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Meeting Info

Speaking: **Khaled El Emam**

Layout

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An Introduction to Re-identification Risk Measurement

Khaled El Emam
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Disclosures

- Khaled El Emam is co-founder and director of Replica Analytics Ltd, a spinoff company from the University of Ottawa / CHEO Research Institute specializing in the development of data synthesis software for health data. In December 2021 Replica was acquired by Aetion.

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Basic definitions – identity disclosure is when a person's identity is assigned to a record

Quasi-identifiers

Sex	Year of Birth	NDC
Male	1975	009-0031
Male	1988	0023-3670
Male	1972	0074-5182
Female	1993	0078-0379
Female	**1989**	**65862-403**
Male	1991	55714-4446
Male	1992	55714-4402
Female	1987	55566-2110
Male	1971	55289-324
Female	1996	54868-6348
Male	1980	53808-0540

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Sally

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Basic definitions – generalization means that more than one record can match a person

Sex	Year of Birth	NDC
Male	1970-1979	009-0031
Male	1980-1989	0023-3670
Male	1970-1979	0074-5182
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Female	**1980-1989**	**65862-403**
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Attacks can be in two directions – population to sample attack

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Female	1990-1999	54868-6348
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- medical history
- language
- income range
- ZIPS

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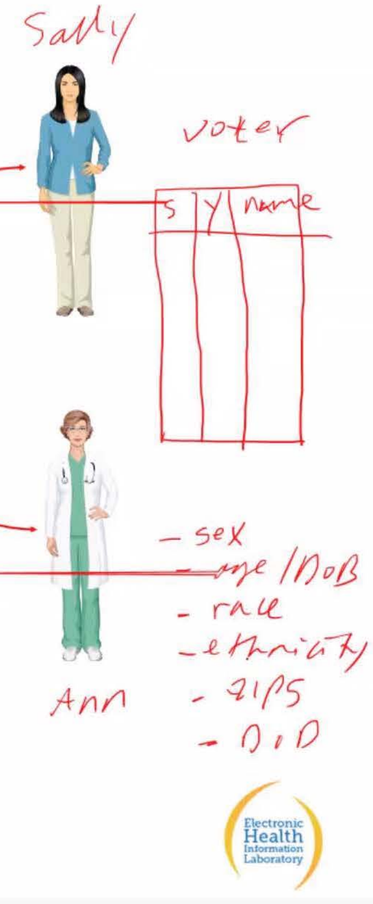

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Risk is measured by the group size

Sex	Year of Birth	NDC	Group Size	Risk
Male	1975	009-0031	1	1
Male	1988	0023-3670	1	1
Male	1972	0074-5182	1	1
Female	1993	0078-0379	1	1
Female	**1989**	**65862-403**	**1**	**1**
Male	1991	55714-4446	1	1
Male	1992	55714-4402	1	1
Female	1987	55566-2110	1	1
Male	1971	55289-324	1	1
Female	1996	54868-6348	1	1
Male	1980	53808-0540	1	1

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When we generalize the group size gets bigger, so the risk decreases

Sex	Decade of Birth	NDC	Group Size	Risk
Male	1970-1979	009-0031	3	0.33
Male	1980-1989	0023-3670	2	0.5
Male	1970-1979	0074-5182	3	0.33
Female	1990-1999	0078-0379	2	0.5
Female	**1980-1989**	**65862-403**	**2**	**0.5**
Male	1990-1999	55714-4446	2	0.5
Male	1990-1999	55714-4402	2	0.5
Female	**1980-1989**	**55566-2110**	**2**	**0.5**
Male	1970-1979	55289-324	3	0.33
Female	1990-1999	54868-6348	2	0.5
Male	1980-1989	53808-0540	2	0.5

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When we generalize the group size gets bigger, so the risk decreases

* public
* k-anonymity
- max = 0.5
strict average
- average ← * non-public
- uricity

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Male	1970-1979	009-0031	3	0.33
Male	1980-1989	0023-3670	2	0.5
Male	1970-1979	0074-5182	3	0.33
Female	1990-1999	0078-0379	2	0.5
Female	**1980-1989**	**65862-403**	**2**	**0.5**
Male	1990-1999	55714-4446	2	0.5
Male	1990-1999	55714-4402	2	0.5
Female	**1980-1989**	**55566-2110**	**2**	**0.5**
Male	1970-1979	55289-324	3	0.33
Female	1990-1999	54868-6348	2	0.5
Male	1980-1989	53808-0540	2	0.5

