

Learning from ICD-10 to Prepare for ICD-11:

Literature Review on the Impact of the Transition to ICD-10 and
ICD-10-CM/PCS

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BACKGROUND



METHODS



RESULTS



CONCLUSIONS

International Classification of Diseases (ICD)

- Standardized system for reporting health conditions and diseases
- Used by over 100 countries
- Maintained by the World Health Organization
- Undergoes periodic updates



Significance

Used by:



HOSPITALS



HEALTHCARE
PROVIDERS



RESEARCHERS



GOVERNMENT



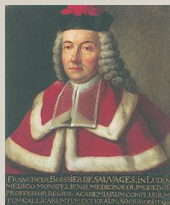
MEDIA



PUBLIC

Used for:

- Recording reasons people die
- Monitoring population health
- Detecting changes in disease patterns
- Guiding delivery of services
- Guiding allocation of resources
- Guiding financial decisions about health systems



François Boissier de
Sauvages
Nosologia Methodica



World Health
Organization

Nosologia
Methodica
1763

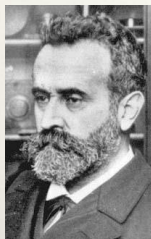
Bertillon
Classification
of Causes of
Death
1893

ICD-6
1948
(WHO)
1949 (U.S.)

ICD-9
1975
(WHO)
1979 (U.S.)

ICD-9-CM
1979 (U.S.)

ICD-10
1990
(WHO)
1999 (U.S.)



Jacques Bertillon
Bertillon Classification
of Causes of Death



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

National Center for Health Statistics

ICD-9 and ICD-10 (Mortality) Comparison

ICD-10



Additions, modifications, and changes to some coding rules and rules for selecting underlying cause of death

	ICD-9	ICD-10
# Categories	5,000	8,000
# Volumes	2	3
Structure	4-digit numeric codes	4-digit alphanumeric codes

ICD-9
1975 (WHO)
1979 (U.S.)

ICD-9-CM
1979 (U.S.)

ICD-10
1990 (WHO)
1999 (U.S.)

ICD-10-CM;
ICD-10-PCS
2015 (U.S.)

 Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

National Center for Health Statistics



ICD-9-CM and ICD-10-CM/PCS Comparison

	ICD-9-CM	ICD-10-CM	ICD-10-PCS
# Diagnosis codes	14,025 codes	69,823 codes	N/A
# Procedure codes	3,824 codes	N/A	71,924 codes
Diagnosis structure	3-5 characters; Character 1 (numeric or alpha); Characters 2-5 (numeric)	3-7 characters; Character 1 (alpha); Character 2 (numeric); Characters 3-7 (alpha or numeric)	N/A
Procedure structure	3-4 characters; numeric	N/A	7 characters; alpha or numeric

Example: Gout

ICD-9-CM	ICD-10-CM
Gouty arthropathy (274.0)	No direct conversion
Gouty nephropathy (274.1X)	No direct conversion
Gout with other specified manifestations (274.8X)	No direct conversion
Gout, unspecified (274.9)	Gout unspecified (M10.9)

ICD-10-CM Code Examples

# Characters	Code	Code	Description
Three characters (base code)	Category of the diagnosis	M1A	Chronic gout
Four characters	Etiology, anatomic site, severity, or other clinical detail	M1A.0	Idiopathic chronic gout
Five characters		M1A.07	Idiopathic chronic gout, ankle and foot
Six characters		M1A.072	Idiopathic chronic gout, left ankle and foot
Seven characters	Extension	M1A.0721	Idiopathic chronic gout, left ankle and foot, with tophus

Example: Knee Replacement

ICD-9-CM	ICD-10-PCS
81.54 – Total knee replacement	0SRD0xx- Replacement of left knee joint 0SRC0xx – Replacement of right knee joint

ICD-10-PCS Code Structure:

Replacement of left knee joint with synthetic substitute, open approach (0SRD0JZ)

