

Automating the Multiple Primary Rules

Peter Ransdell, MS
Frances Ross, BA, CTR
Kentucky Cancer Registry
Markey Cancer Center
University of Kentucky

NAACCR 2015 Annual Conference
Charlotte, NC – June 15-19, 2015

The logo for UK HealthCare Markey Cancer Center is displayed within a dark blue rounded rectangle. The text "UK HealthCare" is in a large, white, sans-serif font, with the "U" and "K" being significantly larger and more prominent. Below it, "Markey Cancer Center" is written in a smaller, white, serif font.

UK HealthCare
Markey Cancer Center

SEER Multiple Primary Rules

- Project was sponsored by the National Cancer Institute (NCI) Surveillance Epidemiology and End Results (SEER) Program
 - Rules were developed with input from a large diverse group of contributors
 - SEER registries
 - American College of Surgeons (ACoS) Commission on Cancer (CoC)
 - American Joint Committee on Cancer (AJCC)
 - Centers for Disease Control and Prevention (CDC) National Program of Cancer Registries (NPCR)
 - National Cancer Registrars Association (NCRA)
 - North American Association of Central Cancer Registries (NAACCR)
 - Canadian Cancer Registries (CCR)
 - Other registry, clinical, and research experts

SEER Multiple Primary Rules

- Rules were established for use in determining whether two cancer records indicate a single primary or separate primaries
- There are multiple rules sets that each apply to cases within different ranges of diagnosis years
- Each rule set is divided into rule groups that each apply to cases with specific types of cancer
- Rules are documented using detailed step-by-step instructions

Florida Cancer Data System (FCDS)

- FCDS implemented automated 2007 MP rules
 - Project was started in early 2007 and in production by mid 2008
 - Contributors
 - Gary Levin, BA, CTR
 - Mayra Alvarez, RHIT, CTR
 - Meg Herna, BA, CTR
 - Jill MacKinnon, PhD, CTR
 - Sarah Manson, BS, RHIT, CTR
 - Mehrdad Nadji, MD
 - Wendy Scharber, RHIT, CTR
 - Brad Wohler, MS
 - Minnesota Cancer Surveillance System

KCR FCDS MP Rules Test

- FCDS provided MP rule code to KCR for testing in 2012
 - Project goals
 - Provide feedback to FCDS on their MP algorithm implementation
 - Determine if automated MP rules would be beneficial for use at KCR
 - Code was ported from Oracle tables and procedures to java for KCR use
 - Testing
 - The automated rules were tested on central registry cases
 - Results were manually reviewed by an experienced CTR
 - No problems were found with the algorithm for KCR cases with diagnosis year 2007 and later
 - The automated rules identified 72 cases in the KCR database that were loaded as a new primary but should have been linked to an existing case

KCR Automated MP Rules

- KCR decided to implement automated MP rules
- Development goals
 - Implement MP rules for linking cases from 1988-present
 - Design maintainable and extensible code
 - Provide straightforward mapping between the code and specifications
 - Return results which include the applicable MP rule set, group, and rule number
 - Develop the application as a standalone component

MP Rule Groups Implemented

- 2014 Hematopoietic Rules
- 2007 MP Rules
 - Head And Neck, Colon, Lung, Melanoma, Breast, Kidney, Urinary, Benign Brain, Malignant Brain, and Other Sites
- 2004 MP Rules
 - Solid Malignant Tumors and Benign Brain
- 2001 Hematopoietic Rules
- 1998 Hematopoietic Rules