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But it is actually the population group size that matters

Sex	Year of Birth	NDC	Group Size	Risk
Male	1970-1979	009-0031	3	
Male	1980-1989	0023-3670	2	
Male	1970-1979	0074-5182	3	
Female	1990-1999	0078-0379	2	
Female	**1980-1989**	**65862-403**	**2**	**0.1**
Male	1990-1999	55714-4446	2	
Male	1990-1999	55714-4402	2	
Female	**1980-1989**	**55566-2110**	**2**	**0.1**
Male	1970-1979	55289-324	3	
Female	1990-1999	54868-6348	2	
Male	1980-1989	53808-0540	2	

N=10

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But it is actually the population group size that matters

sample

Sex	Year of Birth	NDC	Group Size	Risk
Male	1970-1979	009-0031	3	
Male	1980-1989	0023-3670	2	
Male	1970-1979	0074-5182	3	
Female	1990-1999	0078-0379	2	
Female	**1980-1989**	**65862-403**	**2**	**0.1**
Male	1990-1999	55714-4446	2	
Male	1990-1999	55714-4402	2	
Female	**1980-1989**	**55566-2110**	**2**	**0.1**
Male	1970-1979	55289-324	3	
Female	1990-1999	54868-6348	2	
Male	1980-1989	53808-0540	2	

