The elusive sweet spots of privacy and utility

Latanya Sweeney, Ph.D.
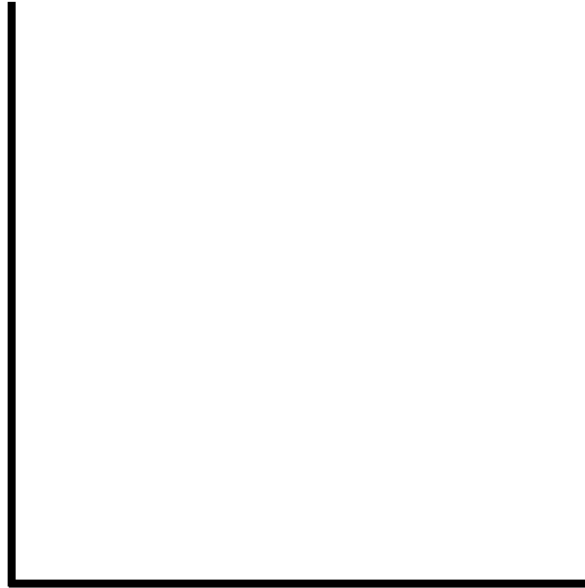
Privacy
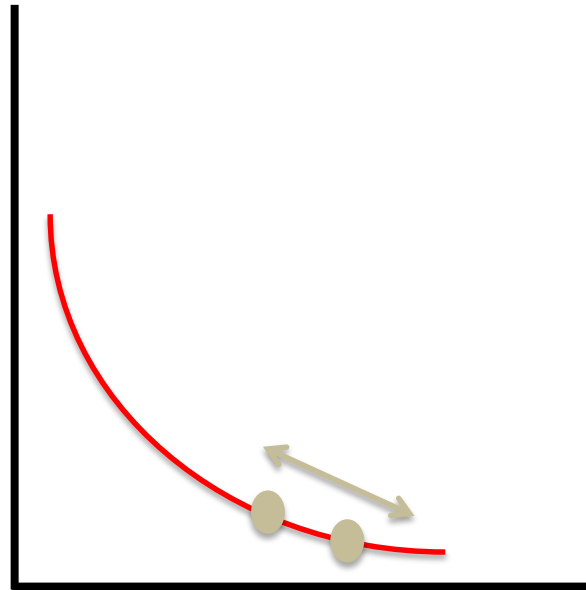
Utility
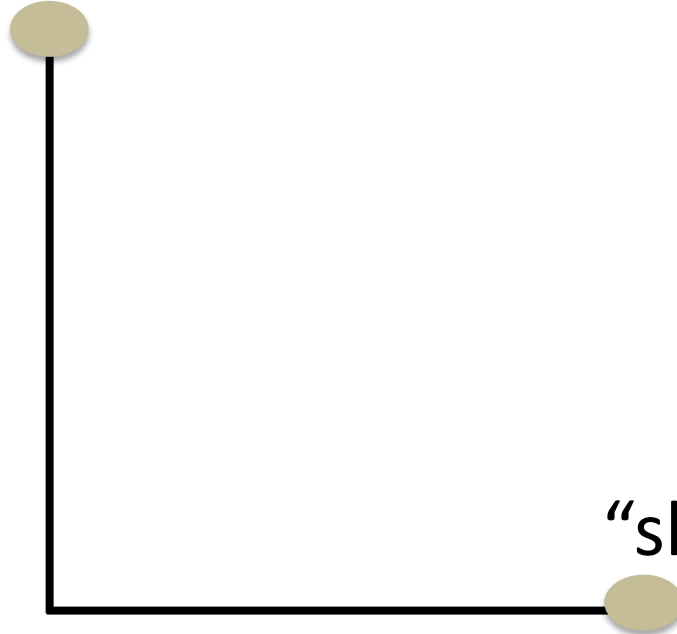
Traditional Belief System   Sweet spots
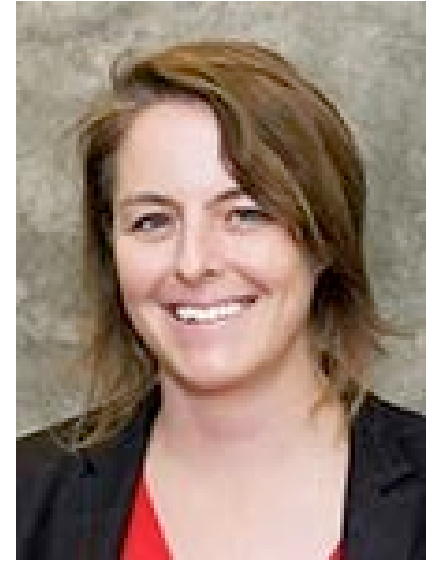
Privacy (y-axis), Utility (x-axis)

Legend: Traditional Belief System, Sweet spot

The Year is 1997.
Building my thinking machine... when...

Dataset

Visit date

Diagnoses

Procedures

ZIP

Birth date

Sex

Voter List

Name

Address

Date registered

Party affiliation

Date last voted

Sweeney Simple Demographics Often Identify People Uniquely. 2000. dataprivacylab.org/projects/identifiability/index.html

[02138, M,7/31/1945]

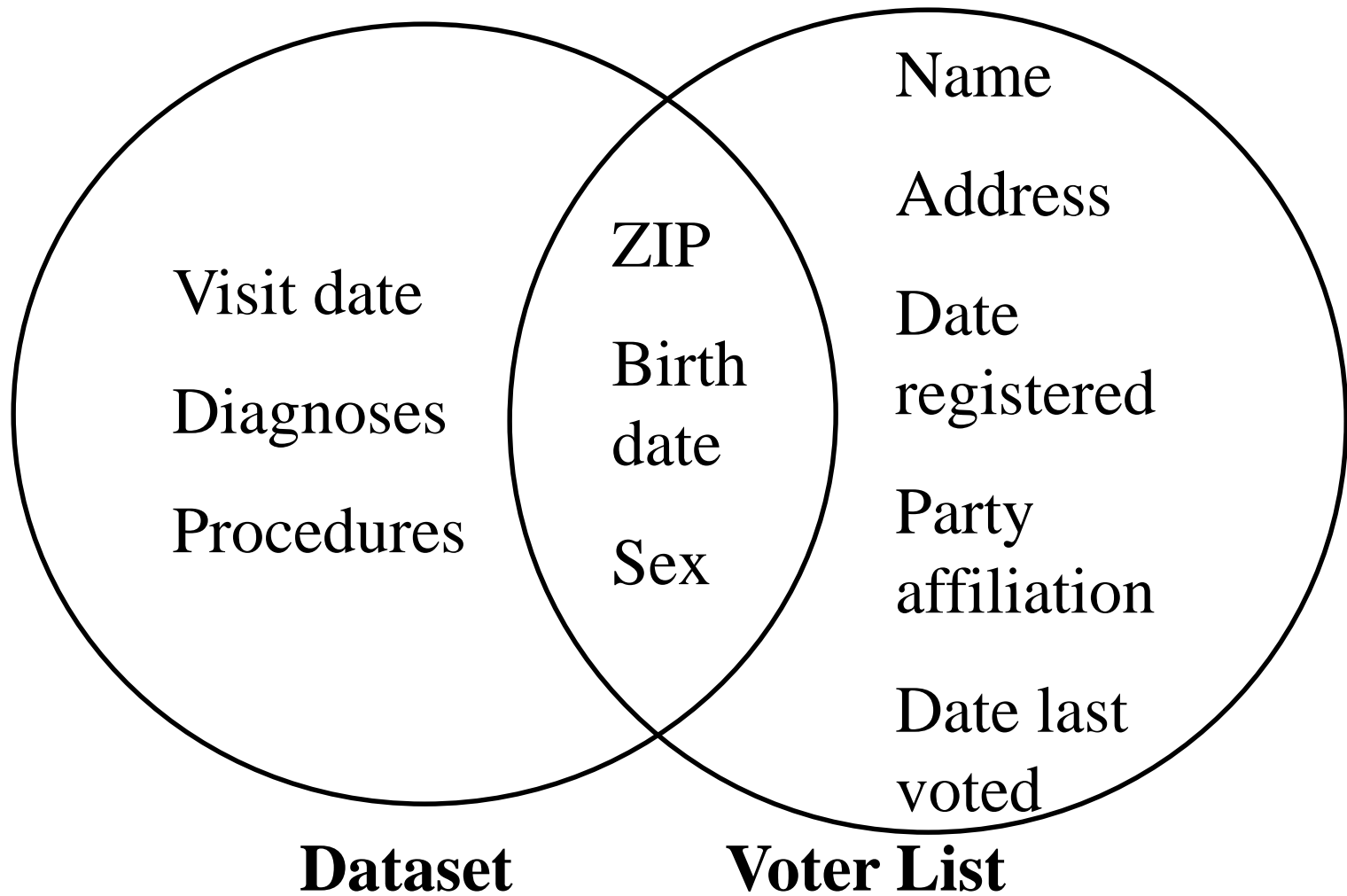|	Lastname	Firstname	Streetnum	Streetname	ZIP	Gender	Birthdate
1							
2			10	CENTRE ST	02139	M	2/5/69
3			121	INMAN ST	02139	F	6/4/74
4			15	STANDISH ST	02138	F	7/6/38
5			15	STANDISH ST	02138	F	1/22/71
6			15	STANDISH ST	02138	M	4/18/25
7			41	DOVER ST	02140	M	7/22/64
8			94	AMORY ST	02139	F	7/17/63
9			18	WOODBRIDGE ST	02140	M	8/31/40
10			12	FARWELL PL	02138	M	8/4/12
11			12	FARWELL PL	02138	F	2/6/15
12			100	LARCH RD	02138	M	12/2/41
13			100	MEMORIAL DR	02142	M	7/2/57
14			17	FARWELL PL	02138	F	1/13/78
15			17	FARWELL PL	02138	M	4/26/46
16			34	IRVING ST	02138		8/4/72
17			124	OTIS ST	02141	F	10/14/64
18			9	LEONARD AVE	02139	F	6/3/62
19			73	DANA ST	02138	F	7/8/64
20			179	PROSPECT ST	02139	M	4/18/58
21			42	COGSWELL AVE	02140	F	7/2/59

