

Final Report: Effective Public Health Reporting Using ICD-10-CM

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I. IMPACT

Introduction:

The emergence of ICD-10-CM brings anticipation about future uses, including the accurate capturing and reporting of public health diseases. A major issue that needs to be addressed in order to accomplish this task is the need to illustrate how ICD-10-CM is designed to accommodate changes and additions more easily than ICD-9-CM, especially for public health disease capturing and reporting.

This is extremely important in this day of newly evolved diseases such as AIDS, SARS, and avian flu as well as the acts of bioterrorism. It is expected that the ICD-10-CM system incorporates these newly found public health diseases as well as easily adapting to ever changing public health conditions. However, this may not occur. Thus, it is important to assess if the ICD-10-CM system is a more effective and efficient public health reporting system than ICD-9-CM.

Purpose:

The purpose of this study is threefold:

1. to investigate the completeness of the ICD-10-CM system in capturing public health diseases
2. to measure the effectiveness and efficiency of ICD-10-CM in public health reporting
3. to collect feedback from users on how applicable the ICD-10-CM systems are in relation to capturing public health diseases

Statement of Need:

According to the National Center for Health Statistics (NCHS)¹ and the Centers for Medicare and Medicaid (CMS)², the ICD-10-CM and ICD-10-PCS have many advantages over the ICD-9-CM coding system. Notable improvements in the content and format include:

1. the addition of information relevant to ambulatory and managed care encounters
2. expanded injury codes
3. the creation of combination diagnosis/symptom codes to reduce the number of codes needed to fully describe a condition
4. the addition of a sixth character
5. incorporation of common 4th and 5th digit subclassifications
6. laterality
7. greater specificity in code assignment
8. further expansion than was possible with ICD-9-CM
9. all substantially different procedures have a unique code
10. new procedures can be added as unique codes

However, in the ICD-10-CM Field Testing Project summary report developed by AHA and AHIMA³, even though ICD-10-CM was felt to be an improvement over ICD-9-CM by 76 % of the participants, a total of 761 errors or conflicts in the instructions in ICD-10-CM were reported. After eliminating the duplications and other problems, a total of 305 issues remained. In the final list of identified problems, difficulty in locating a diagnostic term in the index was by far the most commonly reported problem. However, the only index available at the time of the field testing project was in a format that was difficult to read, which made it difficult to readily locate some diagnostic terms, even though the terms were present. Also, twenty-five of the reported problems pertained to codes for external causes of morbidity; codes that could effect public health reporting. Participants also reported the number of diagnostic statements that were unable to be coded in ICD-10-CM. They were unable to find an ICD-10-CM code for a total of 380 diagnoses. Upon review of the problem identification forms, the reasons why some of the diagnoses could not be coded were eliminated (due to duplication by more than one participant

or misinterpretation of instructions etc.) and 151 diagnoses that could not be coded fell into the following categories:

1. Diagnosis was not indexed under the expected mainterms or subterms
2. Insufficient documentation to assign a code (clarification with a physician would be necessary)
3. Error in index or tabular
4. Concept does not exist in ICD-10-CM
5. Code choices not applicable to diagnosis (i.e., either a clear “default” code that is broad enough to cover the diagnosis should be provided or additional codes should be made available)
6. Diagnosis is more specific than available code choices
7. Unclear instructions

The reported problems have been submitted to NCHS for review and correction. To our knowledge, however, no studies have been conducted to determine if ICD-10-CM is effective in capturing public health diseases. Furthermore, according to the National Vital Statistics Report⁴, the top ten causes of death for 2002 were the following:

1. Diseases of the Heart
2. Malignant Neoplasms
3. Cerebrovascular Diseases
4. Chronic lower respiratory diseases
5. Accidents (unintentional injuries)
6. Diabetes Mellitus
7. Influenza and Pneumonia
8. Alzheimer’s Disease
9. Nephritis, nephritic syndrome and nephrosis
10. Septicemia

These diagnoses accounted for 79% of all deaths occurring in the United States. Comments received from the ICD-10-CM Update: ICD-9-CM Coordination and Maintenance Meeting in November, 1999 for changes to ICD-10-CM⁵ were categorized according to the chapter and recommended disposition. Below, we have linked the comment section to the top 10 causes of

death for 2002 as stated above. The number of comments that required further study is listed below in Table 1 and includes the following:

Table 1: Cause of Death and Number of Comments that Warrant Further Study in ICD-10-CM

Cause of Death	Number of Comments that have Merit and Warrant Further Study
Diseases of the Heart, Cerebrovascular Diseases	6
Malignant Neoplasms	0
Chronic lower respiratory diseases	4
Accidents (unintentional injuries)	19
Diabetes Mellitus	13
Influenza and Pneumonia	4
Alzheimer's Disease	0
Nephritis, nephritic syndrome and nephrosis	2
Septicemia	3
Total	51 Comments need further study

It can be seen from Table 1 that 51 comments for the top ten causes of death were viewed as needing further study. This also demonstrates that ICD-10-CM should be examined to see how well it accurately captures public health related diseases.

Based on all of the above information, it is therefore, important to determine if ICD-10-CM truly captures public health related diagnoses.