Character	Definition	Example
1	Name of section	0 = Medical and Surgical Section
2	Body system	S = Lower Joints
3	Root operation	R = Replacement
4	Body part	D = Knee Joint, Left
5	Approach	0 = Open
6	Device	J = Synthetic Substitute
7	Qualifier	Z = No Qualifier

National Clinical Modifications

Country	Date
Australian Modification (ICD-10-AM)	1998
Canadian Enhancement (ICD-10-CA)	2001
German Modification (ICD-10-GM)	2003-2004
Thai Modification (ICD-10-TM)	2007
Korean Modification (ICD-10-KM)	2008
U.S. Clinical Modification (ICD-10-CM)	2015
U.S. Procedure Coding System (ICD-10-PCS)	2015



Controversy over ICD-10-CM/PCS Implementation

- Concerns
 - Complexity of coding system
 - Costs
 - Reimbursement
 - Time for implementation
- Implementation Delays: Oct. 2013, 2014, 2015



Rand Analysis

Costs

- Training- Coders, code users, physicians
- Productivity losses- Coders, physicians
- System changes- Providers, Software vendors, Payers, CMS

Benefits

- More-accurate payment for new procedures
- Fewer rejected claims
- Better understanding of new procedures
- Improved disease management



Projected Costs of ICD-10-CM/PCS Implementation

Practice size	Definition	2008 estimate	2014 estimate
Small	3 physicians; 2 administrative staff	\$83,290	\$56,639 - \$226,105
Medium	10 physicians, 1 full time coder, 6 administrative staff	\$285,195	\$213,364 - \$824,735
Large	100 physicians, 64 coding staff, 10 full time coders, 54 medical records staff	\$2,728,780	\$2,017,151 - \$8,018,364

ICD-11

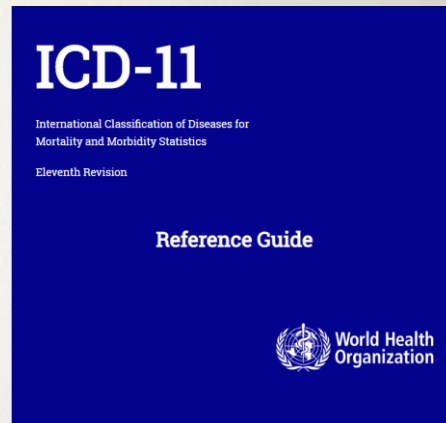
June 2018: ICD-11 was released

May 2019: World Health Assembly agreed to adopt ICD-11

January 2022: Member States will begin reporting with ICD-11

Features of ICD-11:

- Updated to reflect medical, scientific, and technological advances
- 55,000 codes (ICD-10 – 14,400)
- Fully electronic (anticipated to facilitate its ease of implementation and use)



Knowledge Management:

Review the published and gray literature to better understand the impact of the transition to ICD-10 and ICD-10-CM/PCS, including the costs, benefits and challenges.

ICD-9
1975 (WHO)
1979 (U.S.)

ICD-9-CM
1979 (U.S.)

ICD-10
1990 (WHO)
1999 (U.S.)

ICD-10-CM;
ICD-10-PCS
2015 (U.S.)

ICD-11
2022 (WHO)

Gray literature

“That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers”

- 4th International Conference on Grey Literature 1999

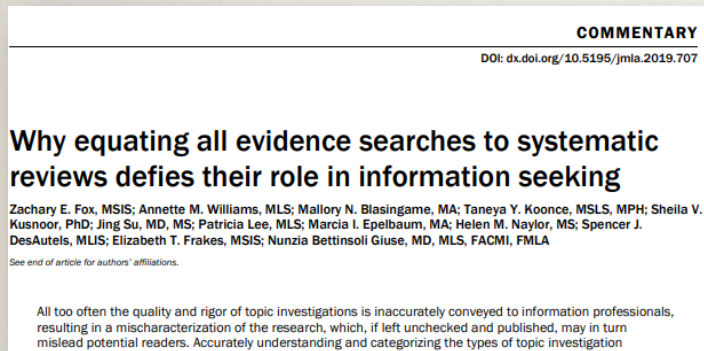
“...literature that is not formally published in sources such as books or journal articles.”

