detailed medical information:

1. **System Organ Class (SOC):** The highest level, grouping terms by body system, cause, or purpose (total 27 categories).
2. **High Level Group Term (HLGT):** Groups together related High Level Terms based on medical features like anatomy or function.
3. **High Level Term (HLT):** A collection of related conditions linked by similar characteristics such as cause or body system.
4. **Preferred Term (PT):** Standard medical terms used to describe specific conditions, symptoms, or procedures clearly and consistently.
5. **Lowest Level Term (LLT):** The most detailed level, containing synonyms or variations of a Preferred Term.[27]

Languages of MedDRA

MedDRA is a globally used medical terminology developed by the International Council for Harmonisation to support consistent drug safety reporting worldwide. To make it easier for users across different countries, MedDRA is available in multiple languages. This allows healthcare professionals and researchers to work in their international language while still maintaining uniform and accurate medical coding. It also helps with smooth data sharing between countries

MedDRA is available in many languages are including English, Chinese, French, German, Japanese, Spanish, Russian, Korean, and others. Each version also includes supporting documentation to guide users in proper application.[28]

4. WHO-ART (World Health Organization Adverse Reaction Terminology):

The WHO Adverse Reactions Terminology (WHOART) is a dictionary developed to help standardize the coding of adverse drug reactions. It was maintained by the Uppsala Monitoring Centre, which works with the World Health Organization. However, this system is now outdated and is no longer actively updated or maintained.[29]

The WHO-ART (World Health Organization Adverse Reaction Terminology) follows a four-level hierarchical structure:

A. System Organ Class (SOC) – Highest level, groups reactions by body system (e.g., gastrointestinal, nervous system)

B. High-Level Term (HLT) – Broad grouping of related adverse reactions

C. Preferred Term (PT) – Standard term used for a specific medical condition

D. Included Term (IT) – Detailed terms or synonyms under a preferred term.[30]

5. WHO Drug Dictionary Enhanced

Pharmacovigilance uses the World Health Organizations WHO Drug Dictionary Enhanced extensively to standardize the coding and identification of medications. It helps guarantee proper data capture by connecting reported adverse medication responses with both generic and brand names. It also categories medications for simpler comparison and safety monitoring through the use of systems such as the ATC classification. All things considered, it enhances data quality and promotes uniform worldwide drug safety reporting.[31]

Information on medications reported in adverse drug reaction instances from nations participating in the World Health Organization International Drug Monitoring Program from 1968 may be found in the computerized database known as the WHO Drug Dictionary Enhanced. It has developed into a special and useful supplier of medicine names from significant pharmaceutical marketplaces as it gathers data from many nations. It is extremely helpful for worldwide drug safety and research because it contains both single-ingredient and combination medications.[32] The Uppsala Monitoring Center maintains the WHO medication Dictionary Enhanced (WHO-DDE), one of the most used medication coding systems worldwide. By ensuring that data from clinical trials and drug safety reports are properly classified, processed, and evaluated, it promotes reliable global pharmacovigilance.[33]

VI. Drug information Resources

Information about drugs must be carefully reviewed, especially when it relates to particular patients or demographics. To deliver safe and efficient treatment, healthcare professionals must seek information with objectivity and balance. Pharmacists and drug information

centers often play an important role in addition to electronic resources. However, as no single source contains all the information, there are occasionally gaps or discrepancies. Inaccurate or missing information might lead to adverse outcomes or medication errors. An adverse event is any unintended damage a patient has because of medical treatment rather than the sickness itself, whereas a medication error is any mistake made when taking a prescription.[34]

Types of Information Resources in Pharmacovigilance: -

1. **Primary Information Resources**
2. **Secondary Information Resources**
3. **Tertiary Information Resources**

1. Primary Information Resources

All medication information is derived from primary sources. Clinical trials, case reports, and pharmacological investigations are examples of original research. It might be challenging to comprehend these findings, though. Randomized controlled studies often yield the most trustworthy data but analyzing them calls for significant expertise. To make these easier, systematic reviews or meta-analyses are frequently created by combining the findings of several research. To improve decision-making, organizations such as the Cochrane Collaboration analyze and summarize this information.[35]

2. Secondary Information Resources

Resources for secondary information serve as a link to original research. They assist in organizing, summarizing, and directing readers to pertinent primary material rather than providing unique investigations. Review papers, meta-analyses, indexes, and abstracting services are some of these resources. Without having to read every original study, they make it simpler to locate and comprehend vast quantities of material. MEDLINE, International Pharmaceutical Abstracts, Index Medicus, Excerpta Medica, and the Iowa Drug Information Service are a few examples of databases and services that may include full-text articles.[36]

3. Tertiary information resources

Information from primary and secondary sources is gathered and condensed into an understandable manner by tertiary information resources. They are devoid of unique research. Rather than requiring users to conduct in-depth research, they offer concise, pre-made material that facilitates rapid comprehension of a subject.[36]

CONCLUSION

Drug classification systems such as ATC, ICD, MedDRA, WHO-ART, and WHO Drug Dictionary Enhanced provide a standardized way to organize and interpret drug and disease information. These systems improve accuracy, consistency, and global comparison of medical data, supporting better clinical practice, research, and pharmacovigilance. They also help with safe drug use, effective communication, and reliable healthcare decision-making. Overall, these resources are crucial for raising patient satisfaction and healthcare quality safety worldwide.

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