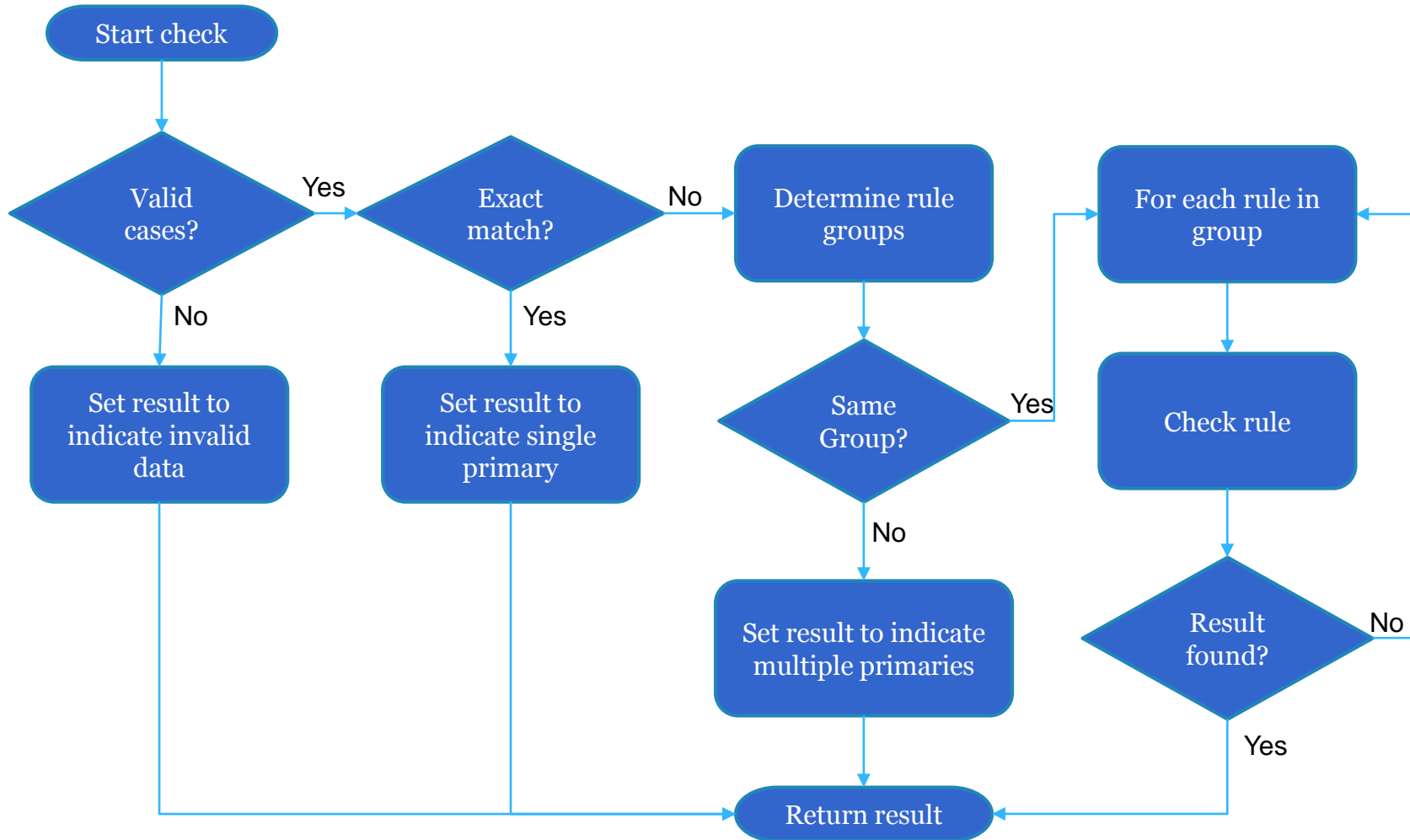
Implementation Details

- Java language was used for code development
- Each rule group is implemented in a separate java class with a name that identifies the rule set and rule group
 - For example MPRules2007Lung
- Each rule is implemented in a separate method with a name that identifies the rule number
 - For example checkRuleM8
- SEER Data Utility java library is used to perform hematopoietic database lookups
 - Provided by SEER
 - Implemented and supported by IMS