1997 Cambridge Voter List   foreverdata.org

[02138, M,7/31/1945]

15283		1105	MASSACHUSETTS	02138	F	7/30/45
15284		5	ELLERY SQ	02138	M	7/30/45
15285		168	HARVARD ST	02139	M	7/30/45
15286	WELD WILLIAM	28	FAYERWEATHER S	02138	M	7/31/45
15287		38	KINNAIRD ST	02139	F	7/31/45
15288		12	ARNOLD CIR	02139	F	7/31/45
15289		127	TREMONT ST	02139	F	7/31/45
15290		321	HARVARD ST	02139	M	7/31/45
15291		245	WALDEN ST	02140	M	7/31/45
15292		9	ELLERY ST	02138	F	8/1/45
15293		95	FAYERWEATHER S	02138	M	8/1/45
15294		3	WILLIAM ST	02139	F	8/2/45
15295		50	HOLWORTHY ST	02138	M	8/3/45
15296		348	HARVARD ST	02138	M	8/3/45
15297		25	CHILTON ST	02138	F	8/4/45
15298		16	GRANVILLE RD	02138	M	8/4/45
15299		142	RAYMOND ST	02140	M	8/4/45
15300		14	MARION ST	02141	F	8/4/45
15301		34	ESSEX ST	02139	F	8/5/45
15302		105	AUBURN ST	02139	M	8/5/45

1997 Cambridge Voter List   foreverdata.org

	Date of Birth	Mon/Yr Birth	Year of Birth
County	18.1%	0.04%	0.00004%
Town/Place	58.4%	3.6%	0.04%
ZIP 5-digit	**87%**	3.7%	0.04%
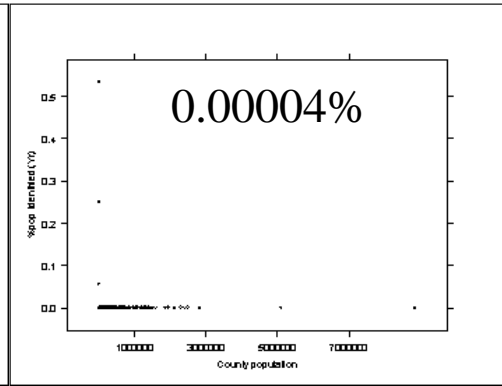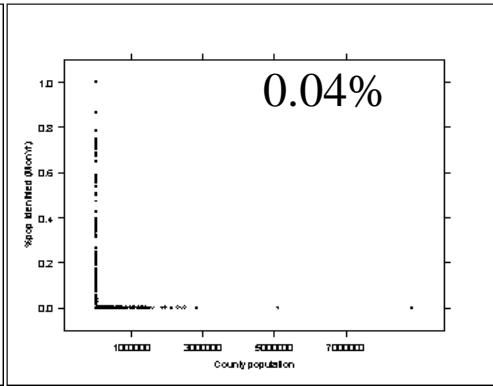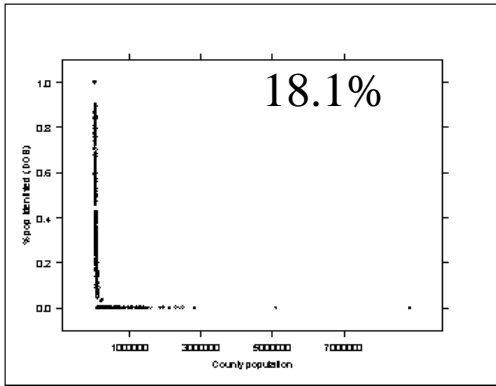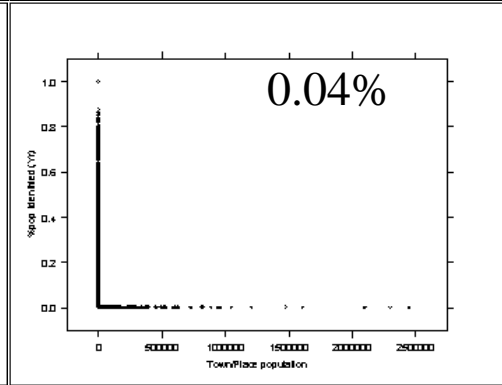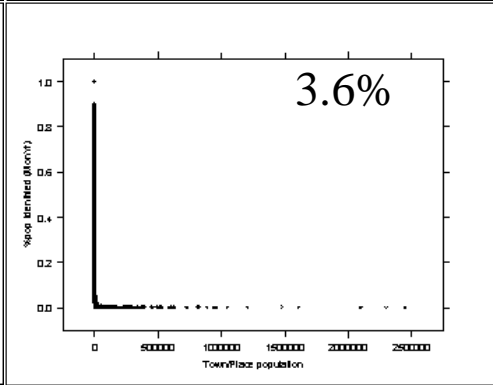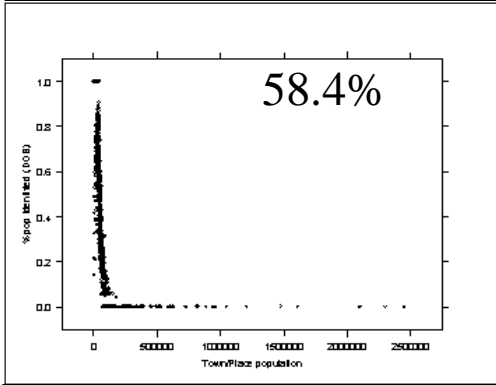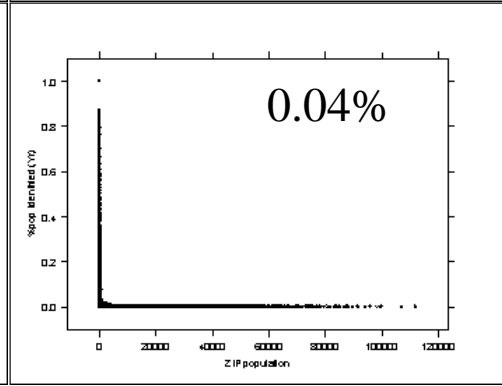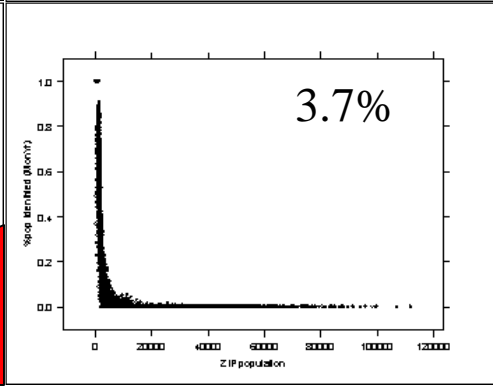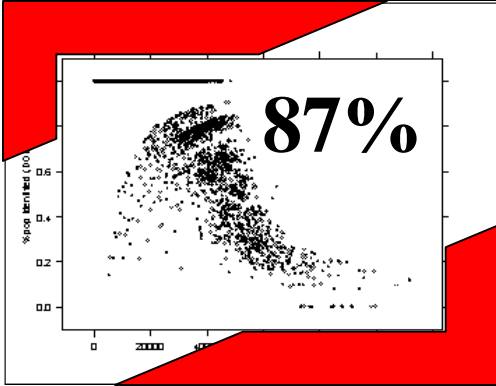
Gender