- Cochrane Handbook for Systematic Reviews of Interventions

Gray Literature Tiers (Adams et al., 2016)

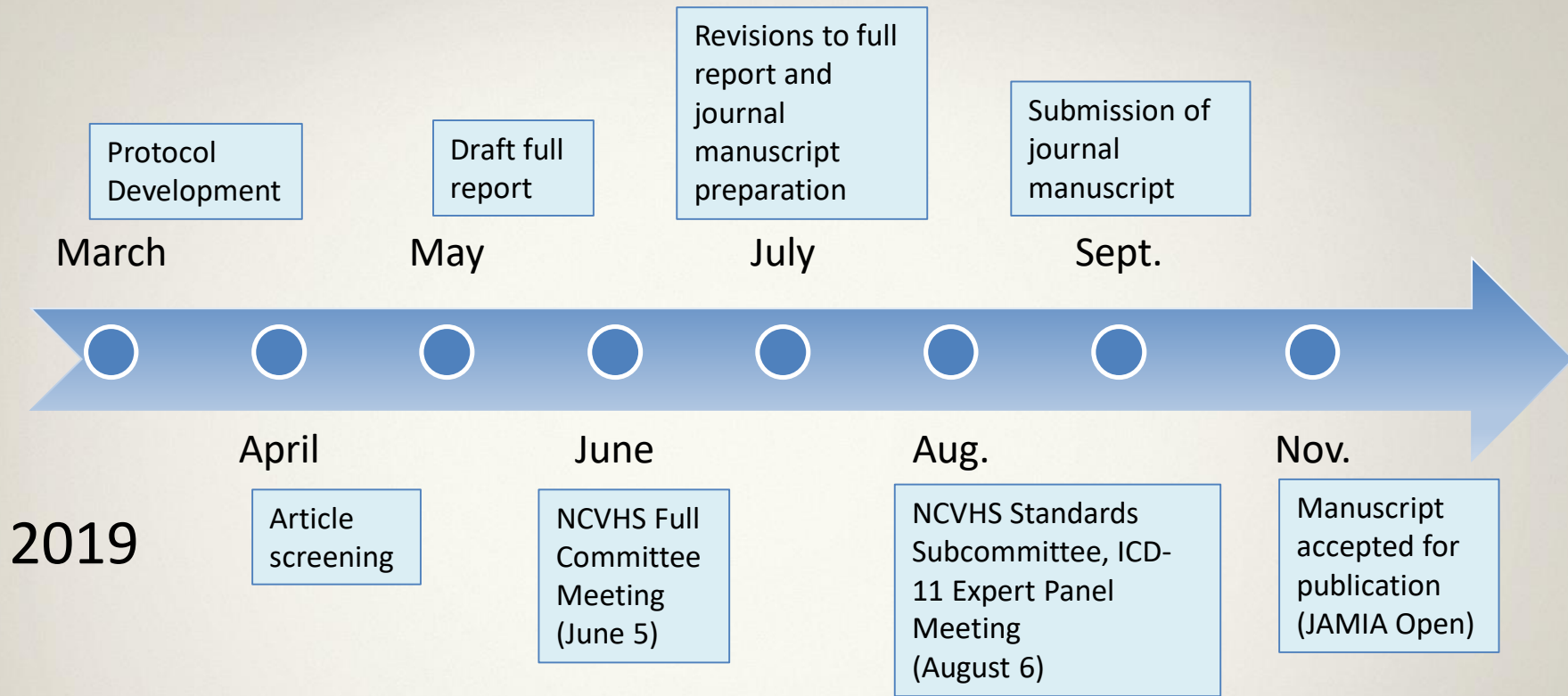
Tier	Definition	Examples
1	Significant retrievability, credibility	Book, book chapters, government reports
2	Moderate retrievability, credibility	Annual reports, news articles, company publications
3	Low retrievability, credibility	Blogs, emails, tweets, letters

Selecting a Review Type



Topic: Review the published and gray literature on the impact of the transition to ICD-10 and ICD-10-CM/PCS, including the costs, benefits and challenges