II. METHODOLOGY

Research Design

A descriptive research study was performed to investigate the completeness of the ICD-10-CM coding system in capturing public health related diagnoses. First, the top 10 causes of mortality as well as other infectious and reportable public health conditions such as SARS, avian flu, smallpox, anthrax and so forth were examined. The website for each state department of health was reviewed to determine what diseases are required to be reported. Once this list was

developed, it was supplemented with two other areas that are very pertinent to public health reporting; the top ten diagnoses for mortality and the classification of death and injury resulting from terrorism, a supplemental classification developed after September 11, 2001. The top ten diagnoses for mortality included the following: Accidents, Alzheimer's disease, Cerebrovascular disease, Diabetes Mellitus, Influenza, Lower Respiratory disease, Nephritis, Septicemia, Heart disease, and the top five malignant neoplasms. A website was developed and included a total of 250 public health related diagnoses. Although this list is not exhaustive of all public health related diagnoses, it was felt that it did provide an adequate number to make comparisons between the two coding systems. A comparison of the ICD-9-CM codes for these diagnoses with the ICD-10-CM codes was made. The June 2003 draft of ICD-10-CM was used for this study and the 2006 version of ICD-9-CM was used. Comparison tables that describe the specificity of the coding for ICD-9-CM and ICD-10-CM for each of the public health diagnoses were developed. A ranked score was assigned to each public health diagnosis for both the ICD-10-CM and ICD-9-CM coding systems. The ranking was determined by comparing the ICD-10-CM and ICD-9-CM systems for the number of codes, the level of specificity, and the ability of the code description to fully capture the diagnostic term. The ranked or ordinal scale consisted of the following:

- 5 = Diagnosis is fully captured by the code/codes
- 4 = Diagnosis is almost fully captured by the code/codes
- 3 = Diagnosis is partially captured by the code/codes
- 2 = Diagnosis is less than partially captured by the code/codes
- 1 = Diagnosis is not captured by the code/codes

Once all rankings were assigned, a focus group was convened, which included experts in ICD-9-CM, ICD-10-CM and public health. The purpose of the focus group was to review and examine the information accumulated from the study and to provide feedback and recommendations regarding where changes need to be made in the ICD-10-CM system.

Therefore, the focus group examined the rankings and made changes. The researchers reviewed and discussed all comments from the focus group, clarifying any questions, and then made the appropriate changes to the rankings and code descriptions.

Part II: Validation Study for Public Health Reportable Diagnoses:

The second part of the research study included using the ICD-10-CM Field Testing Project Study data from AHA and AHIMA to examine whether public health reportable diagnoses are easily captured using ICD-10-CM. We obtained the validity study data from AHIMA and received permission to use the data in this study. The data included 359 patient cases in which up to ten narrative diagnoses were collected. Up to ten ICD-10-CM codes by a coder and then by a validator were also included. Figure 1 shows one example of how the data was organized.

Figure 1: Description of the AHA and AHIMA Validity Study Data Using ICD-10-CM:

DX Narrative 1	DX Narrative 2	DX Narrative 3	DX 1 Code 1	DX1 Code 2	DX2 Code 1	DX 2 Code 2	DX 3 Code 1	VDX1 Code 1	VDX2 Code 1	VDX3 Code 1	Explanation
Pulmonary edema with respiratory failure	CHF	COPD	I50.1	J96.0			J44.9	J96.9	I50.1	J44.9	DX1Code 1 inconsistent with validator

Every diagnosis in the ICD-10-CM Field Testing Project Study database was examined and only those diagnoses that were related to public health were extracted and recoded. Diagnoses were considered related to public health either by being one of the top ten diagnoses for morbidity, mortality, an infectious disease, a disease related to terrorism and so forth. The diagnoses were grouped into the same categories obtained for the first part of this study i.e. top ten diagnoses for mortality etc. A category called “Other” was developed and it included those diagnoses that were considered public health related but did not fit into the categories related to the top ten diagnoses for mortality. The only cases examined in this study were those with differences between the coder and the validator. These cases were recoded by our coders to determine where differences may fall within the ICD-10-CM system. The same procedure was performed using ICD-9-CM in order to obtain a ranking for ICD-9-CM codes (see below) and therefore make objective comparisons between the two systems and to determine if ICD-10-CM is more effective and efficient in capturing public health diagnoses than ICD-9-CM. A total of approximately 170 patient cases met the criteria for inclusion in our study and were reviewed and recoded. Levels of agreement between the coder and the validator were determined and a Kappa statistic was performed to determine if the differences seen were statistically significant. A ranking scale based on the differences between the coder and validator for ICD-10-CM and ICD-9-CM was developed and is listed below:

- 5 = All digits are captured by codes assigned
- 4 = One digit is different between the codes assigned
- 3 = Two digits are different between the codes assigned
- 2 = Three digits are different between the codes assigned
- 1 = >3 digits are different between the codes assigned

Part III: Statistical Analysis of the Data:

The qualitative data (hypotheses and explanations) obtained from the first study was analyzed using qualitative themes. The hypotheses and explanations were categorized into five broad themes or areas such as those explained in the ranking scale. For example, one of the public health reportable diagnoses is HIV and it was coded first in ICD-9-CM and then ICD-10-CM. Hypotheses and explanations regarding which system fully captured everything about the disease and provided specific terms and codes related to the disease were developed. The hypotheses and explanations were categorized into one of the five areas explained in the ranking scale. If it was found that a disease is only partially captured, further explanation was provided as to what should be included in order to fully capture the diagnosis. For the second study, agreement levels between the coder and the validator were determined and a Kappa statistic was performed to determine if the differences seen are statistically significant. All of the statistical data, both qualitative and quantitative was organized in tables for distribution and examination.

Part IV: Focus Group Process:

A focus group was developed. The focus group included experts in ICD-9-CM, ICD-10-CM and public health. The focus group reviewed and examined the information accumulated from the study and has provided feedback and recommendations on where changes need to be made in the ICD-10-CM system.