My work was cited
in the preamble of the
HIPAA Privacy Rule

(and in other policies
worldwide).
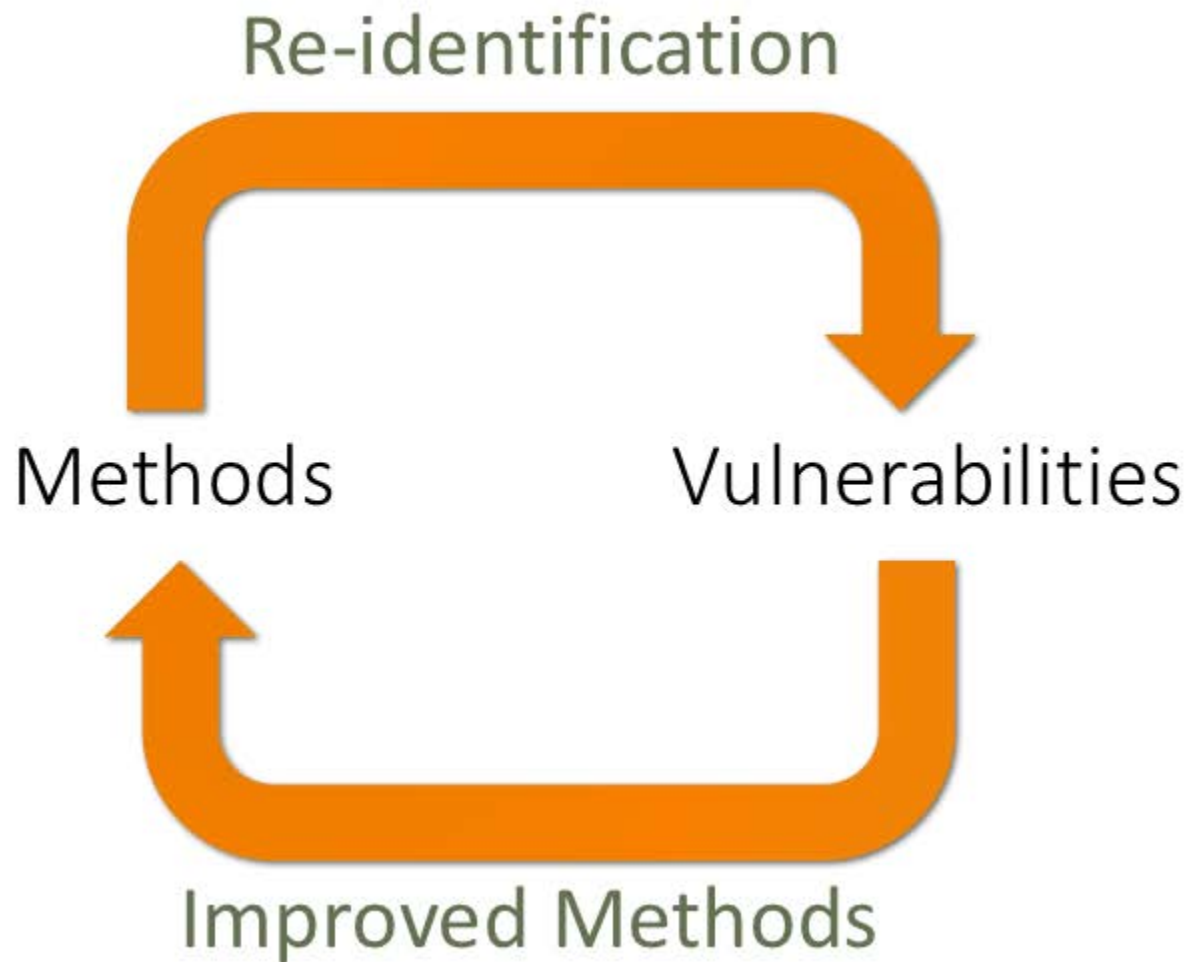
Re-identification stimulates improvement.

33 States Sell or Share Personal Health Data
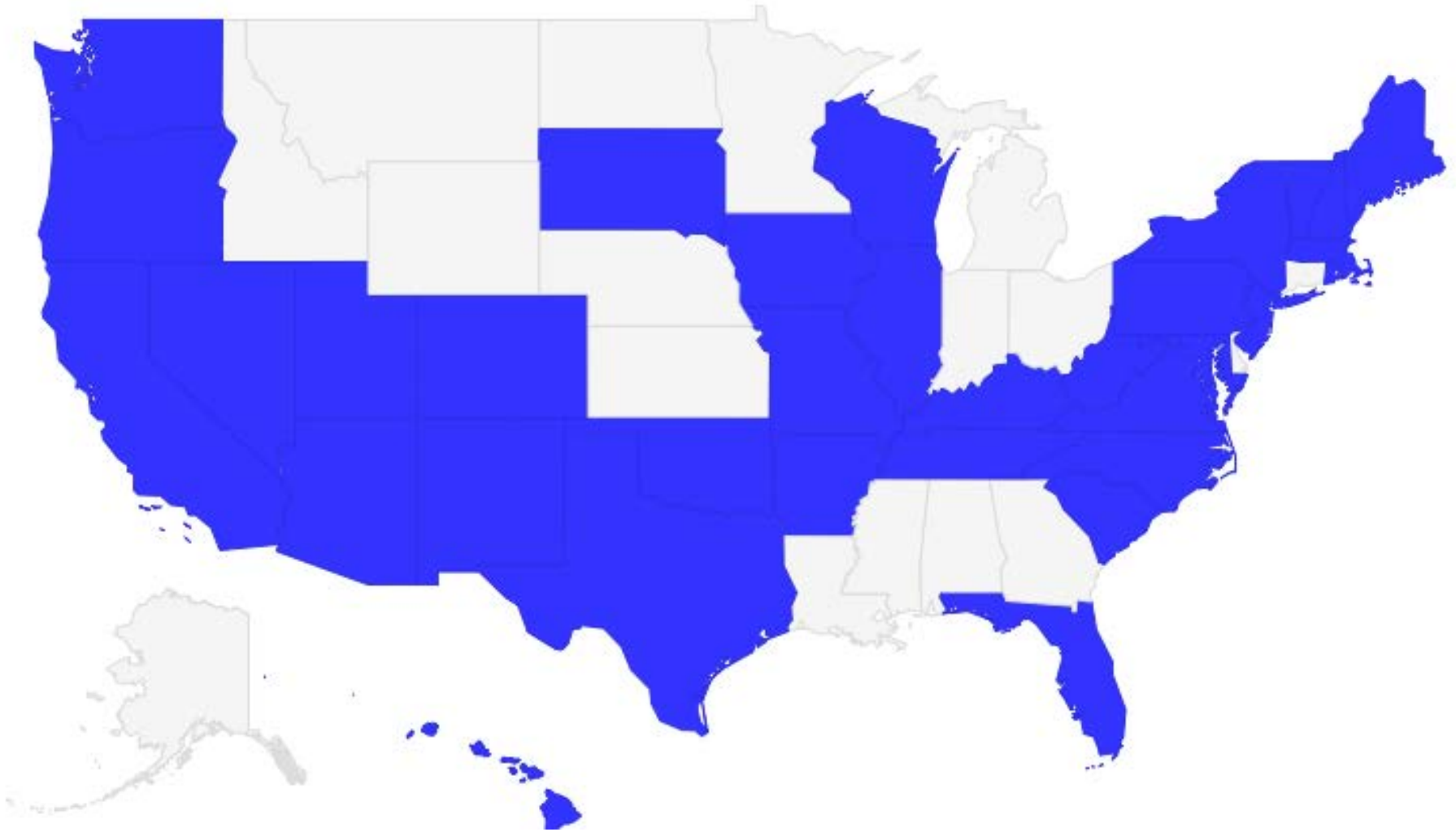
Hooley S and Sweeney L. Survey of Publicly-Available State Health Databases. Paper 1075. 2013.
thedatamap.org/states.html

Only 3 States Used HIPAA Standards

Hooley S and Sweeney L. Survey of Publicly-Available State Health Databases. Paper 1075. 2013.
thedatamap.org/states.html

Record	505825338
Hospital	162: Sacred Heart Medical Center in Providence
Admit Type	1: Emergency
Type of Stay	1: Inpatient
Length of Stay	6 days
Discharge Date	Oct-2011
Discharge Status	6: Dsch/Trfn to home under the care of an health service organization
Charges	$71708.47
Payers	1: Medicare
	6: Commercial insurance
	625: Other government sponsored patients
Emergency Codes	E8162: motor vehicle traffic accident due to loss of control; loss control mv-mocycl
Diagnosis Codes	80843: closed fracture of other specified part of pelvis
	51851: pulmonary insufficiency following trauma & surgery
	86500: injury to spleen without mention of open wound into cavity
	80705: closed fracture of rib(s); fracture five ribs-close
	5849: acute renal failure; unspecified
	8052: closed fracture of dorsal [thoracic] vertebra without mention of spinal cord injury
	2761: hyposmolality &/or hyponatremia
	78057: tachycardia
	2851: acute posthemorrhagic anemia
Age in Years	60
Age in Months	725
Gender	Male
ZIP	98851
State Reside	WA
Race/Ethnicity	White, Non-Hispanic

TechScience.org/a/2015092903/

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MAN, 60, THROWN FROM MOTORCYCLE