Category	Systematic Review	Comprehensive Literature Review
Scope	Narrow	Unspecified
Timeline	12-18 months	Rapid
Protocol	Required	Not required
Systematic Database Searching	Required	Typically conducted
Dual reviewer screening of articles	Required	Not required
Strength of the Evidence	Required	Not required



Methods

Search

- PubMed, Web of Science, Business Source Complete
- Government, association, and news websites
- Google search for white papers and presentations
- Hand-search references

Screen

- Address transition impact
- English
- Single reviewer

PubMed:

((("International Classification of Diseases"[mh] OR "International Classification of Diseases"[tiab]) AND ("10"[tiab] OR ten[tiab] OR tenth[tiab] OR 10th[tiab] OR "version 10"[tiab] OR "tenth revision"[tiab] OR "10th revision"[tiab])) OR ICD10[tiab] OR ICD-10[tiab] OR ICD10CM[tiab] OR ICD10-CM[tiab] OR ICD-10-CM[tiab] OR ICD10PCS[tiab] OR ICD10-PCS[tiab] OR ICD-10-PCS[tiab]) AND (change[tiab] OR conversion[tiab] OR convert[tiab] OR converted[tiab] OR converting[tiab] OR crosswalk[tiab] OR crosswalks[tiab] OR implementation[tiab] OR implemented[tiab] OR implementing[tiab] OR map[tiab] OR mapped[tiab] OR mapping[tiab] OR maps[tiab] OR migration[tiab] OR migrations[tiab] OR rollout[tiab] OR switch[tiab] OR switched[tiab] OR switching[tiab] OR transition[tiab] OR transitioned[tiab] OR transitioning[tiab] OR translating[tiab] OR translation[tiab] OR translations[tiab]) AND ("Change Management"[mh] OR "Cost Control"[mh] OR "Cost-Benefit Analysis"[mh] OR "Costs and Cost Analysis"[mh] OR "Data Accuracy"[mh] OR "delivery of health care"[mh] OR "Diffusion of Innovation"[mh] OR "disease management"[tiab] OR "fraudulent claims"[tiab] OR "Health Care Costs"[mh] OR "Health Expenditures"[mh] OR "Health Information Interoperability"[mh] OR "insurance claim reporting"[mh] OR "insurance claim review"[mh] OR "Insurance, Health, Reimbursement"[mh] OR "lessons learned"[tiab] OR "morbidity/statistics and numerical data"[mh] OR "morbidity/trends"[mh] OR "mortality/statistics and numerical data"[mh] OR "mortality/trends"[mh] OR "Organizational Innovation"[mh] OR "Personnel Management"[mh] OR "Population Surveillance"[mh] OR "Quality Indicators, Health Care"[mh] OR "quality of health care"[mh] OR "rejected claims"[tiab] OR "system change"[tiab] OR "system changes"[tiab] OR "Time Factors"[mh] OR "Workforce"[mh] OR accuracy[tiab] OR Administrative data[tiab] OR advantage[tiab] OR advantages[tiab] OR align[tiab] OR alignment[tiab] OR beneficial[tiab] OR benefit[tiab] OR benefits[tiab] OR burnout[tiab] OR "Burnout, Psychological"[mh] OR challenge[tiab] OR challenges[tiab] OR comparability[tiab] OR concordance[tiab] OR cons[tiab] OR consequence[tiab] OR consequences[tiab] OR cost[tiab] OR costs[tiab] OR discontinuities[tiab] OR discontinuity[tiab] OR "economics"[mh] OR "economics"[sh] OR "efficiency"[mh] OR error[tiab] OR errors[tiab] OR financial[tiab] OR harms[tiab] OR impact[tiab] OR implication[tiab] OR Implications[tiab] OR interoperability[tiab] OR issues[tiab] OR limitation[tiab] OR limitations[tiab] OR payment[tiab] OR payments[tiab] OR personnel[tiab] OR problem[tiab] OR problems[tiab] OR productivity[tiab] OR pros[tiab] OR reimbursement[tiab] OR time[tiab] OR training[tiab] OR validation[tiab] OR workforce[tiab] OR "case mix"[tiab] OR "case mixes"[tiab] OR casemix[tiab] OR casemixes[tiab] OR Diagnosis-Related Groups[mh] OR DRG[tiab] OR DRGs[tiab] OR "diagnosis related groups"[tiab] OR "diagnosis-related groups"[tiab] OR "diagnosis related group"[tiab] OR "diagnosis-related group"[tiab] OR "Patient Generated Health Data"[mh]) AND English[la])