Generally, the focus group members addressed the following questions:

1. After review of the public health diagnoses and procedures reportable list, are there any diagnoses or procedures that you believe should be added, deleted, or changed? If so, please explain.
2. Do the hypotheses and explanations that relate to the coding of the reportable diagnoses and procedures provide enough information so that changes to the coding system can be made? If not, please specify which sections need further detail.

3. Do the ranked scale data and explanations related to differences in the I-10 and I- 9 coding systems make sense? Do you need additional information to clarify any cases? If so, which ones.
4. Based on the information provided to you, what recommendations do you have to improve the ICD-10-CM coding system for public health reporting?

Information from the focus group emails were analyzed and organized into a formal report and sent to all members of the focus group for their clarification and additional comments. The comments and recommendations provided by the focus group members were synthesized and are presented in this report.

This study was submitted to the University of Pittsburgh’s Institutional Review Board (IRB) and received approval at the exempt level.

III. RESULTS

Overall results demonstrate that ICD-10-CM is more specific and fully captures more of the public health related diseases than ICD-9-CM. In the analysis of all the public health related diseases such as reportable diseases, top ten causes of death, and those related to terrorism, it was found that the overall rankings for disease capture for ICD-10-CM were significantly higher for than the rankings for ICD-9-CM (Table 2)

Table 2: Comparison of Rankings between ICD-9-CM and ICD-10-CM and its Ability to Capture the Disease

	ICD-9-CM Rank (Mean)	ICD-10-CM Rank (Mean)	P value
National Reportable Diseases**	3.85	4.61	<0.001
Top 10 Mortality Diagnoses***	3.49	4.97	<0.001
Accidents***	3.3	5	<0.001
Alzheimer’s	3	5	N/A
Cerebrovascular***	2.83	5	<0.001
Diabetes Mellitus*	2.75	5	0.013
Influenza	4.8	5	0.317
Lower Respiratory**	3.2	5	0.005
Nephritis***	3.07	4.85	<0.001
Septicemia	5	5	1.000

	ICD-9-CM Rank (Mean)	ICD-10-CM Rank (Mean)	P value
Heart Disease*	4.5	5	0.030
Cancer (Top 5)	4	5	0.136
Terrorism***	1.90	4.2	<0.001

P values determined by Mann Whitney U non parametric test
*Significance: p<0.05
**High Significance: p<0.01
***Very High Significance: p<0.001
N/A – Too few cases

Ranking:
5=Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Furthermore, when we examined differences in disease capture by each system, several diseases were captured differently. Table 3 shows those differences by rank as well as an explanation for where the differences occurred. It can be seen, again, that ICD-10-CM fully captured more of the national health reportable diseases than ICD-9-CM. However, some diseases were not fully captured by ICD-10-CM. These include: basidiobolus , histoplasmosis, hypothermia, outbreaks related to illnesses in a child care setting, pediculosis, plague, poliomyelitis, perinatal exposure of newborn to HIV, smallpox, toxins, and vaccine adverse reactions. **Please note that only those diseases in which there are differences between the two coding systems or where diseases are not fully captured are displayed in the following tables. Because of the large number of diseases examined, it would be very extensive to include all the diseases reviewed and since many of the diseases examined were fully captured by both coding systems, they were not reported in the following tables.**

Table 3: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for National Health Reportable Diseases

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Amebiasis	3	5	I-10 has 3 add'l codes and breaks out specific site of abscess

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Animal Bites**	4	5	I-10 more specific and span more sections of codes
Arthropod borne infections	2	5	Codes similar for both systems but I-10 more specific and offers more classification types.
Bartonellosis	3	5	I-10 more codes and covers more in the description i.e. Oroya fever
Basidiobolus	1	3	Found in I-10 under “other zygomycoses” only and not found in I-9.
Blastomycosis	2	5	I-10 has more codes
Campylobacter enteritis	3	5	I-9 uses two general codes to capture (009.1 +008.43)
Carbon monoxide poisoning	2	5	I-10 has many more codes
Chickenpox	3	5	I-10 has more codes/descriptions
Ciguatera Fish Poisoning	2	5	I-10 has more codes/descriptions
Clostridium perfringens intoxication	1	5	I-10 does code this while I-9 has no code
Coccidioidomycosis*	3	5	I-10 has more codes/descriptions
Conjunctivitis: acute	3	5	I-10 has more codes/descriptions
Cysticercosis	2	5	I-10 has more codes/descriptions
Dengue Fever	4	5	I-10 has one add'l code
Encephalitis	3	5	I-10 has many more codes and is more specific and captures more
Gonococcal infection*	4	5	I-10 has more codes and codes related to pregnancy complications
Haemophilus influenzae (invasive disease)*	2	5	I-10 has more codes/descriptions
Hansen’s disease*	4	5	I-10 has more codes/descriptions
Hepatitis A acute/chronic*	4	5	Captured by both with similar descriptions but I-10 has an “other” category

