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A resource- and context-based evaluation of ICD implementation worldwide

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Abstract: A resource- and context-based evaluation of ICD implementation worldwide

The implementation of ICD is a critical step toward establishing robust and effective vital registration systems in all WHO member states. ICD implementation was evaluated based on the availability of ICD resources, as measured by ICD sales and licensing; the contexts in which ICD resources have been used via a Web-based search; and a mechanism for comparing socioeconomic development (SED) and quality-adjusted completeness of mortality data, a novel indicator for measuring the effectiveness of implementation. The results deemphasized the relationship between SED and implementation, and instead promoted a more complex network of factors each contributing to the establishment of registration systems. Identification and careful analysis of these factors can lead the development of a more sensitive framework for offering assistance and resources to member states.

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Introduction

The implementation of ICD-10 in WHO member states is a critical step toward improved measurement of and progress toward the WHO's mission of "the attainment by all peoples of the highest possible level of health" [1]. However, the progress of worldwide implementation has yet to be definitively evaluated, in part due to the numerous realms of health measurement and vital registration systems that are affected by ICD-related information. Without accurate, non-biased information about the deployment of resources and the implementation of ICD in critical health measurement systems in WHO member states, it has been difficult to assess the specific needs of each state in terms of improving the quality of reporting to WHO and of evaluating the state of health and progress of health interventions within a member state. Thus, understanding not simply whether implementation of ICD has occurred but also the state of implementation and its impacts, if known, on health measurement systems and other related infrastructures is important for developing more effective frameworks for improving health metrics and realigning resource deployment to all member states.

A review of worldwide implementation of ICD and an evaluation of the preliminary results of implementation were conducted using a number of methods. Specifically, observations were made into the availability of ICD-related resources, the known and novel contexts in which ICD resources have been used, and the correlations between socioeconomic development (SED) and the quality of mortality data collected using ICD in reporting member states. This paper reports the findings of the evaluation and suggests lines of inquiry for further study.

Methods

In order to evaluate worldwide implementation of ICD, a number of survey methods were used. These methods were established to investigate resource availability, context of information usage, and/or quality of reported mortality data in all member states for which the information was possible to obtain. This work was carried out between July and September, 2005.

ICD licensing and sales

The WHO Press is authorized to sell the latest revision of ICD-10 in both printed book and digital CD-ROM forms, as well as to sell licences to individuals, organizations, and for-profit businesses for use of the information contained within or directly related to ICD-10, in part or in full. Licences can be for internal use, i.e. use within an existing organization, or for product development, either as a third-party developer or for an end product resulting in commercial sales. Data of all ICD-related licensing during 1994-2004 and of all sales of the English version of ICD-10, second edition, during 1993-2004 were requested and collected from the WHO Press. In this analysis, only the data related to ICD-10 for global use or for limited country-specific use was allowed (n = 43).

For sales data, only the figures on fulfilled orders for ICD-10 to agents (stock and special) and non-agents/WHO were incorporated (n = 30,917).

Contexts of use

To determine the known and novel, if any, contexts of use of ICD information in member states having already completed implementation, a Web-based search strategy was employed. Using online search engines, the first fifty results relevant to ICD-related information use were noted. The data recorded for each result consisted of the title of the product or use, the online address (URL) of the webpage were the information was accessed, the latest date of revision, the author or organization maintaining authorship of the information, and the general context of the use (e.g. commercial software, reimbursement, research, learning and education). The queries used were combinations, permutations, and abbreviations of "International Classifications of Diseases" in all WHO languages. For examples, search queries in English included "International Classification of Diseases," "ICD," "ICD-10," "ICD-10 modified," "ICD-9," "ICD-9 modified," "ICD classification," and "disease classification."

Socioeconomic development

Using World Bank definitions and rankings, the socioeconomic development (SED) of WHO member states was classified according to gross domestic product (GDP) per capita and then sub-classified based on absolute conditions of GDP. Member states with GDP < $5,000 (in U.S. Dollars) were defined as "low-income" (LI); states with GDP < $10,000 but > $5,000 were defined as "middle-income" (MI); states with GDP > $10,000 were defined as "high-income" (HI).