Web of Science:

TI=(((("International Classification of Diseases" OR ICD) NEAR (10 OR ten OR tenth OR 10th OR "version 10" OR "10th revision" OR "tenth revision")) OR ICD10 OR ICD-10 OR ICD10CM OR ICD10-CM OR ICD-10-CM OR ICD10PCS OR ICD10-PCS OR ICD-10-PCS)) AND TS=((change OR conversion OR convert OR converted OR converting OR crosswalk OR crosswalks OR implementation OR implemented OR implementing OR map OR mapped OR maps OR mapping OR migration OR migrations OR rollout OR switch OR switched OR switching OR transition OR transitioned OR transitioning OR translating OR translation OR translations) AND ("change management" OR cost OR costs OR accuracy OR delivery OR innovation OR diffusion OR "disease management" OR fraudulent OR expenditures OR interoperability OR "claim reporting" OR "claim review" OR reimbursement OR "lessons learned" OR morbidity OR mortality OR surveillance OR quality OR rejected OR rejection OR rejections OR "system change" OR "system changes" OR time OR workforce OR "administrative data" OR advantage OR advantages OR align OR alignment OR beneficial OR benefit OR benefits OR burnout OR challenge OR challenges OR comparability OR concordance OR cons OR consequence OR consequences OR discontinuities OR discontinuity OR economics OR efficiency OR error OR errors OR financial OR harms OR impact OR implication OR implications OR issues OR limitation OR limitations OR payment OR payments OR personnel OR problem OR problems OR productivity OR pros OR training OR validation OR "case mix" OR "case mixes" OR casemix OR casemixes OR "diagnosis-related groups" OR "diagnosis-related group" OR DRG OR DRGs OR "diagnosis related group" OR "diagnosis related groups"))

Business Source:

TI (((("International Classification of Diseases" OR ICD) AND (10 OR ten OR tenth OR 10th OR "version 10" OR "10th revision" OR "tenth revision")) OR ICD10 OR ICD-10 OR ICD10CM OR ICD10-CM OR ICD-10-CM OR ICD10PCS OR ICD10-PCS OR ICD-10-PCS) AND TI (change OR conversion OR convert OR converted OR converting OR crosswalk OR crosswalks OR implementation OR implemented OR implementing OR map OR mapped OR maps OR mapping OR migration OR migrations OR rollout OR switch OR switched OR switching OR transition OR transitioned OR transitioning OR translating OR translation OR translations)

POTENTIAL OUTCOMES OF INTEREST

#	Outcomes	Definition
1	Training	Costs of training coders, code users (such as employees of payer organizations), and physicians ¹
2	Productivity	Impact on productivity of coders and clinicians (time required to code; need for physician input on coding) ¹
3	Staffing	Impact on staffing needs due to changes in productivity ²
4	System changes	Costs due to changes in billing and administrative systems to handle the new codes, software changes, and testing system changes ^{1,3}
5	Reimbursement	Impact of the ICD-10-CM & ICD-10-PCS code sets on DRG grouper logic and prospective payment calculation; accuracy of payments for new procedures; miscoded, rejected, and improper reimbursement claims ^{1,2}
6	Coding accuracy	Impact on coding errors or level of coding detail/specificity ⁴
7	Mapping between ICD-9 and ICD-10	Complexities of mappings between the two versions ⁵
8	Disease surveillance/management	Ability to identify patients in need of disease management and to provide tailored disease management programs; ability to track outcomes of care and compare data over time; tracking of emergent diseases ¹
9	Other	Articles that still address the impact of ICD-10, ICD-10-CM, or ICD-10-PCS implementation, but do not address the categories listed above

¹Libicki M, Brahmakulam I. The Costs and Benefits of Moving to the ICD-10 Code Sets. Rand Science and Technology Technical Report prepared for the Department of Health and Human Services, March 2004.