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Hepatitis B acute/chronic*	5	4	Captured by both systems but I-9 more specific for some categories
Hepatitis B, surface antigen*	1	5	I-9 does not have a code for this
Hepatitis C, acute/chronic*	5	4	Captured by both systems but descriptions are different and I-9 more specific with add'l code
Hepatitis D	5	4	Captured by both systems but descriptions are different and I-9 more specific with add'l code
Herpes, neonatal or genital	3	5	I-10 much more specific
Histoplasmosis	5	2	I-9 much more specific. I-10 requires add'l codes for higher level of specificity/granularity
HTLV (human T-lymphotrophic virus	3	5	I-10 more specific
Hyperthermia	3	5	I-10 has more codes/descriptions
Hypothermia	5	3	I-9 more specific
Legionellosis*	4	5	I-10 includes an add'l code for nonpneumonic Legionnaires" disease
Listeriosis	2	5	I-10 has more codes/descriptions/specificity
Lyme disease	2	5	I-10 has more codes/descriptions/specificity
Marburg virus	4	5	Captured by both but I-10 more specific stating "Marburg virus" while I-9 states "other specified diseases due to viruses".
Malaria*	3	5	I-10 much more specific
Maple syrup urine disease	4	5	Captured by both but I-10 more specific in description
Measles*	3	5	I-10 much more specific
Melioidosis	3	5	I-10 more specific with more codes
Meningitis, viral, bacterial, fungal, parasitic	3	5	I-10 more specific with more codes
Meningococcal disease*	3	5	I-10 more specific with more codes

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Mercury poisoning	3	5	I-10 more specific with more codes
Monkeypox	4	5	Captured by both but I-10 more specific in description
Mumps*	3	5	I-10 more specific with more codes
Neonatal herpes	3	5	I-10 more specific with more codes
Neonatal bacterial sepsis	2	5	I-10 more specific with more codes
Foodborne outbreak	3	5	I-10 more specific with more codes
Outbreaks or Illnesses in childcare settings	1	3	Both have one code but I-10 is more specific in place of occurrence
Nosocomial Outbreak	1	5	Captured by I-10
Pediculosis	5	4	Captured by both systems but I-9 has one add'l code
Pelvic inflammatory disease	4	5	Captured by both but I-10 has more specific codes
Pertussis*	3	5	Captured by both systems but I-10 has more specific codes pertaining to poisoning by pertussis vaccine which I-9 does not include
Pesticide related illness	3	5	I-10 more specific codes
Plague*	5	4	Captured by both but I-9 has one more code-secondary pneumonic plague
Poliomyelitis*	5	3	I-9 has many more specific codes but specificity may be outdated
Perinatal exposure of NB to HIV	2	4	I-10 more specific and has O codes to denote a complication in pregnancy due to HIV exposure
Pneumococcal disease	2	5	I-10 more codes/more specific
Primary congenital hypothyroidism	2	5	I-10 more codes/more specific
Rabies*	3	5	I-10 more codes/more specific
Rickettsial disease/infection	2	5	I-10 more codes/more specific
Rocky mountain spotted fever*	4	5	I-10 more specific description

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Rubella*	2	5	I-10 more codes/more specific
Scombroid fish poisoning	2	5	I-10 more specific for fish type
Smallpox*	5	2	I-9 more codes /more specific but could be due to smallpox being eradicated
Sporotrichosis	2	5	I-10 more codes/more specific
Staphylococcus aureus	3	5	I-10 more codes/more specific
Streptococcal infections*	3	5	I-10 has more codes; descriptions are different
Syphilis*	3	5	I-10 more specific with more specific categories
T-2 mycotoxins	1	5	Not captured at all in I-9
Tetanus*	3	5	I-10 has more codes related to OB and the neonate
Toxins (Ricin, <i>S. enterotoxin</i>)	2	4	I-10 more detailed; includes use of extensions for initial encounter
Tularemia*	4	5	Captured by both; I-10 one more code
Typhoid*	2	5	I-10 more codes/more specific
Typhus, louse-borne	4	5	I-10 more specific with one more code
Vaccine adverse reactions	5	3	I-9 descriptions provide more detail about the virus the vaccine is protecting against while I-10 group many together
Varicella*	4	5	I-10 has one more code; varicella keratitis
Viral hemorrhagic fever	2	5	I-10 more specific with many more codes

*CDC National Reportable Disease

** Multiple S codes by site. ICD-10 is more specific. Also, ICD-10 spans Tcodes and W codes. Over 100 codes that deal with bites and area of effect for I-10.

Ranking:

5= Diagnosis is fully captured by the code/codes

4=Diagnosis is almost fully captured by the code/codes

3=Diagnosis is partially captured by the code/codes

2=Diagnosis is less than partially captured by the code/codes

1=Diagnosis is not captured by the code/codes

Table 4 displays those reportable diseases that are ranked the same in ICD-9-CM and ICD-10-CM but still do not fully capture the true description of the illness. It can be seen that several diseases are not captured at all by either system. These include: anaplasmosis,

basidiobolomycosis, campylobacteriosis, emerging or exotic disease, Nipah virus, norovirus, and waterborne and all “other” outbreaks.

Table 4: National Reportable Diseases Not Fully Captured by Either Coding System

National Health Reportable Diseases	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Anaplasmosis	1	1	Not captured by either system
Aseptic Meningitis	3	3	Codes and descriptions different
Basidiobolomycosis	1	1	Not captured by either system
Campylobacteriosis	1	1	Not captured by either system
Emerging or exotic disease**	1	1	Not captured by either system
Influenza like illnesses*	4	4	Captured by both systems but in I-9, there is a code for influenza with pneumonia and in I-10 it is coded as influenza with respiratory manifestations without another specific code for influenza with pneumonia. I-10 includes a code for influenzal gastroenteritis and I-9 does not
Nipah virus	1	1	Not captured by either system
Norovirus	1	1	Not captured by either system
Outbreaks waterborne	1	1	Not captured by either system
Outbreaks– all other	1	1	Not captured by either system
Mucopurulent cervicitis	4	4	Neither specify mucopurulent, only capture cervicitis
Vancomycin-resistant enterococci*	3	1	Found in I9 under “Infections with microorganisms resistant to other specified drugs”

*CDC National Reportable Disease

** Could be used as a placeholder for future code additions.

Ranking:

5= Diagnosis is fully captured by the code/codes

4=Diagnosis is almost fully captured by the code/codes

3=Diagnosis is partially captured by the code/codes

2=Diagnosis is less than partially captured by the code/codes

1=Diagnosis is not captured by the code/codes

The following tables (Table 5 - 9) break out the ranked differences for each of the top ten diagnoses that are related to mortality, such as accidents, cerebrovascular disease and so forth.