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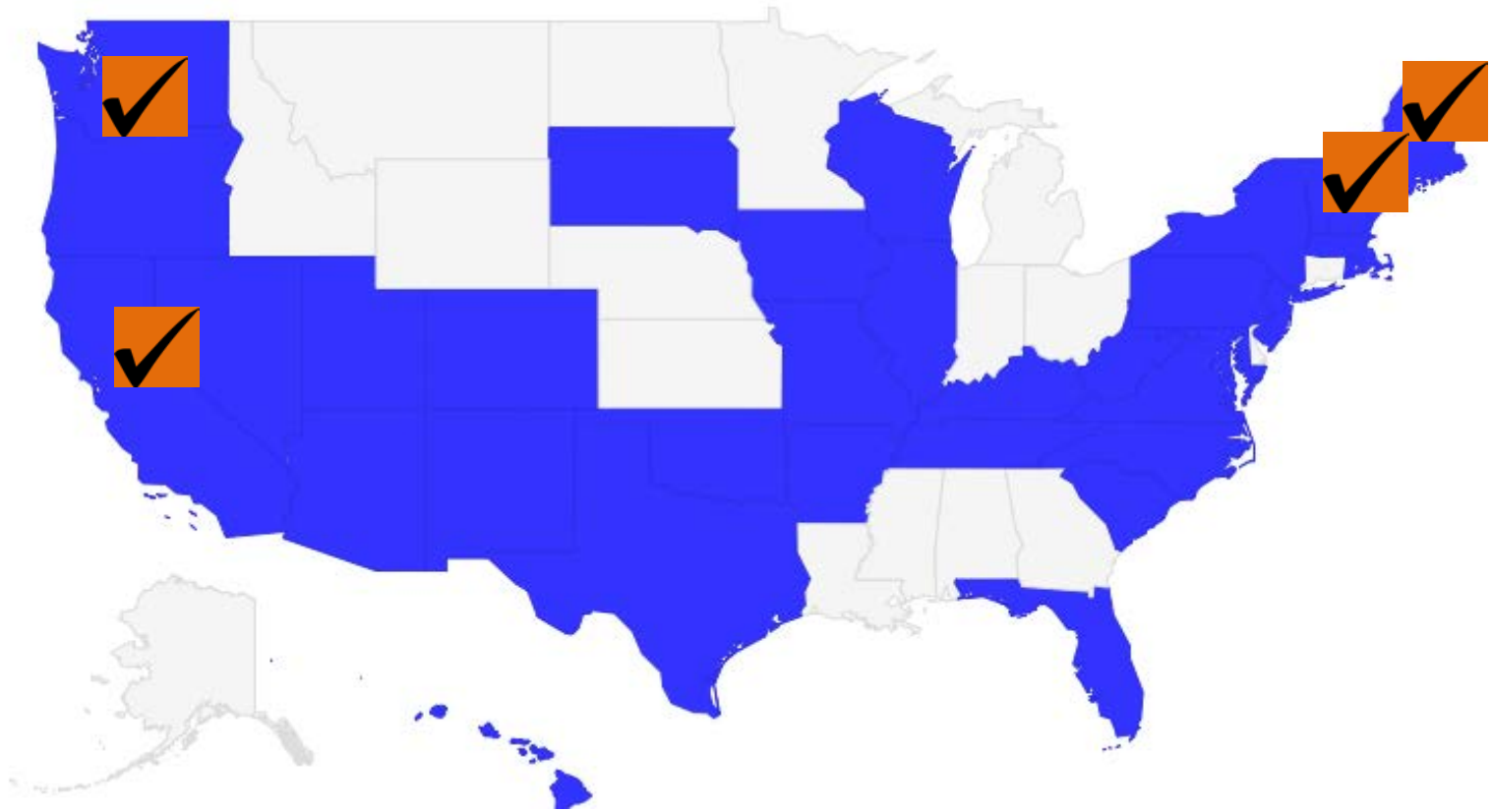| Record	
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Matched correct names to **43 percent** of 81 samples of shared "anonymous" data.
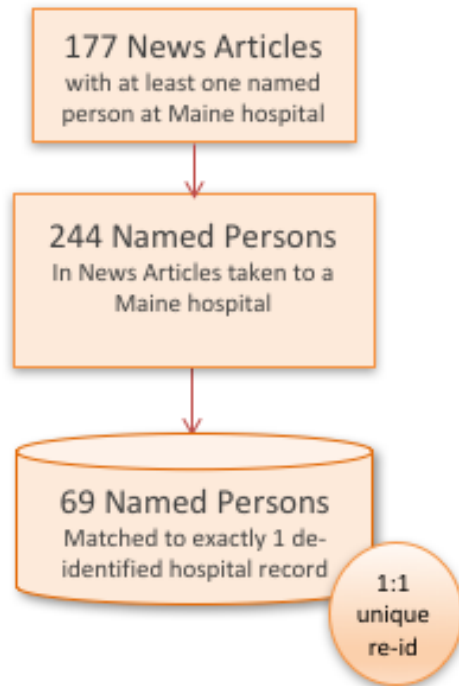
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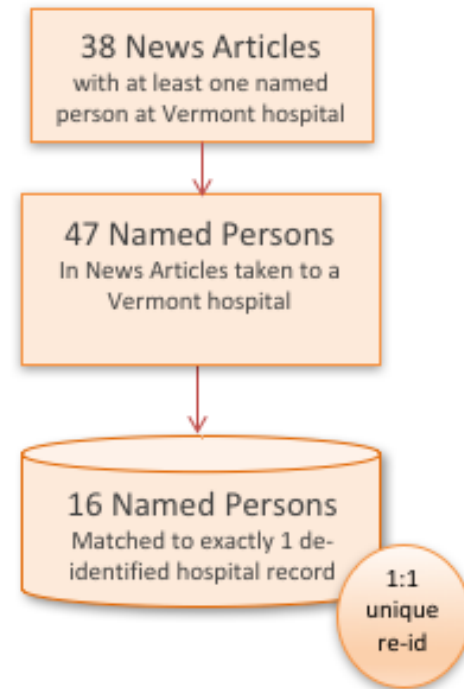
Only 2 of the 30 states responded to the WA re-identification
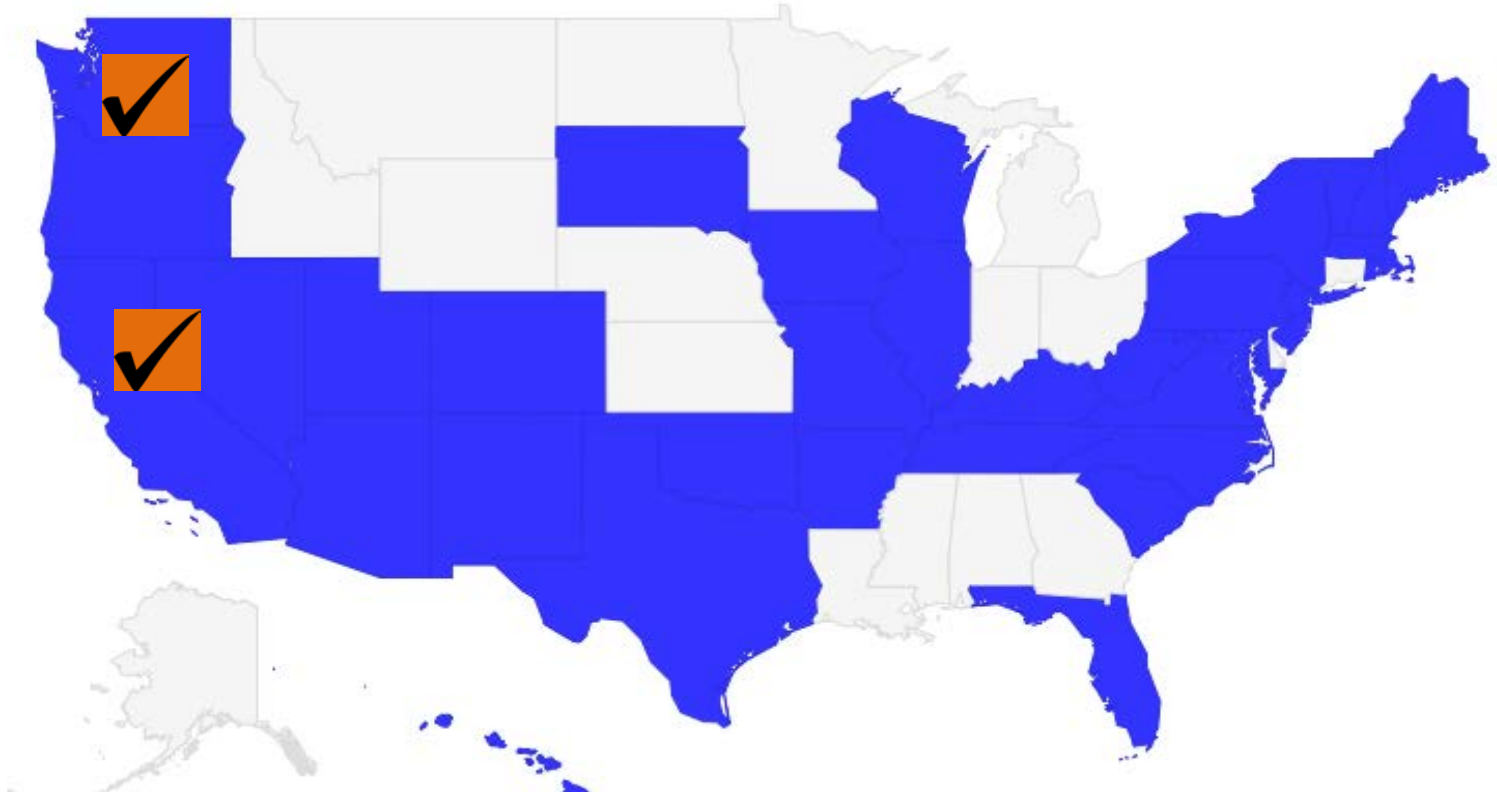
So 20 years later,
we have to build evidence state-by-state…

Maine Inpatient Data
28.3% named individuals re-identified

177 News Articles
with at least one named person at Maine hospital

↓

244 Named Persons
In News Articles taken to a Maine hospital

↓

69 Named Persons
Matched to exactly 1 de-identified hospital record

1:1 unique re-id

Vermont Emergency Data
34% named individuals re-identified

38 News Articles
with at least one named person at Vermont hospital

↓

47 Named Persons
In News Articles taken to a Vermont hospital

↓

16 Named Persons
Matched to exactly 1 de-identified hospital record

1:1 unique re-id

Yoo J, Thaler A, Sweeney L, and Zang J. Risks to Patient Privacy: a re-identification of patients in Maine and Vermont statewide hospital data. Technology Science. 2017110701. November 7, 2017. http://techscience.org/a/2017110701 (White paper: dataprivacylab.org/projects/me/)

Re-identification stimulates improvement.

20 years later: privacy vulnerabilities exist.