²Stanfill MH, Hsieh KL, Beal K, Fenton SH. Preparing for ICD-10-CM/PCS implementation: impact on productivity and quality. Perspect Health Inf Manag. 2014 Jul 1;11:1f.

³Workgroup for Electronic Data Interchange (WEDI) Strategic National Implementation Process ICD-10 Workgroup - Testing Subworkgroup. Testing: lessons learned from ICD-10 [Internet]. Reston (VA): WEDI; 2016 Apr 29

⁴Foley, Margaret M. DRG grouping and ICD-10-CM/PCS. J AHIMA. 2015 Jul;86(7):56-59.

⁵Butler R. The ICD-10 General Equivalence Mappings. Bridging the translation gap from ICD-9. J AHIMA. 2007 Oct;78(9):84-5.

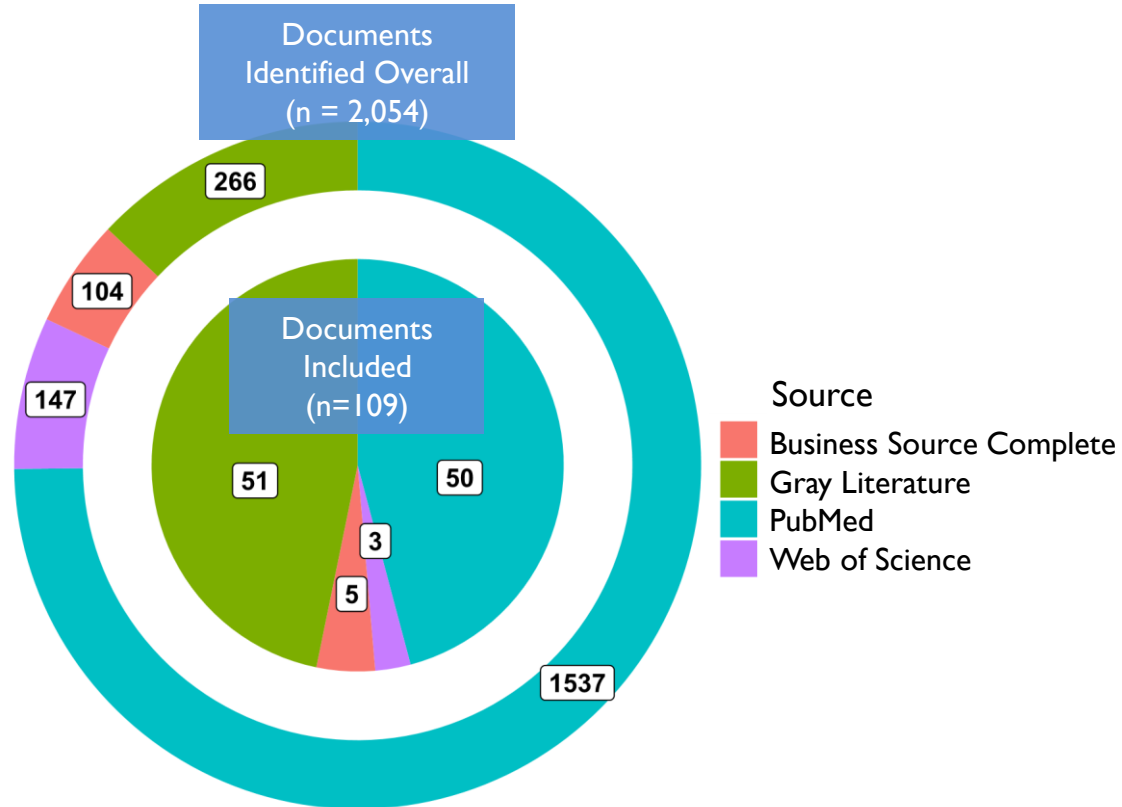
Document Identification and Selection

Identified 2,054 documents total

Included 109 documents after screening according to eligibility criteria

- 51 documents- Gray literature
- 58 documents- PubMed, Web of Science, or Business Source Complete