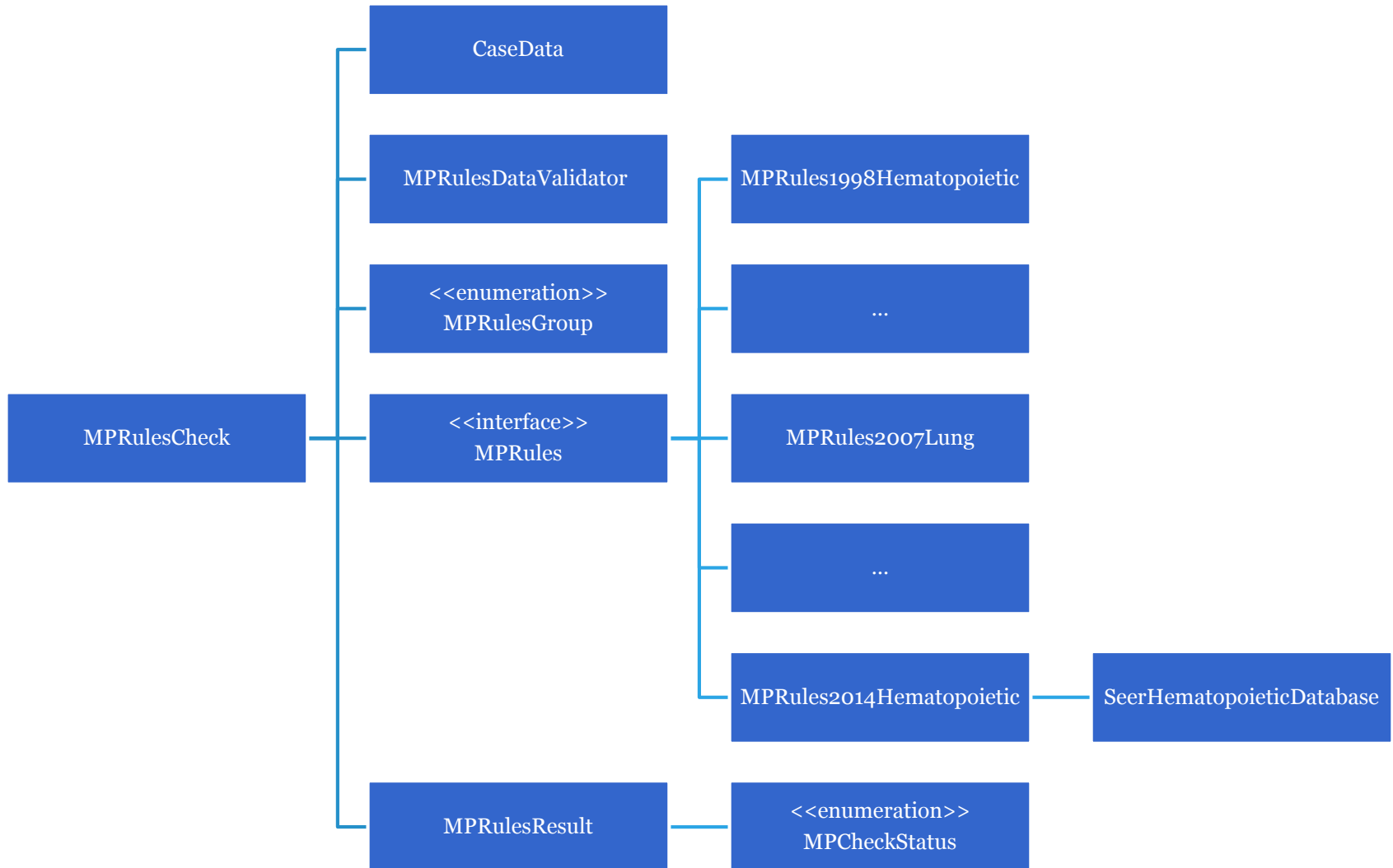
MP Rule Implementation Challenges

- Some rules need to be interpreted
 - Some rules are specified with text that must be translated to coded values for implementation
- Some rules cannot be implemented
 - Data required by a rule may not be available as a coded field in registry records