These results demonstrate that ICD-10-CM fully captures more of the diagnoses related to mortality than ICD-9-CM. It can also be seen that ICD-10-CM provides more codes, specificity,

categories, and explicit terminology than ICD-9-CM. There was only one diagnosis; chronic renal failure, that was not fully captured by ICD-10-CM. However, chronic renal failure is no longer recognized in the clinical classification of chronic kidney disease and the clinical classification of chronic kidney disease has changed since the development of ICD-10-CM, so the decreased specificity in ICD-10-CM is related to changes in medicine since the development of ICD-10-CM rather than an intention to be less specific.

It is also important to note that when examining Asthma (Table 9), the terminology between the two systems differs a great deal. This is because the terminology and code structure reflect the current clinical classification of asthma whereas the terminology and codes in ICD-9-CM do not. This has important implications for public health because if you are using ICD-9-CM codes to analyze treatment outcomes, prevalence of asthma in the population, and occurrences of acute episodes of asthma, you are not examining the correct clinical categorization.

Table 5: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Top 10 Diagnoses Related to Mortality: **Accidents**

Top 10 Diagnoses Related to Mortality: Accidents	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Pedestrian Injured in Collision with Pedal Cycle	3	5	I-10 many more codes/more specific
Pedestrian Injured in Collision with two or three wheeled motor vehicle	3	5	I-10 many more codes/more specific; no codes in I-9 to state that it is unspecified whether traffic or nontraffic
Pedestrian Injured in Collision with car, pickup, or van	4	5	Number of codes same but I-10 description more detailed
Motor vehicle related	3	5	I-10 much more specific and includes injury; no codes in I-9 to state that is unspecified whether traffic or nontraffic
Pedestrian injured in collision with heavy transport vehicle or bus	3	5	I-10 more codes/more specific
Pedestrian injured in collision with railway train or railway vehicle	3	5	I-10 provides more codes/categories
Pedestrian injured in collision with other non-motor vehicle	3	5	I-10 provides more categories with more descriptive terminology

Pedestrian injured in other and unspecified transport accidents; pedal cycle rider injured in transport accident	3	5	I-10 more descriptive with add'l codes
Pedal cycle rider injured in collision with pedestrian or animal	2	5	I-10 more descriptive with add'l codes
Pedal cycle rider injured in collision with other pedal cycle	3	5	I-10 more descriptive with add'l codes
Pedal cycle rider injured in collision with two or three wheeled motor vehicle	3	5	I-10 more descriptive with add'l codes
Pedal cycle rider injured in collision with car, pick-up truck, or van	3	5	I-10 more descriptive with add'l codes
Pedal cycle rider injured in collision with railway train or railway vehicle	3	5	I-10 more descriptive with add'l codes
Motor vehicle related (fractures and other injuries)	3	5	I-10 much more descriptive with add'l codes
Falls	3	5	Although number of codes do not differ much, I-10 has more detailed terminology

5= Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Table 6: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Top 10 Diagnoses Related to Mortality: **Cerebrovascular Disease**

Top 10 Diagnoses Related to Mortality: Cerebrovascular Disease	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Subarachnoid hemorrhage	3	5	I-10 much more specific with many more codes
Intracerebral hemorrhage	3	5	I-10 much more specific with many more codes
Other intracranial hemorrhage	3	5	I-10 more specific with more codes
Cerebral infarction	3	5	Difficult to do code to code comparison since I-10 categories are different but I-10

			much more specific
Occlusion and stenosis for precerebral arteries not resulting in cerebral infarction	2	5	I-10 more specific with categories differentiating between right and left side etc.
Occlusion and stenosis for precerebral arteries resulting in cerebral infarction	2	5	I-10 more specific with categories differentiating between right and left side etc.
Occlusion and stenosis for precerebral arteries right, left, bilateral	2	5	I-10 more specific with categories differentiating between right and left side etc.
Cerebrovascular disorders in diseases classified elsewhere	1	5	Captured only by I-10
Sequelae of cerebrovascular disease	3	5	I-10 differentiates between non-traumatic, hemorrhages etc. while I-9 puts all CVAs together

5= Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Table 7: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Top 10 Diagnoses Related to Mortality: **Nephritis**

Top 10 Diagnoses Related to Mortality: Nephritis	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Acute nephritic syndrome	2	5	I-10 terminology different and much more specific
Rapidly progressive nephritic syndrome	1	5	No detailed category for this in I-9
Recurrent and persistent hematuria	1	5	No specific code for this in I9, only states “hematuria”, I-10 more specific with add’l codes
Chronic nephritic syndrome	2	5	I-10 terminology different and much more specific
Nephritic syndrome	4	5	I-10 terminology different and much more specific
Unspecified nephritic syndrome	4	5	I-10 terminology different and much more specific
Isolated proteinuria with specified morphological lesion	1	5	No specific code for this in I9 only states “proteinuria”, I-10 more specific with add’l codes
Chronic renal failure	4	3	More specificity in I-9 but chronic renal disease is now used with different stages and

			this change was made after the development of I10
Unspecified contracted kidney	3	5	Codes similar except “page kidney” no code in I-9
Hereditary nephropathy, NEC	1	5	No specific code for this in I9, only states “other specified congenital abnormalities”, I-10 more specific with add’l codes

5= Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Table 8: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Top 10 Diagnoses Related to Mortality: **Heart Disease and Top 5 Cancers**

Top 10 Diagnoses Related to Mortality: Heart Disease and Cancers	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Angina	4	5	Both similar but I-10 has a unique code for angina pectoris with documented spasm
Diseases of Arteries: Atherosclerosis	4	5	I-10 differentiates between R & L leg
Diseases of Arteries: Aortic aneurysm	3	5	I-10 more specific differentiating between R & L
Rheumatic heart disease and rheumatic fever	4	5	Similar for both but I-10 provides more specificity for other and unspecified mitral valve diseases
Cancers			
Malignant Neoplasm of Lung	2	5	I-10 much more specific and breaks out each anatomic category for both right and left side
Malignant Neoplasm of Breast	3	5	I-10 much more specific and breaks down category by right and left side, male and female

5= Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Table 9: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Top 10 Diagnoses Related to Mortality: **(Alzheimer’s, Chronic lower respiratory disease, Diabetes, Influenza)**

Top 10 Diagnoses Related to Mortality	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Alzheimer's Disease	3	5	I-10 more specific with add'l codes
Bronchitis: chronic and acute	4	5	Most similar between two systems
Emphysema	4	5	I-10 more specific with add'l codes
Other COPD	2	5	I-10 much more specific with add'l codes
Asthma	2	5	I-10 much more specific with add'l codes; terminology differs between two systems Terminology and code structure in ICD-10 reflects the current clinical classification of asthma, whereas the terminology and codes in ICD-9 do not
Bronchiectasis	4	5	I-10 more specific with add'l codes; terminology slightly different
Type I DM	4	5	I-10 terminology more detailed and offers more codes within subcategories
Type II DM	4	5	I-10 terminology more detailed and offers more codes within subcategories
Other unspecified DM	1	5	This category does not exist in I-9
Unspecified DM	3	5	I-9 Type II and Unspecified type are classified together under 5 th digit of "0", I-10 breaks them into separate categories
Influenza	4	5	I-10 more specific with add'l code

5= Diagnosis is fully captured by the code/codes
4=Diagnosis is almost fully captured by the code/codes
3=Diagnosis is partially captured by the code/codes
2=Diagnosis is less than partially captured by the code/codes
1=Diagnosis is not captured by the code/codes

Improvements in the ICD-10-CM coding system for diagnoses related to terrorism is needed (Table 10). Even though the ICD-10-CM system captured more of the diagnoses than ICD-9-CM, the overall mean ranking for ICD-10-CM is 4.2, the lowest of any of the other categories reviewed. Improvements include: 1. specifying which type of weapon is used for each of the

explosions; 2. specifying which type of biological, chemical, or nuclear weapon was used; 3. how the aircraft was destroyed; and 4. what caused the explosion or fire. If this information could be added to the description of the code, the ICD-10-CM system would fully capture the necessary information related to terrorism.

Table 10: Differences in Disease Capture by Rank for ICD-9-CM and ICD-10-CM for Diagnoses Related to **Terrorism**

Terrorism	ICD-9-CM Rank	ICD-10-CM Rank	Explanation
Explosion of marine weapons	2	4	I-10 describes who is injured, whether it is initial encounter etc. Does not specify what type of weapon is used
Destruction of aircraft	2	4	Same as above but I-10 does not specify how aircraft was destroyed
Other explosions and fragments	2	4	Same as above but I-10 does not specify what caused the explosion
Fires, conflagration, hot substances	2	4	Same as above but I-10 does not specify the cause
Firearms	2	4	Same as above but I-10 does not specify type of firearm used
Nuclear weapons	2	4	Same as above but I-10 does not specify which type of nuclear weapon is used
Biological weapons	2	4	Same as above but I-10 does not specify which type of biological weapon is used
Chemical weapons	2	4	Same as above but I-10 does not specify which type of chemical weapon is used
Terrorism unspecified	1	5	Not captured in I-9
Sequelae of terrorism	2	5	I-10 uses 7 th digit extension for late effects; I-9 does not capture exact type

5= Diagnosis is fully captured by the code/codes

4=Diagnosis is almost fully captured by the code/codes

3=Diagnosis is partially captured by the code/codes

2=Diagnosis is less than partially captured by the code/codes

1=Diagnosis is not captured by the code/codes

Part II: Validation Study for Public Health Reportable Diagnoses:

Comparisons were made between ICD-9-CM and ICD-10-CM using the AHIMA and AHA Field Testing Project study data. Significant differences in coding between the coder and validator

were found. The average ranking for ICD-9-CM, average percentage of agreement, and kappa values were higher than the average rank, average percentage of agreement and kappa values for ICD-10-CM (Table 11 and 12). Statistically significant differences were found for external causes of injury, diabetes (average rank only), lower respiratory disease, heart disease, malignant neoplasms and other. This type of result is logical to anticipate because the coders in the study were more experienced with the ICD-9-CM system than the ICD-10-CM system due to the current use of ICD-9-CM in healthcare in the United States. However, it also demonstrates how coders may perform when using ICD-10-CM. In this study the coders were trained to use the ICD-10-CM system. The less than equal performance when using ICD-9-CM as compared to ICD-10-CM points to the potential need for more specific coding education and practice with the ICD-10-CM system in order to have accurate coding.