Classified 78 key reports



Impact area	Total Reports N	U.S. ICD-10- CM/PCS n (%)	U.S. ICD-10 n (%)	International n (%)
1. Morbidity surveillance	24	23 (96%)	N/A	1 (4%)
2. Reimbursement	16	16 (100%)	N/A	0 (0%)
3. Productivity	13	11 (85%)	0 (0%)	2 (15%)
4. Mortality surveillance	13	N/A	6 (46%)	7 (54%)
5. Coding accuracy	12	8 (67%)	0 (0%)	4 (33%)
6. Costs	7	7 (100%)	0 (0%)	0 (0%)
7. Mapping between versions	4	3 (75%)	0 (0%)	1 (25%)
8. Patient care	2	2 (100%)	N/A	0 (0%)
9. Staffing	1	1 (100%)	0 (0%)	0 (0%)



AUSTRALIA

Phased implementation beginning in 1998

Training & productivity:

Anecdotal report (Innes et al., 2000):

- 2 year lead time was insufficient
- Minimum of 12 weeks to adjust to the new system.



Canada

Phased implementation beginning in 2001

Productivity impact:

Humber River Regional Hospital (605 beds; Johnson 2004)

- Initial decrease in coding productivity
- Observed improved productivity at 3-6 months post-implementation
- At 1 year, productivity levels were still not back to pre-ICD-10 levels

Coding accuracy impact:

Reviewed 4,008 charts from four teaching hospitals (Quan et al., 2008)

- Used dual coded database: ICD-10-Canadian Enhancement (ICD-10-CA); ICD-9-CM
- Assessed presence or absence of 32 conditions and assessed agreement between ICD-9-CM or ICD-10-CA data and chart data
- Calculated sensitivity and positive predictive value of ICD-9-CM and ICD-10-CA

ICD-10 Conversion Impact: Mortality Surveillance

Compared ICD-9 vs. ICD-10 using U.S. death certificates (1996):

- Discontinuities in cause-of-death trends
- Impacted rankings of top causes of death

Rank	ICD-9	ICD-10
6	Pneumonia and influenza	Diabetes mellitus
7	Diabetes mellitus	Influenza and pneumonia
8	HIV infection	Alzheimer's disease
9	Suicide	HIV disease
10	Chronic liver disease and cirrhosis	Intentional self-harm (suicide)

Survey Studies Addressing the Impact of the ICD-10-CM/PCS Implementation

Reference	Population (N)	Survey dates	Training	Productivity	Staffing	System changes	Reimbursement	Coding accuracy	Conversion costs	Patient care
Health Care Collector, 2016	Change Healthcare clients (Not reported)	Nov. 2015		X						
Navicare, 2016	Physician practices (N=360)	Dec. 2015	X	X		X	X		X	
Healthcare Billing and Management Association (Louie, 2016)	Billing companies (N=38)	Feb. 2016		X	X	X	X	X		
Workgroup for Electronic Data Interchange, 2016	Respondents from vendor/clearinghouse, health plans, providers (N=66)	March 2016		X		X			X	
The Physicians Foundation, 2016	Physicians (N=17,236)	April-June 2016		X			X			X
Rudman et al., 2016	Coding professionals (N=156)	June 2016		X				X		

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes

Mainor et al., 2018

- Evaluated inpatient Medicare data from 2012-2015
- Observed sudden changes in the frequencies of certain diseases in the fourth quarter of 2015
- Range of discontinuities: -8.9% (cardiac arrhythmias) to +10.9% (psychoses)

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact

Impact on claims rejections or denials – mixed (4 retrospective studies; 3 surveys)

Two survey studies, >50% of respondents reported minimal/no impact on revenue
(Navicure, 2016; The Physicians Foundation, 2016)

Retrospective study of an ophthalmology practice found no impact on overall revenue based on a comparison of the period 12 months before and after ICD-10-CM/PCS conversion (Hellman et al., 2018)

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery

Physician's Foundation 2016 biennial survey (N=17,236) found that ~43% of respondents reported that ICD-10 detracted from efficiency, and 6% reported that it improved efficiency.