Quality-adjusted completeness

Previously reported information on the quality and completeness of mortality data in WHO member states, where available, was used in this study [2]. The definitions and measurement units of data completeness and quality indicators was left intact and applied throughout this analysis. In order to compare SED with mortality data taking into account completeness, a factor due to the extent of the implementation of ICD-related measurement systems, an adjustment of the completeness of the data was made based on quality. Completeness was reduced by 25% for medium-quality data and by 60% for low-quality data as previously determined [2]; no reduction was made for high-quality data. The amount of adjustment was determined only to separate data points for meaningful comparison; the actual values are somewhat arbitrary. After comparison for each country, there were 106 member states for which data pairs could be made. The quality-adjusted completeness (QAC) was plotted against SED in U.S. Dollars for each of these member states (n = 106). Based on QAC figures, three tiers were determined and applied. QAC < 50 was defined as "low"; QAC < 80 but > 50 was defined as "moderate"; and QAC > 80 was defined as "good." Actual boundaries for each tier were determined

according to rates of adjustment applied based on data quality.

Population size

In order to account for relative sizes of populations in WHO member states in the SED/QAC analysis, the size of the data points was made logarithmically dependent on the comparative size of the population. Four tiers of population size were applied: small (pop. < 1 million, n = 26), medium (pop. < 10 million, n = 39), large (pop. < 100 million, n = 36), and very large (pop. > 100 million, n = 5).

Results

The state of implementation of ICD in WHO member states was evaluated from multiple perspectives in order to survey the "before" and "after" illustrations of implementation worldwide. The results of the evaluation can be cross-referenced in order to gain a more thorough understanding of how extensive, how effective, and how reproducible the process is. From this, it may be possible to develop a more sensitive framework in which to adjust resources to the various parties of WHO member states to assist in improving implementation or, in the case of the approximately 80 countries unaccounted for in this study, in establishing ICD-based registration systems.

During the years surveyed, 37 percent of all sales of ICD-10 were to agents or private parties in the United Kingdom, the largest purchaser by volume. Other high-income purchasers include second-largest purchaser South Africa (12%), the United States (8%) and Japan (2%). The third largest purchaser was the Philippines, a low-income country accounting for 14 percent of all sales. Other low-income purchasers include India (7%) and Egypt (5%). These seven countries account for 85 percent of all ICD-10 sales during this period. Surprisingly, no middle-income countries are in seven largest purchasers, which may indicate a shift of political priorities to issues other than health measurement. At the same time, purchasing does not equal implementation; while the availability of ICD resources is an important factor, it cannot alone account for if and how measurement systems are working. Other indicators, such as collection methods and data quality, contribute to a more complete picture of the state of ICD implementation.

Of the ICD licences sold during 1994-2004, nearly half (48%) were worldwide licences to organizations intending to sell or otherwise distribute products internationally. Most of these organizations are large, multinational firms that sell software or other medical or technical products that are required to include ICD codes. While most of the sales generated by the organizations holding worldwide licences occur in middle- or high-income with already established vital registration systems, the worldwide licence allows the expansion of these sales to countries trying to develop systems using these products, which may be promising. For country-specific licences, the countries with the largest number of licences are South Africa (16%), the United Kingdom (9%), France (9%), and the United Arab Emirates

(5%). It is interesting to note that South Africa and the United Kingdom were some of the largest purchasers of ICD resources during a nearly overlapping time period, indicating the likely translation of ICD into usable products.

Missing from this list are the United States and the Philippines. The U.S. hosts many of the firms and companies acquiring worldwide licences, so it is probable that most American need for these products are being satisfied by these organizations. It is unclear in this analysis whether the Philippines is using purchased ICD resources for application other than software or product development, or if resources are not being effectively turned into usable goods for health measurement.

An additional nine percent of licences were "internal" licences, which shows almost one in ten organizations using ICD for products that are then sold to other distributors to be incorporated into products for end-users. The significant number of third-party developers parallels an equally significant demand for products incorporating ICD codes.

Software products are not the only context in which ICD can be used. Based on the findings of the Web-based search for products and programmes using some aspect of ICD, over a hundred (n = 117) unique results were collected. Ninety percent of these results grouped into one of five general contexts of use: medical practice management software, productivity software for alternative computing platforms, searchable databases in non-standard languages, information for the general public, and classroom-based or online education programmes. About three in five (59%) of "hits" identified by search engines were exclusive to ICD-10, with a further 11 percent adding a modified version of ICD-10. Of the ICD-10 contexts, nearly a quarter were from the United States, supporting the evidence of the licensing data that the organizations in the U.S. produce products for worldwide consumption. Also significant in ICD-10 use were Germany, Japan, Switzerland, and the Scandinavian countries. Interestingly, some Scandinavian countries continue to use older versions of ICD within their own registration systems, although all countries report to WHO in ICD-10, despite issues with compatibility. This may explain the small but significant percentage of contexts of use for versions of ICD prior to the ninth edition.

Socioeconomic development (SED) is one of many factors that can contribute to health outcomes around the world. In order to assess a similar relation between SED and mortality coding systems, and more specifically, efficacy of ICD implementation, SED was plotted against quality-adjusted completeness (QAC) for each member state for which data was available [2]. The three tiers for SED (LI, MI, HI) and for QAC (low, moderate, good) were applied by boundary lines separating each group of data points, thus creating nine SED-QAC sectors.

