# Integrating BigMatch into Automated Registry Record Linkage Operations

2014 NAACCR Annual Conference
June 25, 2014
Jason Jacob, MS, Isaac Hands, MPH, David Rust, MS
Kentucky Cancer Registry

# Overview

- Record Linkage Basics
- Record Linkage in a Cancer Registry
- What is BigMatch ?
- Comparing BigMatch to LinkPlus
- Building a Master Patient Index
- Lessons Learned
- Software Demo

# Record Linkage Basics

**Record Linkage:** Comparing 2 lists of patient records to find out which patients are the same

Exact matches are easy.

Partial matches can be hard:

- Is SSN or MRN enough ?
- Is First + Middle + Last Name + DOB enough ?
- Can transposed or smudged characters be handled ?
- What about maiden names or nicknames ?
- Which records do we compare ?

  $10{,}000 * 100{,}000 = 10^9$
- How can we resolve ambiguities ?

# Record Linkage Basics

**Blocking**

- Which records will be compared?

**Matching**

- Which fields within the record will be scored ?

**Scoring Algorithm**

- How will the scores be calculated ?

**Score Cutoff Value**

- What is the minimum score for a true match ?

**Manual Review**

- How many pairs must be reviewed ?

# Record Linkage in a Cancer Registry

- Casefinding
  - epath
  - Hospital discharge lists
  - disease indexes
  - Nonreportable lists
- Data from other registries
- Death clearance
- Follow-up Sources: SSA, CMS, NDI, other TLAs that help with data submissions and follow-up
- Research studies

# Record Linkage in a Cancer Registry

- Most cancer registries use LinkPlus and SAS for record linkages
- KCR needs a way to automate record linkages, with minimal human intervention
- LinkPlus requires user interaction at multiple steps, does not run on Linux
- KCR is investigating BigMatch for automated record linkages

# What is BigMatch ?

"…a record linkage tool that can perform high speed, large file matching. The program can be used to match a moderate-sized file against several large files, and it can be used for deduplicating a file. The files do not have to be sorted prior to running the program."

- Bigmatch manual, William E. Yancey, Feb. 5, 2008

- Developed at the U.S. Census Bureau, freely available by contacting the authors:

  william.e.yancey@census.gov or william.e.winkler@census.gov.

# What is BigMatch ?

- Command-line driven software, does not provide graphical user interface

- Input files and Configuration file can be difficult to create:

```
6 1 1 0 1 1 0 100 100
6 6 2 3 3 4
6 6 6 6 6 6
st 81 2 81 2 1
tract 88 3 88 3 1
first 64 13 64 13 0 uo 0.90 0.10
```

- Very fast results for very large files, but requires tuning

# Comparing BigMatch to LinkPlus

- Using published methodologies and data sets, we compared the results of a BigMatch de-duplication with LinkPlus

(http://www.sciencedirect.com/science/article/pii/S1532046411001729)

| Software | Precision | Recall | F-measure |
|---|---|---|---|
| BigMatch | 0.96 | 0.81 | 0.88 |
| LinkPlus | 0.94 | 0.83 | 0.88 |

Blocking: first name initial and Soundex of NYSIIS code for last name, DOB
Matching: last name, first name, dob, sex, postal code

Precision = True Matches / (True Matches + False Positives)
Recall = True Matches / (True Matches + False Negatives)
F-Measure = 2* (Precision * Recall) / (Precision + Recall)

# Comparing BigMatch to LinkPlus

- Using LinkPlus to identify true matches from a Death Certificate linkage, we observed very good results from BigMatch

| Software | Precision | Recall | F-measure |
|---|---|---|---|
| BigMatch | 0.993 | 0.995 | 0.994 |

Blocking: SSN, DOB, Soundex LastName

Matching: LastName, FirstName, MiddleName, DOB, Sex, SSN

Total Death Certificates: 70,000

Total Registry Records: 300,000

# Comparing BigMatch to LinkPlus

## BigMatch

| Pro | Con |
|---|---|
| Fast | No Graphical Interface |
| Free | Hard to configure |
| Good Accuracy | |
| Scriptable | |
| Multi-platform | |

## LinkPlus

| Pro | Con |
|---|---|
| Fast | Not Easily Scriptable |
| Free | Windows only |
| Good Accuracy | |
| Graphical Interface | |
| Easier to configure | |