HIPAA Safe Harbor, Remove following:

(A) Names;

(B) All geographic subdivisions, except first 2 digits
    of ZIP code (no digits if ZIP population < 20K)

(C) All elements of dates (except year) for dates

(D) Telephone numbers;   (E) Fax numbers;

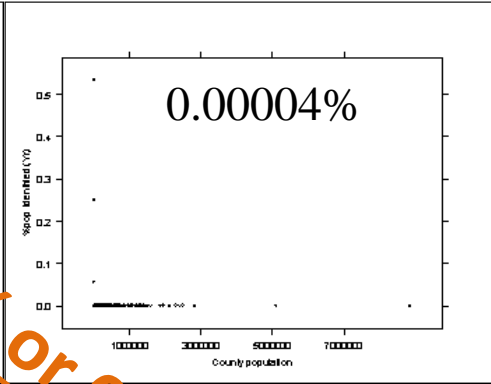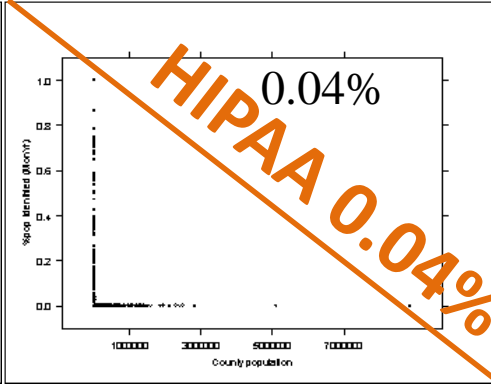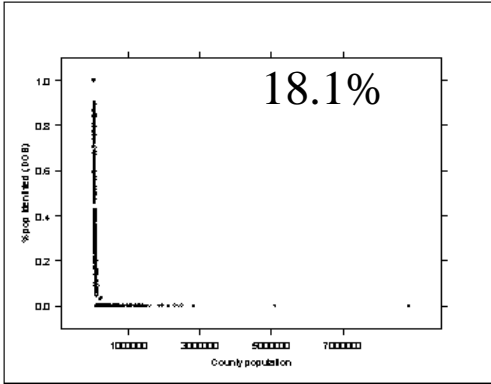(F) Electronic mail addresses;   (G) Social security numbers;

(H) Medical record numbers; and other numbers
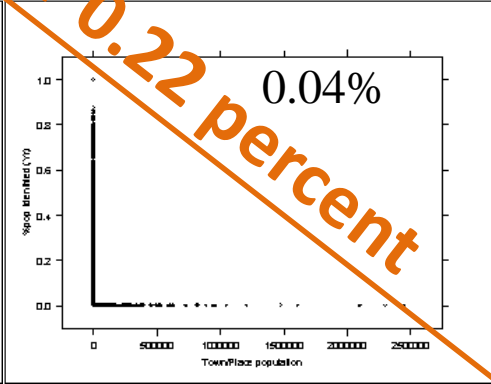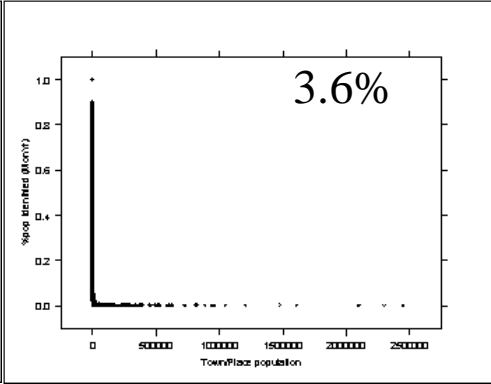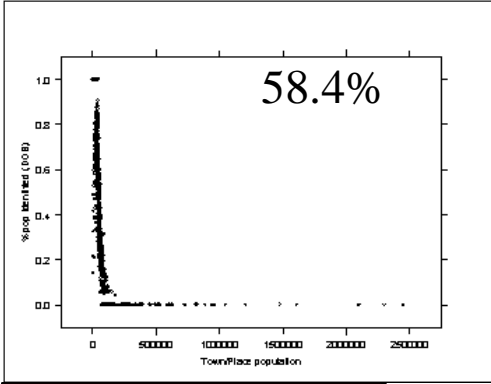
(N) Web Universal Resource Locators (URLs);

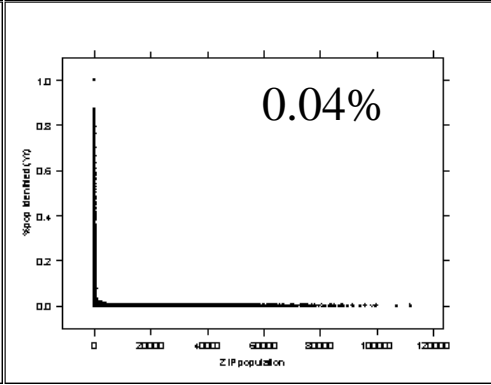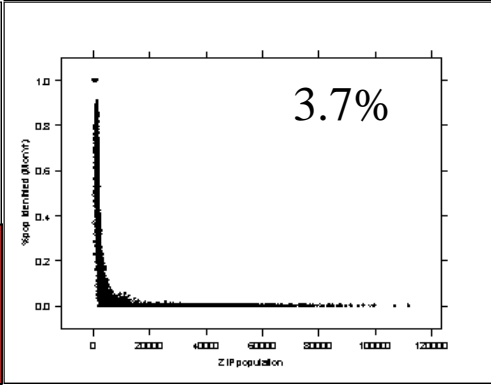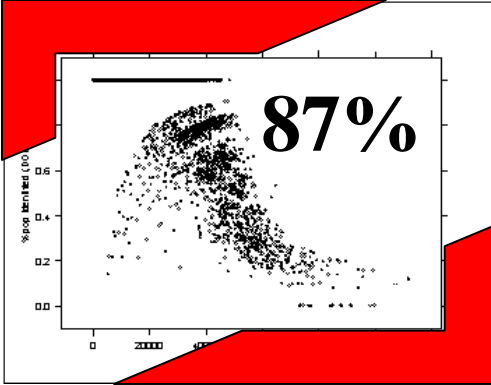(O) Internet Protocol (IP) address numbers;

(P) Biometric identifiers, etc

	Date of Birth	Mon/Yr Birth	Year of Birth
County	18.1%	0.04%	0.00004%
Town/Place	58.4%	3.6%	0.04%
ZIP 5-digit	**87%**	3.7%	0.04%

Gender

HIPAA 0.04% or 0.22 percent

Venn diagram of Study Data and Property Data.

Study Data (left circle): ID, Gender, Birth decade, Move-in decade, Race/ethnicity

Overlap (center): beds, baths, square ft, built decade

Property Data (right circle): Address, Owner names

Sweeney L, Yoo J, Perovich L, Boronow K, Brown P, Brody J. Re-identification Risks in HIPAA Safe Harbor Data: A study of data from one environmental health study. *Technology Science*. 2017082801. August 28, 2017. https://techscience.org/a/2017082801

(a) Phase 1 → (b) Phase 2

Sweeney L, Yoo J, Perovich L, Boronow K, Brown P, Brody J. Re-identification Risks in HIPAA Safe Harbor Data: A study of data from one environmental health study. *Technology Science*. 2017082801. August 28, 2017. https://techscience.org/a/2017082801

(a) Phase 1

(b) Phase 2

When the redacted data contained the exact birth year, as allowed by the HIPAA Safe Harbor, we correctly identified 8 of 32 (25 percent) participants by name.
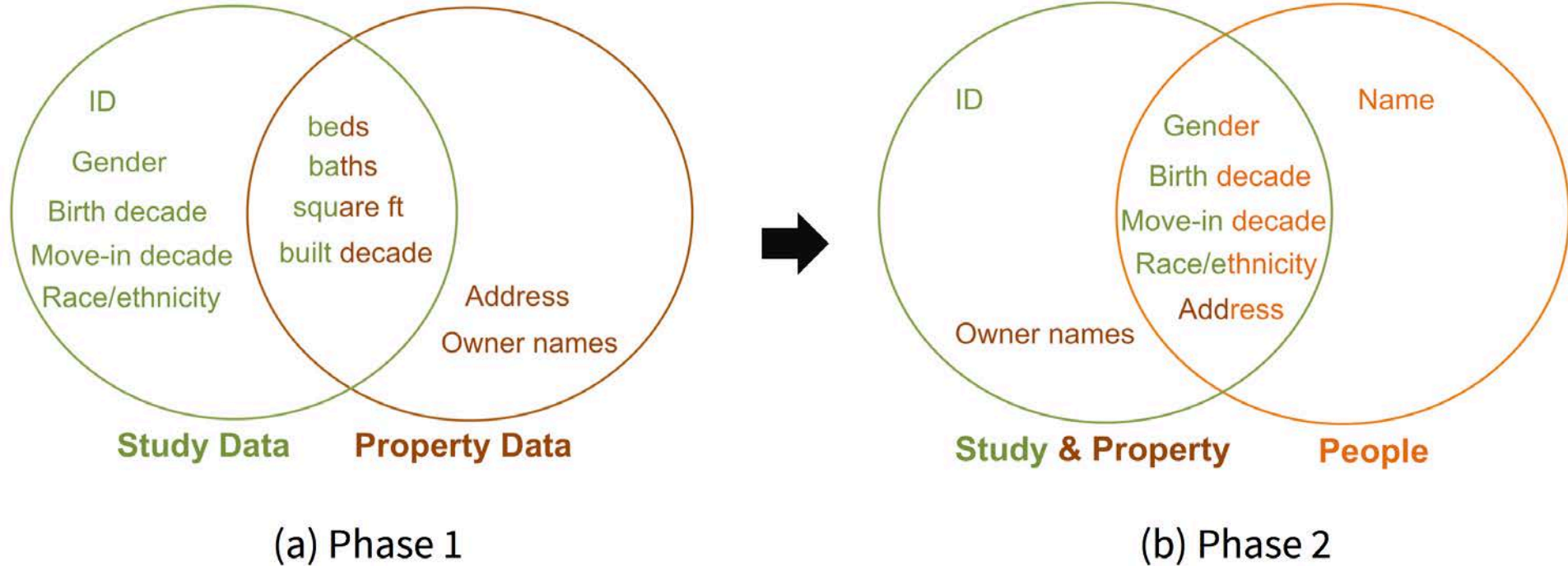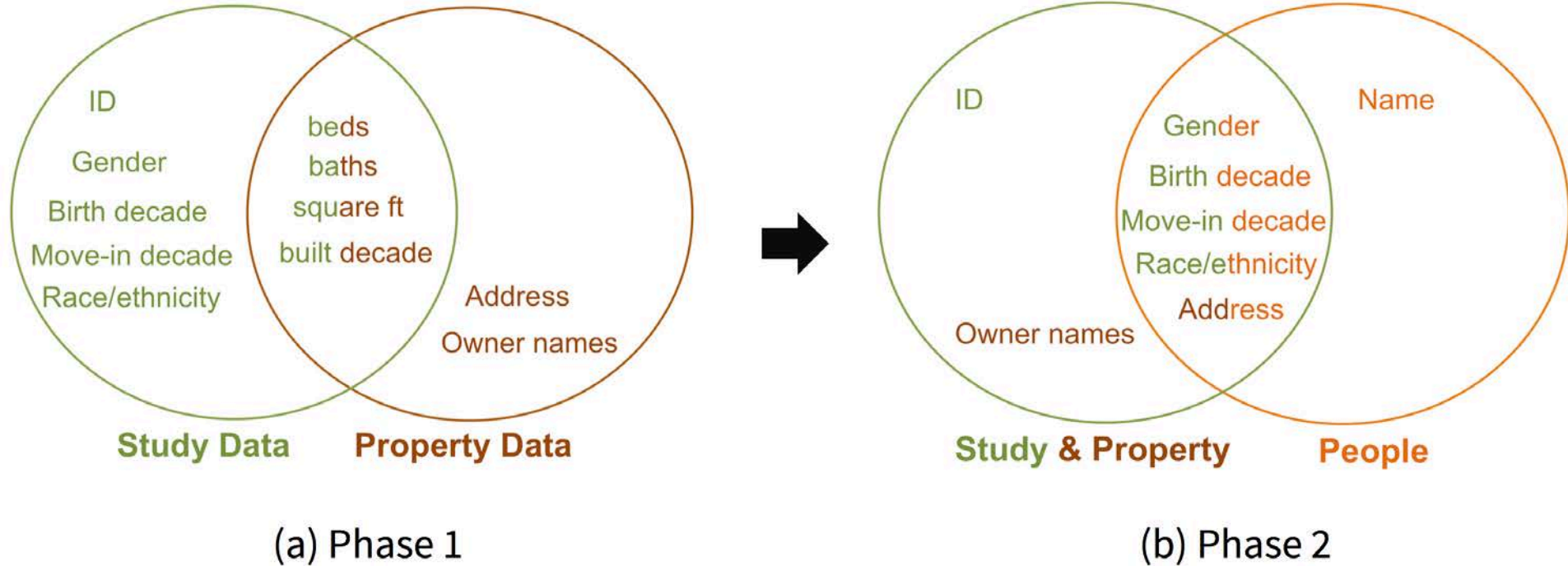
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Re-identification stimulates improvement.