Flow Diagram



Java Classes



Test Plans

- Duplicate primary check
 - Test to determine software accurately specifies when two case records indicate a single primary
- Multiple primary check
 - Test to determine software accurately specifies when two case records indicate separate primaries

Duplicate Primary Testing - Methodology

- Find duplicate primaries in KCR Central Registry
 - Input
 - NAACCR file with all cases for KCR Central patients with multiple cases from 1992-early 2012
 - Output
 - Report of cases where multiple primaries at central were determined to be single primaries by the automated MP rules
 - Verification
 - Results were manually reviewed by an experienced CTR

Duplicate Primary Testing - Results

Total Counts

Pairs Tested	Reported Duplicates	Verified Duplicates	Verified Different - Case Miscoded	Verified Different - Physician Statement	Verified Different - Other
57,396	290	261	22	7	0

Duplicate Primary Testing - Results

Over counts by year

Diagnosis Year (Highest Sequence)	Pairs Tested	Reported Duplicates	Verified Duplicates
1992	498	8	7
1993	777	5	5
1994	938	7	5
1995	1217	8	8
1996	1503	6	6
1997	1727	7	6
1998	1796	14	11
1999	2077	8	7
2000	2318	13	11
2001	2564	7	5

Duplicate Primary Testing - Results

Over counts by year

Diagnosis Year (Highest Sequence)	Pairs Tested	Reported Duplicates	Verified Duplicates
2002	2803	5	3
2003	3103	9	8
2004	3452	10	9
2005	3755	8	6
2006	4008	25	22
2007	4606	28	25
2008	4854	29	23
2009	5149	20	20
2010	5325	18	17
2011	4279	45	45
2012	647	10	10

Duplicate Primary Testing - Results

Rule groups with highest percentage of verified duplicates

Rule Group	Pairs Tested	Reported Duplicates	Verified Duplicates	Duplicates (Percent)
Hematopoietic 1998	57	12	10	17.54 %
Benign Brain 2004	31	4	4	12.90 %
Urinary 2007	401	38	38	9.48 %
Malignant Brain 2007	14	1	1	7.14 %

Duplicate Primary Testing - Results

Duplicate counts by rule number for Breast 2007 rule group

Rule Number	Pairs Tested	Reported Duplicates	Verified Duplicates	Duplicates (Percent)
M5	979	0	0	0 %
M7	785	0	0	0 %
M8	44	0	0	0 %
M9	1	0	0	0 %
M10	8	8	8	100 %
M11	9	9	9	100 %
M12	49	0	0	0 %
M13	4	1	1	25 %

Multiple Primary Testing - Methodology

- Find multiple primaries that should not have been linked as a single primary in KCR Central Registry
 - Input
 - Case records for KCR Central patients that have multiple source records
 - Hospital source records for patients in KCR Central file
 - Output
 - Report of hospital cases not considered the same primary as any of the corresponding patient's central cases when using the automated MP rules
 - Verification
 - Results were manually reviewed by an experienced CTR

Multiple Primary Testing - Results

Total Counts

Central Cases Tested	Reported New Primaries	Central Cases Reviewed	Verified New Primaries	Verified Same – Case Miscoded	Verified Same - Other
8754	898	35	0	35	0

Conclusions

- Automated MP check has benefits
 - Quality analysis
 - Identifies possible improperly linked cases for review
 - Identifies areas to improve MP rule training
 - Automated Linkage
 - May be able to reduce the number of case linkages requiring manual review

Future Development

- Design more useful multiple primary test
- Implement review flags
 - Flag cases subject to rules where manual review is beneficial
 - Flag cases that may be subject to rules that are not implementable
- Implement use in KCR Central merge

Thank You!

U.KHealthCare
Markey Cancer Center