# Building a Master Patient Index

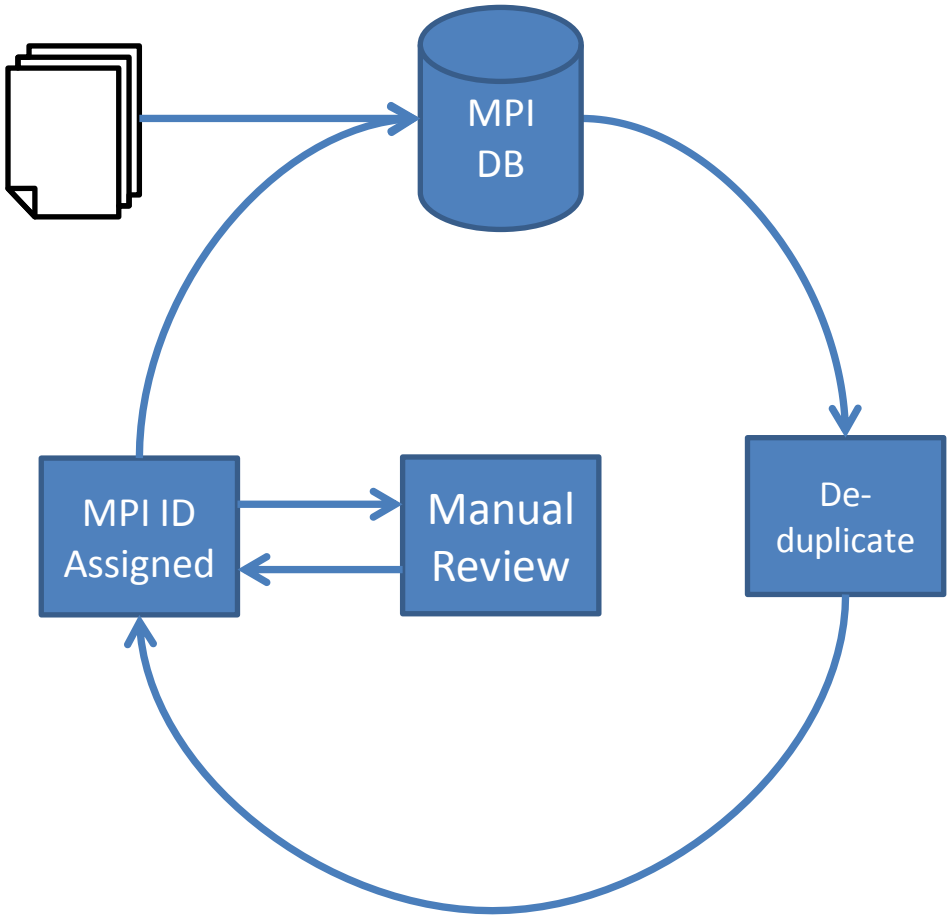
- KCR has a continuous feed of 4 different message types from 99 reporting facilities:
  - ePath
  - Hospital Discharge Reports
  - HL7 ADT Discharge Messages
  - Oncology Appointment Records

- All messages are stored in a relational database
  - About 3 million total messages
  - 200-3000 new messages each day
  - Multiple messages for each patient

# Building a Master Patient Index

- How many unique patients are represented by our 3 million messages ?
- Each patient should have a unique ID
- As we receive new messages for the same patient, we want to assign the same patient ID

# Building a Master Patient Index




1. Messages are posted to database daily
2. BigMatch de-duplication runs every night
3. New patients are given new IDs
4. Messages for existing patients are assigned existing MPI IDs
5. Ambiguous matches are set aside for manual review

# Lessons Learned

- Creating a Master Patient Index is time consuming and requires constant refinement
- Need staff resources for manual review
- Need to develop graphical interface for BigMatch manual review that can feed back into database
- Configuring linkage parameters is difficult
- BigMatch can be fast – BigMatch can be slow
  - Depends on configuration parameters

# Lessons Learned

Not everything can be automated.

- ✓ Input file creation
- ✓ Configuration file creation
- ✓ Running Linkage
- ✓ Process Definite Matches

- X Handling Ambiguous Matches

# What Next ?

- Refine configuration and performance
- Refine interface for manual review
- Commit staff resources for manual review
- Identify other registry processes for automated record linkage
- Investigate other record linkage engines
  - Scriptable
  - Cross-Platform

# Demo