20 years later: privacy vulnerabilities exist.

25% re-identified in HIPAA Safe Harbor study

What about expert determinations and best practices?

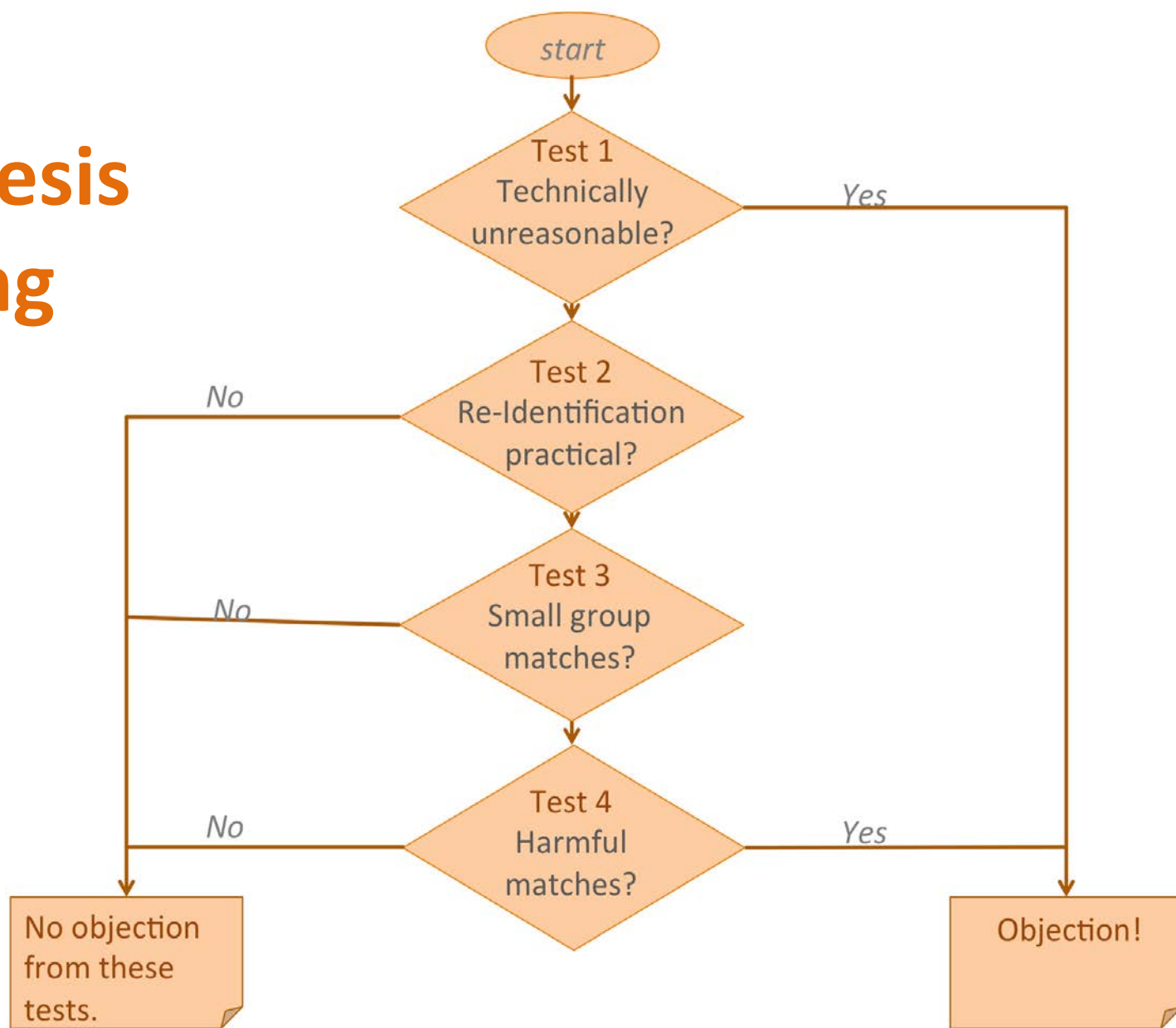# A Public Records Request (FOIA) on the Original Bar Dataset.

recnum	lawschool	gradYr	LSAT	GPA	race	result	tries	scores
1001	Whittier	199806	141	91.78	White	Pass	Multi	
1002	Whittier	199807	128	85.09	Asian	Pass		
1003	Whittier	199807	132	70.36	Asian	Pass		
1004	Whittier	199808	134	70.36	Hispanic	Pass	Multi	
1005	Pepperdine	199810	143	70.59	White	Pass		
1006	Pepperdine	200006	132	92.65	White	Pass	Multi	
1007	Pepperdine	200006	144	84.2	White	Pass	Multi	
1008	Pepperdine	200006	148	67.45	White	Pass		

Experts submitted protocols and datasets that they asserted were privacy protected and useful for the study.

We assumed the experts were correct and then tested whether we found examples of re-identifications that should not occur ("null hypothesis test").

Null Hypothesis Testing

start

Test 1 Technically unreasonable? — Yes

Test 2 Re-Identification practical? — No

Test 3 Small group matches? — No

Test 4 Harmful matches? — No — Yes

No objection from these tests.

Objection!

Sweeney L, Von Lowenfeldt M and Perry M. Saying it's Anonymous Doesn't Make It So: re-identifications of "anonymized" law school data. Harvard University. Data Privacy Lab. White Paper. Oct 25, 2017. (White paper: dataprivacylab.org/projects/lawdata)

Protocol	Description	Test Result
11-Anonymity	Recodings and aggregations, some subsets had 11 copies	Failed! Re-identifications.
11-Anonymity Plus	Same as above with less precise GPA and 25% drop of records	Failed! Re-identifications.
Enclave	5-anonymity version of first protocol in a secured setting	Failed! Re-identifications.
Standardized	All values replaced with z-scores	Failed! Re-identifications. Effort, Know-how.

11-Anonymized Protocol, Steps 1-2/14

1. Preliminary Steps
   a. Recode School Name Abbreviations
   b. Compute number of times bar taken for each person
   c. Recode Bar's assignment of race differently

2. "Cleaning Steps"
   a. Drop students attending one than one law school
   b. Eliminate students who graduated prior to 1982
   c. Drop students that have a graduation date of 0
   d. Rename graduation year variable
   e. Eliminate schools that are not accredited or correspondence law schools from AMSCHMP file
   f. Drop unaccredited law schools
   g. Drop correspondence law schools

11-Anonymized Protocol, Step 3/14

3. Create graduation year ranges and recode variables by law school class:

   Class One: 1982-1987, 1988-1990, 1991-1993, 1994-1996,
   1997-1999, 2000-2002, 2003-2005, 2006-2008

   Class Two: 1982-1990, 1991-1999, 2000-2008

   Class Three: 1982-1990, 1991-1999, 2000-2008

4. LSAT Protocol Two Cleaning
    a. Drop students from Class Three Schools that are not in a 9 year band of at least 20 students
    b. Create median LSAT value for law schools that remain
    c. Divide law schools into two categories: those on the 10-48 scale and those on the 120-180
    d. Categorize 1982-1990 students, Class Three schools into quintiles
    e. Ascribe median school value to all students in school/period group, even if no LSAT score
    f. Categorize 1991-1999 students, Class Three schools into deciles
    g. Categorize 2000-2008 students, Class Three schools into deciles
    h. Set law school name to missing for students for any of the above that have a quintile and decile values
    i. Drop remaining Class Three students. These are students that did not fall into the quantile or decile distributions.