General trends. There appears to be some relationship between development and completeness of mortality data. The relationship is strongest for low- and middle-income countries, which tend to group in the low completeness (for LI countries) or the moderate completeness (for MI countries) tiers. On the other hand, high-income countries tend to be distributed among the three QAC tiers fairly equally, indicating that a direct SED and QAC relationship does not always hold, and especially for HI

countries. It should be noted that before adjustment, most HI countries were categorized as having good completeness. The discrepancies, though somewhat arbitrary, created when completeness is adjusted based on quality of data implies that even HI countries with sophisticated morality registration systems may have room for improvement. Certainly the needs of LI countries vary greatly from those of HI countries in terms of how best to maximize the efficiency and capabilities of ICD implementation; however, this further supports the needs for a more sensitive framework of resource deployment that accounts not only for SED of member states, but also other non-economic factors. These factors may be identified by observing more closely the "deviant" cases at each SED tier.

Low or medium income/Good completeness. This sector presents some cases where developing countries have established highly effective mortality registration systems. Not only is the data collected complete, but the quality of the data is also excellent. Potential reasons for the sophistication and proper execution of these systems include strong political will, successful and effective advocacy, legislative intervention, and a "spill over" effect from neighbouring countries. Countries in this sector include Moldova, Cuba, Venezuela, Romania, and Mexico.

High income/Low completeness. This sector includes cases where high GDP has not led to effective implementation and thus poor data quality or completeness, or has not been invested in health measurement systems. Potential reasons for this disparity include lack of political will, insufficient expertise to manage the implementation or collection systems, or ineffective use of financial resources. Countries in this sector include South Africa, Poland, Argentina, Portugal, Greece, and Qatar. It is important to note that South Africa is a major purchaser of ICD resources and licences; the country may be in transition to better health registration.

Low income/Low completeness. This sector presents cases arguably most in need of assistance. Low SED is likely impeding the establishment of registration systems, especially when what health dollars are available are spent toward interventions with immediate outcomes, e.g. vaccinations. However, SED is not a primary reason for low completeness; reasons include geopolitical instability, economic or health crises, or other destabilizing factors requiring attention. Mortality registration is critical so that crises can be identified and managed, especially if likely to lead to an epidemic. Countries in this sector include Nicaragua, Syria, Ecuador, and Egypt.

Conclusions

The results of this study show that the implementation of ICD in WHO member states varies greatly, not only by socioeconomic development, but also based on what ICD resources are available, how those resources are distributed and used, and who or what forces are guiding effective implementation and data collection. It is important to consider that there are far more exceptions to what rules may be applied in regards to implementation than previously thought. The development of a framework that considers and is sensitive to the collection of conditions each country faces in making decision about vital registration systems is crucial for greater

outcome efficacy in resource deployment and assistance in implementation. Future studies should identify and address these conditions given each country's needs.

References

[1] "Constitution of the World Health Organization," *World Health Organization: Basic Documents.*

[2] Mathers, CD, *et al*. Bulletin of the World Health Organization 2005; 83: 171-177.

Annex

GDP per capita, completeness, data quality, QAC, and population

Country	GDP/capita	Completeness	Quality	Adjusted	Pop. (2005)
Albania	4,900	60	1	24	3,563,112
Antigua and Barbuda	11,000	90	2	67.5	68,722
Argentina	12,400	100	1	40	39,537,943
Armenia	4,600	68	1	27.2	2,982,904
Australia	30,700	100	3	100	20,090,437
Austria	31,300	100	2	75	8,184,691
Azerbaijan	3,800	74	2	55.5	7,911,974
Bahamas	17,700	100	3	100	301,790
Bahrain	19,200	100	1	40	688,345
Barbados	16,400	100	2	75	278,870
Belarus	6,800	100	2	75	10,300,483
Belgium	30,600	100	2	75	10,364,388
Belize	6,500	100	2	75	281,084
Bosnia and Herzegovina	6,500	100	1	40	4,430,494
Brazil	8,100	84	2	63	186,112,794
Brunei Darussalam	23,600	84	2	63	372,361
Bulgaria	8,200	100	2	75	7,450,349
Canada	31,500	100	3	100	32,805,041
Chile	10,700	100	2	75	15,980,912
Colombia	6,600	81	2	60.75	42,954,279
Cook Islands	5,000	100	2	75	21,388
Costa Rica	9,600	90	2	67.5	4,016,173
Croatia	11,200	100	2	75	4,495,904
Cuba	3,000	100	3	100	11,346,670
Cyprus	12,700	100	1	40	780,133
Czech Republic	16,800	100	2	75	10,241,138
Denmark	32,200	100	2	75	5,432,335
Dominica	5,500	100	2	75	69,029
Ecuador	3,700	70	1	28	13,363,593
Egypt	4,200	85	1	34	77,505,756
El Salvador	4,900	76	2	57	6,704,932
Estonia	14,300	100	3	100	1,332,893
Fiji	5,900	100	1	40	893,354
Finland	29,000	100	3	100	5,223,442
France	28,700	100	2	75	60,656,178
Georgia	3,100	75	2	56.25	4,677,401
Germany	28,700	100	2	75	82,431,390
Greece	21,300	100	1	40	10,668,354
Grenada	5,000	0	2	0	89,502
Guatemala	4,200	87	2	65.25	12,013,907
Guyana	3,800	67	2	50.25	765,283
Hungary	14,900	100	3	100	10,006,835