Education and training should focus on the categories in which there were significant differences in the coding such as in external causes of injury, heart disease etc. Also, the tabular index of ICD-10-CM was found to be very cumbersome to navigate. However, ICD10-CM is still, technically a draft and has not been implemented yet and the implementation date is not yet known so the code books, encoding software, and other tools that coders typically use for ICD-9-CM coding purposes are not yet available for ICD-10-CM. Once these coding tools are available for ICD-10-CM, improvements in the navigation of the system will certainly improve. However, product development should aim to increase the accuracy of code assignment particularly in the areas (shown in Table 11) that have statistically significant differences.

Table 11: Differences in Coding Agreement for ICD-9-CM and ICD-10-CM for Public Health Diagnoses

Public Health Categories	ICD-9-CM Rank (Mean)	ICD-10-CM Rank (Mean)	P value
External Causes***	4.85	2.98	<0.001
Alzheimer's	N/A	N/A	N/A
Cerebrovascular	4.64	4.3	0.057
Diabetes*	5	4.55	0.037
Influenza	N/A	N/A	N/A
Lower respiratory disease***	4.95	4.02	<0.001
Nephritis	5	2.33	0.114
Septicemia	N/A	N/A	N/A
Heart Disease***	4.89	4.077	<0.001
Malignant Neoplasms*	4.78	4.27	0.012
Other***	4.8	4	<0.001

P values determined by Mann Whitney U non parametric test:

*Significance: p<0.05

**High Significance: p<0.01

***Very High Significance: p<0.001

N/A – Too few cases

Ranking for Agreement:

5 = All digits are captured by codes assigned

4 = One digit is different between the codes assigned

3 = Two digits are different between the codes assigned

2 = Three digits are different between the codes assigned

1 = >3 digits are different between the codes assigned

Table 12: Differences in Percentage of Agreement and Kappas Between ICD-9-CM and ICD-10-CM

Public Health Categories	ICD9 (mean) % Agreement	ICD-9-CM Kappa (mean)	ICD10 (mean)% Agreement	ICD-10-CM Kappa (mean)	P value for difference in Kappa
External Causes of Injury***	95.3	0.965	14.6	0.153	<0.001
Alzheimer's	N/A	N/A	N/A	N/A	N/A
Cerebrovascular	78.5	0.828	58.9	0.618	.076
Diabetes	100	1	71.5	0.777	.121
Influenza	N/A	N/A	N/A	N/A	N/A
Lower respiratory disease***	95.6	0.965	55.5	0.594	<0.001
Nephritis	100	1	25	0.25	.317
Septicemia	N/A	N/A	N/A	N/A	N/A
Heart disease***	90.5	0.911	42.1	0.483	<0.001
Malignant neoplasms**	90.1	0.914	51.1	0.532	.003
Other***	91.3	0.917	41.3	0.456	<0.001

P values determined by Mann Whitney U non parametric test:

*Significance: p<0.05

**High Significance: p<0.01

***Very High Significance: p<0.001

N/A – Too few cases

It was also important to determine what type of coding differences occurred between the coder and validator when using ICD-10-CM. Many differences were found but the most common ones are listed in Table 13 by public health category. It was found that use of the 7th character extension for initial encounter tended to cause differences between the research coder and the validator. Also, for codes less than 6 digits, a place holder should be assigned, and this also caused differences. These are two new coding rules within ICD-10-CM and this could be why they frequently differed. Other differences include choosing a code that may be more or less specific than the validator. Within the external causes of injury category, specificity related to the cause of the injury led to differences as well as the deactivation of certain codes such as in the

X50 area which were replaced by Y92-93 codes. Other differences were grouped into a category called “Variation in Code” simply because the two codes chosen did not match in relation to the disease description. Also, some differences occurred because an additional code was not included when needed or when an additional code was added when it was not necessary.

Table 13: Description of Most Common Differences Between Coder and Validator for ICD-10-CM Public Health Diagnoses:

Description of Coding Differences	Category Where Most Differences Occurred
7th character extension for initial encounter, required by ICD10	External Causes of Injury Heart Disease Other
For codes less than 6 characters that require a 7th character extension a place holder x should be assigned for all characters less than 6.	External Causes of Injury Other Heart Disease
Specificity of right and left side as well as region of body, type of infection etc.	Other Heart Disease External Causes of Injury Lower Respiratory Disease Cerebrovascular Diabetes Malignant neoplasms Nephritis
More specific causes	External Causes of Injury
Deactivation of codes in tabular	External Causes of Injury
Variation in code description	Other Heart Disease Lower Respiratory Disease Cerebrovascular Malignant neoplasms External Causes of Injury
Missing additional code	Other Heart Disease Lower Respiratory Disease Cerebrovascular Diabetes Nephritis Malignant Neoplasms
Additional code not necessary	Other Lower Respiratory Disease Heart Disease

V. LIMITATIONS:

As with any research study there are always limitations to the study design. Some limitations to this study include:

1. Examining only a sample of public health related diagnoses
2. Rankings for both coding systems for public health related diseases, top ten causes of mortality and diseases related to terrorism may be subjective when assigned.
3. Possibly missing some of the ICD-10-CM codes since this tabular list is very difficult to navigate and the latest version is from 2003.