11-Anonymized Protocol, Steps 5-6/14

5. Compute cell counts.

6. Racial redaction for Class One school students, black and Hispanic:

    a. Create a variable to count school/Class One graduation year band/race groupings

    b. Create variable to indicate the number of students in the grouping

    c. Create URM variable that collapses race if school/graduation year band group has less than 11 blacks or less than 11 hispanics, or less than 11 blacks and 11 hispanics.

    The URM variable sums black and hispanic students within the schoo/graduation year band group, based on one of these three conditions, and assigns the sum value to all black or hispanic students in that group. If the URM sum for the group is less than 11, all black and hispanic students within group have race set to missing.

11-Anonymized Protocol, Steps 7-9/14

7. Racial redaction for Class One school students, white and other:

    a. Create White/Other variable that collapses race if school/graduation year band group has less than 11 white or less than 11 other, or less than 11 whites and 11 others.

    The White/Other variable sums white and other students within the schoo/graduation year band group, based on one of these three conditions, and assigns the sum value to all white or other students in that group. If the White/Other sum for the group is less than 11, all white and other students within group have race set to missing.

8. If a school/graduation year group has a value for URM or White/Other (or both variables) that is less than 11, set race equal to missing for all students in that school/graduation year group

9. If there is a URM or White/Other variable value for a student (meaning race had to be collapsed) code race as URM or White/Other and set race for those students to missing

11-Anonymized Protocol, Step 10/14

10. Racial redaction for Class Two school students, white and other

    a.   Create a variable to count band/race groupings

    b.   Create variable to indicate whether the groupings created have more or less than 11 students in them

    c.   Create White/Other variable that collapses race if school/graduation year band group has less than 11 white or less than 11 other, or less than 11 whites and 11 others.

        The White/Other variable sums white and other students within the schoo/graduation year band group, based on one of these three conditions, and assigns the sum value to all white or other students in that group. If the White/Other sum for the group is less than 11, all white and other students within group have race set to missing.

    d.   If the White/Other sum for the group is less than 11, all white and other students within group have race set to missing.

11-Anonymized Protocol, Step 11-12/14

11. If a school/graduation year group has a value for URM or White/Other (or both variables) that is less than 11, set race equal to missing for all students in that school/graduation year group

12. If there is a URM or White/Other variable value for a student (meaning race had to be collapsed) code race as URM or White/Other and set race for those students to missing

11-Anonymized Protocol, Steps 13-14/14

13. Racial redaction for Class Three school students

    Race is not Redacted for Class Three students as all Class Three students have already had law school name set to missing.

14. Create graduation year category variable to replace student's actual graduation year

Sample of 11-Anonymity Dataset.

lawschool	grad Period	LSAT	GPA	race	result	tries	school Category	avg LSAT	decile 00-08	...
Whittier	1997-1999	141	91.78	White	Pass	Multi	Class One			...
Whittier	1997-1999	128	85.09	Other	Pass		Class One			...
Whittier	1997-1999	132	70.36	Other	Pass		Class One			...
Whittier	1997-1999	134	70.36	Hispanic	Pass	Multi	Class One			...
Pepperdine	1997-1999	143	70.59	White	Pass		Class One			...
Pepperdine	2000-2002	132	92.65	White	Pass	Multi	Class One			...
Pepperdine	2000-2002	144	84.2	White	Pass	Multi	Class One			...
Pepperdine	2000-2002	148	67.45	White	Pass		Class One			...

Identifiability of 11-Anonymity Dataset
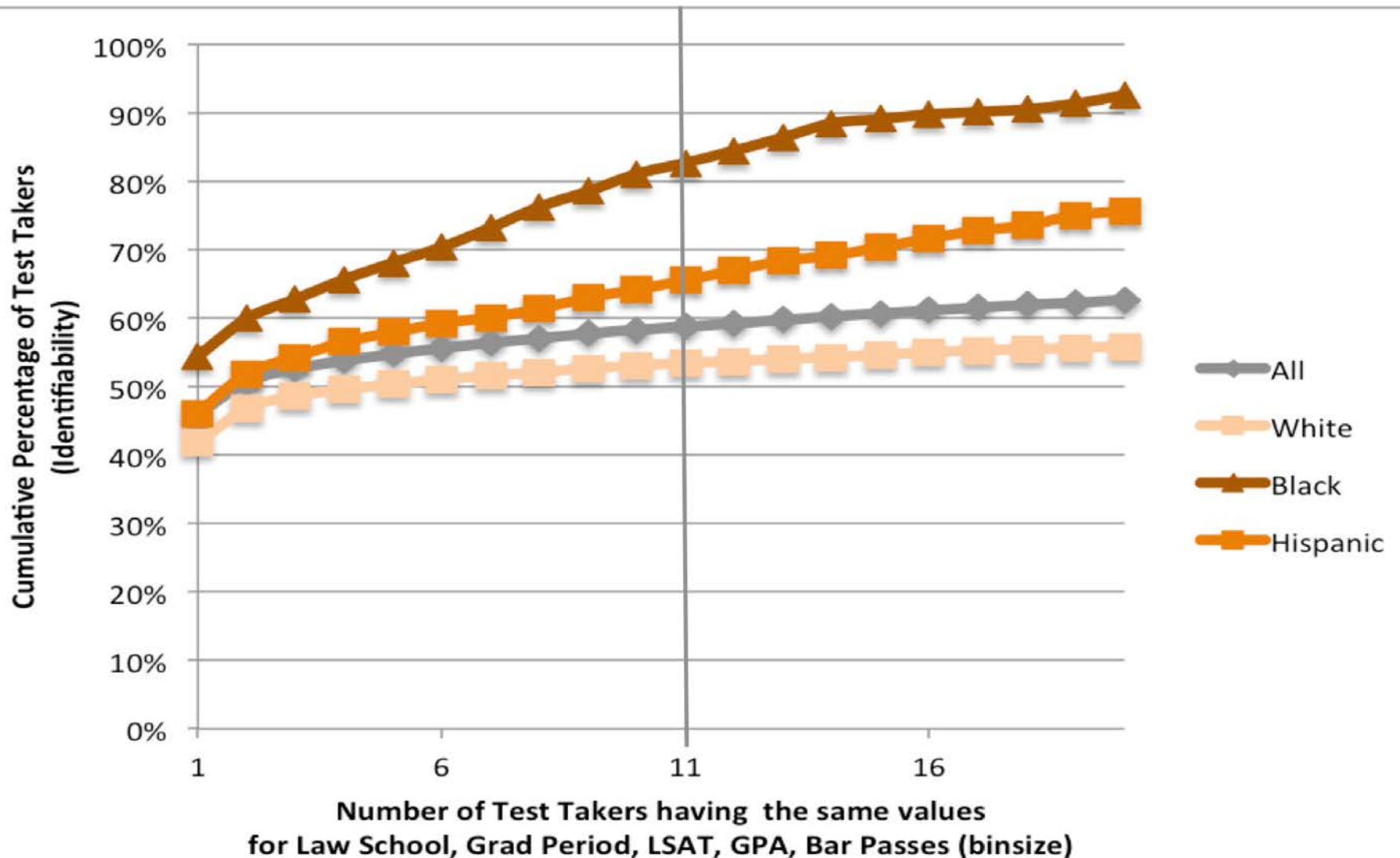
Law School Graduation Programs

Juris Doctor

JAY PAUL SPAGNOLA
Valedictorian
summa cum laude
Law Review
B.A., University of Maryland, College Park

DANIEL D. DROOG
Salutatorian
summa cum laude
Law Review, Honor Board
B.A., Dordt College

JESSE A. CRIPPS, JR.
summa cum laude
Law Review, Dean's Award
B.A., Pepperdine University

BETH ALICIA NUNNINK
summa cum laude
Law Review, Dean's Award
B.A., Luther College

CYNTHIA BURNS McCAUGHEY
magna cum laude
B.S., University of Redlands

TYLER CHRISTOPHER NEAL
magna cum laude
Law Review
B.A., Stanford University

JONATHAN BELL RUBENSTEIN
magna cum laude
Law Review
B.A., University of California, Los Angeles

NICOLLE TAYLOR
magna cum laude
CETL Certificate, Law Review
B.S., Pepperdine University

Official List of Attorneys

THE STATE BAR OF CALIFORNIA
Protecting the Public and Enhancing the Administration of Justice