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data
5. Cost- varied; delays increased costs

Costs for small practices (276 small practices; Blanchette et al., 2006)

- Dec. 2014 – Jan. 2015
- Average costs: \$8,168 per practice

Navicare survey study (360 healthcare organizations; Navicare 2015)

- Dec. 2015
- Reports of costs ranged from none to >\$200,000

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data
5. Cost- varied; delays increased costs
6. Mapping- many codes lacked straightforward mapping

ICD-9-CM to ICD-10-CM (Boyd et al., 2013)

- 36% convoluted
- 63% simple
- 1% no mapping

ICD-9-CM-Vol3 to ICD-10-PCS (Boyd et al., 2018)

- 55% convoluted
- 40% simple
- 5% no mapping

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data
5. Cost- varied; delays increased costs
6. Mapping- many codes lacked straightforward mapping
7. Patient care- negative impact

Physician's Foundation 2016 Survey
(N=17,236 physicians)

- Nearly 30% reported it detracted from patient care

Physician social media network SERMO
Nov. 2015 poll (N=1,249 physicians):

- Nearly 2/3 indicated it took time away from patient care

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data
5. Cost- varied; delays increased costs
6. Mapping- many codes lacked straightforward mapping
7. Patient care- negative impact
8. Staffing- insufficient data

Alabama Hospital Survey (43 responding organizations)

- Dec. 2011- Feb. 2012
- 35% planned to hire more coders
- 18% planned to increase hours for coding staff

ICD-10-CM/PCS Transition

1. Morbidity surveillance- impact for some health outcomes
2. Reimbursement- varied; some reported little impact
3. Productivity- initial loss; recovery
4. Coding accuracy- insufficient data
5. Cost- varied; delays increased costs
6. Mapping- many codes lacked straightforward mapping
7. Patient care- negative impact
8. Staffing- insufficient data

Evidence:

Non peer-reviewed literature

Survey studies

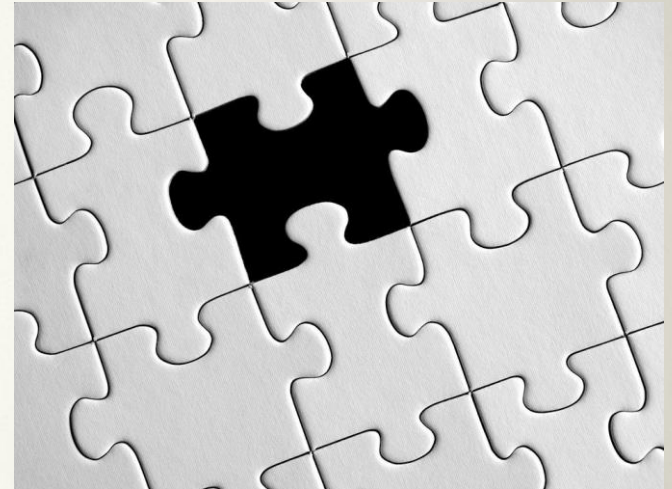
Retrospective reviews

Meta-analysis would not be feasible

No prospective studies

Knowledge Gaps

- **Costs** for organizations of various sizes
- Impact on **staffing**
- Impact on **coding accuracy**
- How **patient care** was impacted
- Extent of disruptions in **morbidity and mortality** surveillance



Conclusion

- Significant gaps in the literature
- Opportunities for future research and knowledge sharing
- Much of the data was qualitative, except morbidity/mortality surveillance
- Need for better reporting of data



Acknowledgements

Center for Knowledge Management (CKM)

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Chair:

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Professor of Medicine
Vanderbilt University Medical Center

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Panelists**

June and August 2019 NCVHS
Meetings