VI. CONCLUSION:

This is certainly the time for the use of new, extensive, specific, coding systems such as ICD-10-CM. With President Bush stating that all Americans should have an EHR in the next ten years, the ICD-10-CM system is definitely needed. As this study demonstrates, the use of ICD-10-CM has great implications for our entire nation since public health diagnoses, which include epidemics and other diagnoses that relate to bioterrorism, are generally captured in a more specific way when using the ICD-10-CM system. This could be seen for all public health reportable diseases, diseases related to the top ten causes of mortality and diseases related to terrorism. Also, the differences found within this study were statistically significant for public health reportable diseases, accidents, cerebrovascular, diabetes mellitus, lower respiratory, nephritis, heart disease and terrorism related diagnoses. However, there were some public health related diseases that were not fully captured by ICD-10-CM. These include: basidiobolus, histoplasmosis, hypothermia, outbreak illnesses in child care settings, pediculosis, plague, poliomyelitis, perinatal exposure of newborn to HIV, smallpox, toxins (Ricin, *S. enteroxin*), Vancomycin resistant enterococci (VRE) and vaccine adverse reactions. It was also found that some public health diseases were not captured at all by either system. These include: anaplasmosis, basidiobolomycosis, campylobacteriosis, emerging or exotic disease, Nipah virus, norovirus, waterborne and all “other” outbreaks.

It is recommended that NCHS evaluate the specificity for those conditions that are less specific in ICD-10-CM and determine whether additional specificity should be added. However, the less specificity found in some ICD-10-CM codes may be intentional due to a valid reason. For

example, perhaps the greater specificity found in ICD-9-CM was determined to no longer be clinically significant or represents outdated thinking.

Also, ICD-9-CM is updated annually, whereas the most recent version of ICD-10-CM available is from 2003. It is possible that some of the differences in specificity relate to changes that have been made to ICD-9-CM since ICD-10-CM was developed. It is assumed that whenever updates are made to ICD-9-CM that are not already reflected in ICD-10-CM, corresponding modifications will also be made to ICD-10-CM, but this will not be known for certain until a new version of ICD-10-CM is made available.

When examining the differences in coding for the top ten causes of mortality, it was found that ICD-10-CM fully captures more of the diagnoses related to mortality than ICD-9-CM. It can also be seen that ICD-10-CM provides more codes, specificity, categories, and explicit terminology than ICD-9-CM. Only one diagnosis, chronic renal failure, was not fully captured by ICD-10-CM. However, chronic renal failure is no longer recognized in the clinical classification of chronic kidney disease and the clinical classification of chronic kidney disease has changed since the development of ICD-10-CM, so the decreased specificity in ICD-10-CM is related to changes in medicine since the development of ICD-10-CM rather than an intention to be less specific.

It is also important to note that when examining Asthma, the terminology between the two systems differs a great deal. This is because the terminology and code structure reflect the current clinical classification of asthma whereas the terminology and codes in ICD-9-CM do not. This has important implications for public health because using ICD-9-CM codes to analyze treatment outcomes, prevalence of asthma in the population, and occurrences of acute episodes of asthma, would not provide the correct clinical categorization.

Improvements to the ICD-10-CM coding system are needed for diagnoses related to terrorism. Improvements include: specifying which type of weapon is used for each of the explosions as well as which type of biological, chemical, or nuclear weapon was used, how the aircraft was destroyed and what caused the particular explosion or fire.

When comparing coder agreement from the AHA and AHIMA ICD-10-CM Field Testing Project study data cases, it was found that the ICD-9-CM had higher levels of agreement than ICD-10-CM. This finding was expected but is also important in that it provides insight regarding

areas of focus for education. The areas that appear to need education may include external causes of injury, diabetes, lower respiratory disease, heart disease, and malignant neoplasms since each of these categories showed statistically significant differences in coder agreement between ICD-10-CM and ICD-9-CM. Other areas needing educational attention include the use of the 7th character extension, use of a placeholder, use of additional codes and overall use of greater specificity. However, it is also important to note that even though ICD-10-CM is more specific, it may be less useful if less reliable. The finding that ICD-9-CM has higher kappa between the different coders may mean that while ICD-9-CM descriptors may seem less specific, there is strong agreement between coders. However, this finding may be present because coders within this study were more familiar and more educated on the ICD-9-CM coding system than the ICD-10-CM system.

Another important point is that there will be a new draft version of ICD-10-CM available soon and some of the improvements discussed here may be incorporated into this new version. It is not certain how this will impact the results of this report with respect to codes relevant for public health reporting.

This study provides needed guidance regarding which specific disease codes are lacking in the ICD-10-CM coding system. The findings and recommendations in this study will provide guidance to health care and public health stakeholders so that improvements to the coding system and education related to its implementation can be addressed. These changes will facilitate a smooth transition from the use of ICD-9-CM to ICD-10-CM.

Endnotes

¹ NCHS, <http://www.cdc.gov/nchs/about/otheract/icd9/abtcd10>

² CMS, <http://www.cms.hhs.gov/providers/pufdownload/icd10.asp>

³ AHA and AHIMA, ICD-10-CM Field Testing Project Summary Report, September 23, 2003 pgs. 26-30.

⁴ National Vital Statistics Report, CDC “Deaths: Leading Causes for 2002, Vol.53 No. 17., March 7 2005, pg. 1.

⁵ ICD-10-CM Update: From the ICD-9-CM Coordination and Maintenance Meeting, November 2, 1999