ATTORNEY SEARCH

Daniel Dale Droog - #224596

Current Status: Active

This member is active and may practice law in California.
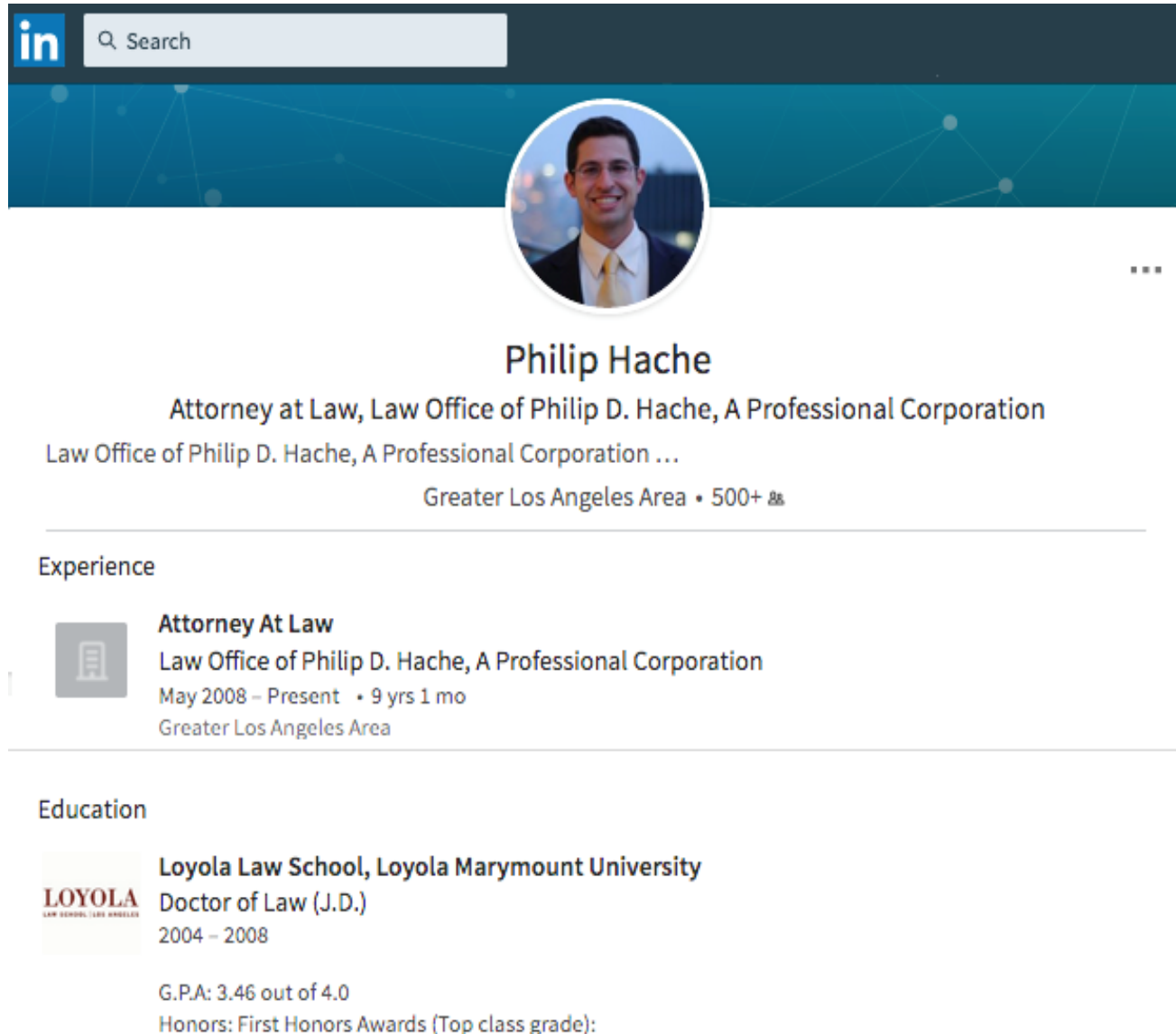
See below for more details.

Profile Information

The following information is from the official records of The State Bar of California.

Bar Number:	224596		
Address:	**Chevron Upstream and Gas Litigation Management Group 1400 Smith Fl 5 Houston, TX 77002**	**Phone Number:**	(713) 372-9071
		Fax Number:	Not Available
		e-mail:	Not Available
County:	**Non-California**	**Undergraduate School:**	Dordt Coll; Sioux Center IA
District:	Outside California		
Sections:	None	**Law School:**	Pepperdine Univ SOL; Malibu CA

Status History

Effective Date	Status Change
Present	Active
4/9/2003	Admitted to The State Bar of California

Self-Published Resumes w GPAs

Philip Hache

Attorney at Law, Law Office of Philip D. Hache, A Professional Corporation

Law Office of Philip D. Hache, A Professional Corporation …

Greater Los Angeles Area • 500+ 👥

Experience

Attorney At Law
Law Office of Philip D. Hache, A Professional Corporation
May 2008 – Present   • 9 yrs 1 mo
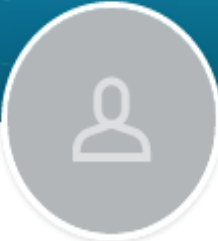Greater Los Angeles Area

Education

Loyola Law School, Loyola Marymount University
Doctor of Law (J.D.)
2004 – 2008

G.P.A: 3.46 out of 4.0
Honors: First Honors Awards (Top class grade):

Self-Published Resumes w LSATs

Photos of Graduation Classes

Natalie Griffiths

Greater Los Angeles Area

Attorney at InterCon Security Systems, Inc.

Legal Services

Show more
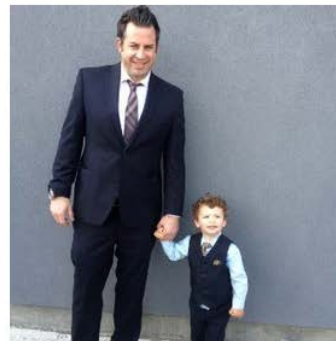
Paul Efstratis

San Francisco Bay Area

Law Practice

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Payam Khodadadi

Los Angeles, California

Associate at McGuireWoods LLP

Legal Services

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Peter C. Leonard

Greater Los Angeles Area

CPA and Attorney

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Rachel Stilwell

Greater Los Angeles Area

Owner at Law Offices of Rachel Stilwell

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Raven Sarnoff

San Francisco Bay Area

Partner at Sarnoff + Sarnoff, APLC

Law Practice

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Club Memberships

McGeorge School of Law Black Law Student Association

A member of

1968

Striving to Balance

NBLSA

BLSA PAST/PRESENT BOARD MEMBERS

2003-2004 Board: Denise Williams (Vice-President); Samantha Munroe (Treasurer); Christy LaPierre (Minority Affairs Representative).

2002-2003 Board: Shakira Pleasant (President); Marcia Randle (Vice-President); Mishael Pine (Secretary); Daune Kirrene (Treasurer).

BLSA PICTURES

	Bar Dataset	Grad Programs	Resumes Bios	Alumni lists	Club Members	Photos	Attorney Dataset
name							
lawschool							
gradYr							
lsat							
gpa		honors	honors	honors			
race		club name	club name photo	club name photo	club name photo	name photo	name
result							
tries		gradYr& passdate	gradYr& passdate	gradYr& passdate	gradYr& passdate	gradYr& passdate	gradYr& passdate
scores							
clubs							
honors							
photos							
passdate							
	complete recnum	complete	partial	partial	partial	partial	complete barnum

Re-identification stimulates improvement.

20 years later: privacy vulnerabilities exist.

25% re-identified in HIPAA Safe Harbor study

Best practices have privacy vulnerabilities.

Formal Protection Models Provide Privacy, but utility?

- K-anonymity

- Differential privacy

- Synthetic Data

Re-identification stimulates improvement.

20 years later: privacy vulnerabilities exist.

25% re-identified in HIPAA Safe Harbor study

Best practices have privacy vulnerabilities.

Formal protection models work but not appropriate for all uses.

What can be done?

1. Risk assessment instead of prescription
2. Sliding scales of access
3. Transparent processes

U.S. Commission on Evidence-Based Policy Making. CEP Final Report: The Promise of Evidence-Based Policymaking. https://www.cep.gov/cep-final-report.html

Sharing Sensitive Data with Confidence: The Datatags System

Latanya Sweeney, Mercè Crosas, and Michael Bar-Sinai

Tag Type	Description	Security Features	Access Credentials
Blue	Public	Clear storage, Clear transmit	Open
Green	Controlled public	Clear storage, Clear transmit	Email- or OAuth Verified Registration
Yellow	Accountable	Clear storage, Encrypted transmit	Password, Registered, Approval, Click-through DUA
Orange	More accountable	Encrypted storage, Encrypted transmit	Password, Registered, Approval, Signed DUA
Red	Fully accountable	Encrypted storage, Encrypted transmit	Two-factor authentication, Approval, Signed DUA
Crimson	Maximally restricted	Multi-encrypted storage, Encrypted transmit	Two-factor authentication, Approval, Signed DUA

Definitions for each of six ordered Blue to Crimson sample datatags.

- We introduce datatags as a means of specifying security and access requirements for sensitive data
- The datatags approach reduces the complexity of thousands of data-sharing regulations to a small number of tags
- We show implementation details for medical and educational data and for research and corporate repositories

Published 2015-10-16

techscience.org

Multi-level Repository   DataTags

Tag Type	Description
Blue	Public
Green	Controlled public
Yellow	Accountable
Orange	More accountable
Red	Fully accountable
Crimson	Maximally restricted

Multi-level Repository DataTags

Tag Type	Description	Security Features
Blue	**Public**	Clear storage Clear transmission
Green	**Controlled public**	Clear storage Clear transmission
Yellow	**Accountable**	Clear storage Encrypted transmit
Orange	**More accountable**	Encrypted storage Encrypted transmit
Red	**Fully accountable**	Encrypted storage Encrypted transmit
Crimson	**Maximally restricted**	MultiEncrypt store Encrypted transmit

Multi-level Repository DataTags

Tag Type	Description	Security Features	Access Requirements
Blue	**Public**	Clear storage Clear transmission	Open
Green	**Controlled public**	Clear storage Clear transmission	Email, OAuth verified registration
Yellow	**Accountable**	Clear storage Encrypted transmit	Password, Registered , Approval, Click DUA
Orange	**More accountable**	Encrypted storage Encrypted transmit	Password, Registered, Approval, Signed DUA
Red	**Fully accountable**	Encrypted storage Encrypted transmit	Two-factor authentication, Approval, Signed DUA
Crimson	**Maximally restricted**	MultiEncrypt store Encrypted transmit	Two-factor authentication, Approval, Signed DUA

Latanya Sweeney

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