Iceland	31,900	100	3	100	296,737
Ireland	31,900	100	3	100	4,015,676
Israel	20,800	100	2	75	6,276,883
Italy	27,700	100	2	75	58,103,033
Jamaica	4,100	75	1	30	2,735,520
Japan	29,400	100	3	100	127,417,244
Kazakhstan	7,800	89	2	66.75	15,185,844
Kiribati	800	86	1	34.4	103,092
Kuwait	21,300	100	2	75	2,335,648
Kyrgyzstan	1,700	85	2	63.75	5,146,281
Latvia	11,500	100	3	100	2,290,237
Lithuania	12,500	100	3	100	3,596,617
Luxembourg	58,900	100	2	75	468,571
Malaysia	9,700	90	2	67.5	23,953,136
Malta	18,200	100	3	100	398,534
Mauritius	12,800	100	2	75	1,230,602
Mexico	9,600	100	3	100	106,202,903
Mongolia	1,900	100	2	75	2,791,272
Netherlands	29,500	100	2	75	16,407,491
New Zealand	23,200	100	3	100	4,035,461
Nicaragua	2,300	58	1	23.2	5,465,100
Niue	3,600	70	2	52.5	2,166
Norway	40,000	100	2	75	4,593,041
Oman	13,100	0	1	0	3,001,583
Panama	6,900	88	2	66	3,140,232
Paraguay	4,800	74	1	29.6	6,347,884
Peru	5,600	50	1	20	27,925,628
Philippines	5,000	77	2	57.75	87,857,473
Poland	12,000	100	1	40	38,557,984
Portugal	17,900	100	1	40	10,566,212
Qatar	23,200	100	1	40	863,051
Republic of Korea	19,200	89	2	66.75	48,640,671
Republic of Moldova	1,900	100	3	100	4,455,421
Romania	7,700	100	3	100	22,329,977
Russian Federation	9,800	100	2	75	143,420,309
Saint Kitts and Nevis	8,800	100	2	75	38,958
Saint Lucia	5,400	100	2	75	166,312
Saint Vincent and the Grenadines	2,900	100	2	75	117,534
San Marino	34,600	100	1	40	28,880
Serbia and Montenegro	2,400	100	2	75	10,829,175
Seychelles	7,800	94	2	70.5	81,188
Singapore	27,800	100	3	100	4,425,720
Slovakia	14,500	100	3	100	5,431,363
Slovenia	19,600	100	3	100	2,011,070
South Africa	11,100	84	1	33.6	44,344,136
Spain	23,300	100	2	75	40,341,462

Sri Lanka	4,000	91	1	36.4	20,064,776
Suriname	4,300	100	1	40	438,144
Sweden	28,400	100	2	75	9,001,774
Switzerland	33,800	100	2	75	7,489,370
Syrian Arab Republic	3,400	71	1	28.4	18,448,752
Tajikistan	1,100	60	1	24	7,163,506
Thailand	8,100	86	1	34.4	64,185,502
The Former Yugoslav Republic of Macedonia	7,100	100	2	75	2,045,262
Tonga	2,300	86	1	34.4	112,422
Trinidad and Tobago	10,500	100	2	75	1,075,066
Turkmenistan	5,700	78	2	58.5	4,952,081
Tuvalu	1,100	77	1	30.8	11,636
Ukraine	6,300	100	2	75	46,996,765
United Kingdom of Great Britain and Northern Ireland	29,600	100	3	100	60,441,457
United States of America	40,100	100	3	100	295,734,134
Uruguay	14,500	100	2	75	3,415,920
Uzbekistan	1,800	91	2	68.25	26,851,195
Venezuela	5,800	96	3	96	25,375,281