N=10

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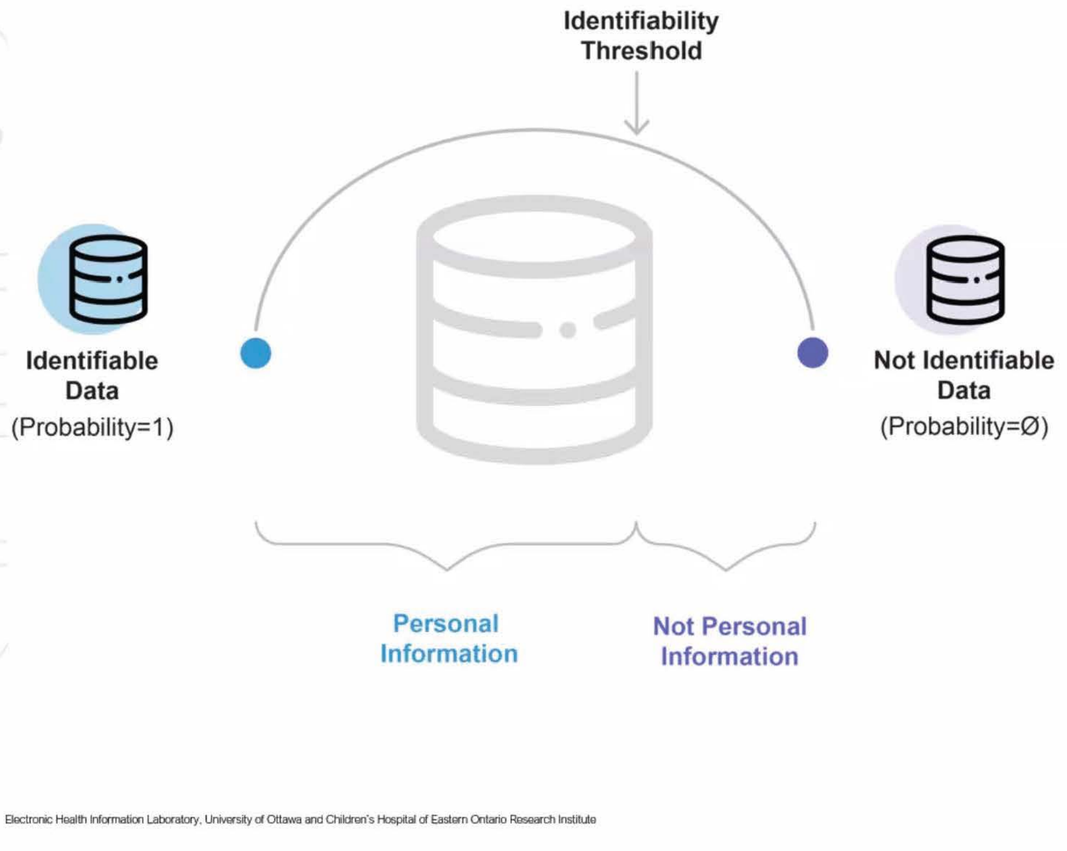
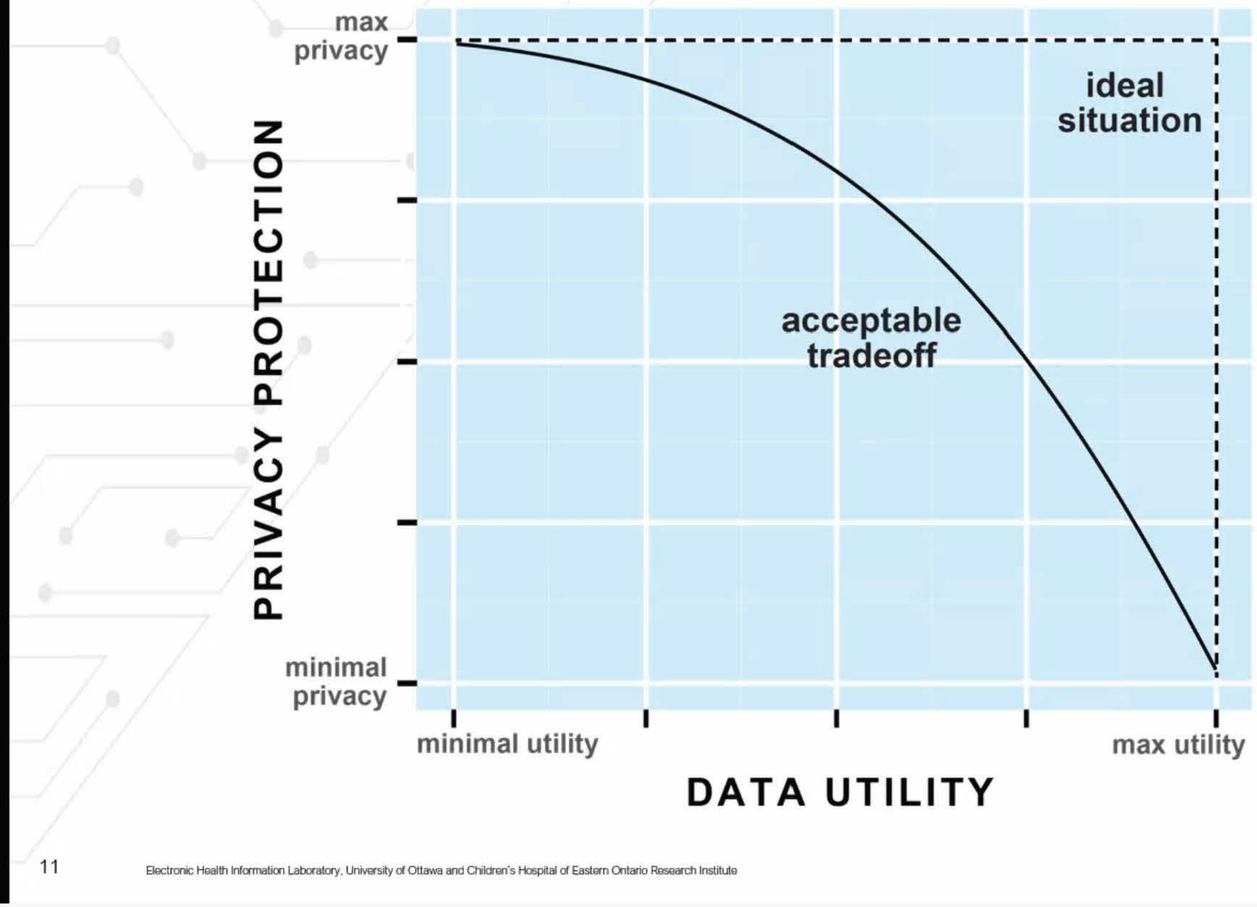
Identifiability spectrum and risk thresholds



Privacy-Utility Trade-off



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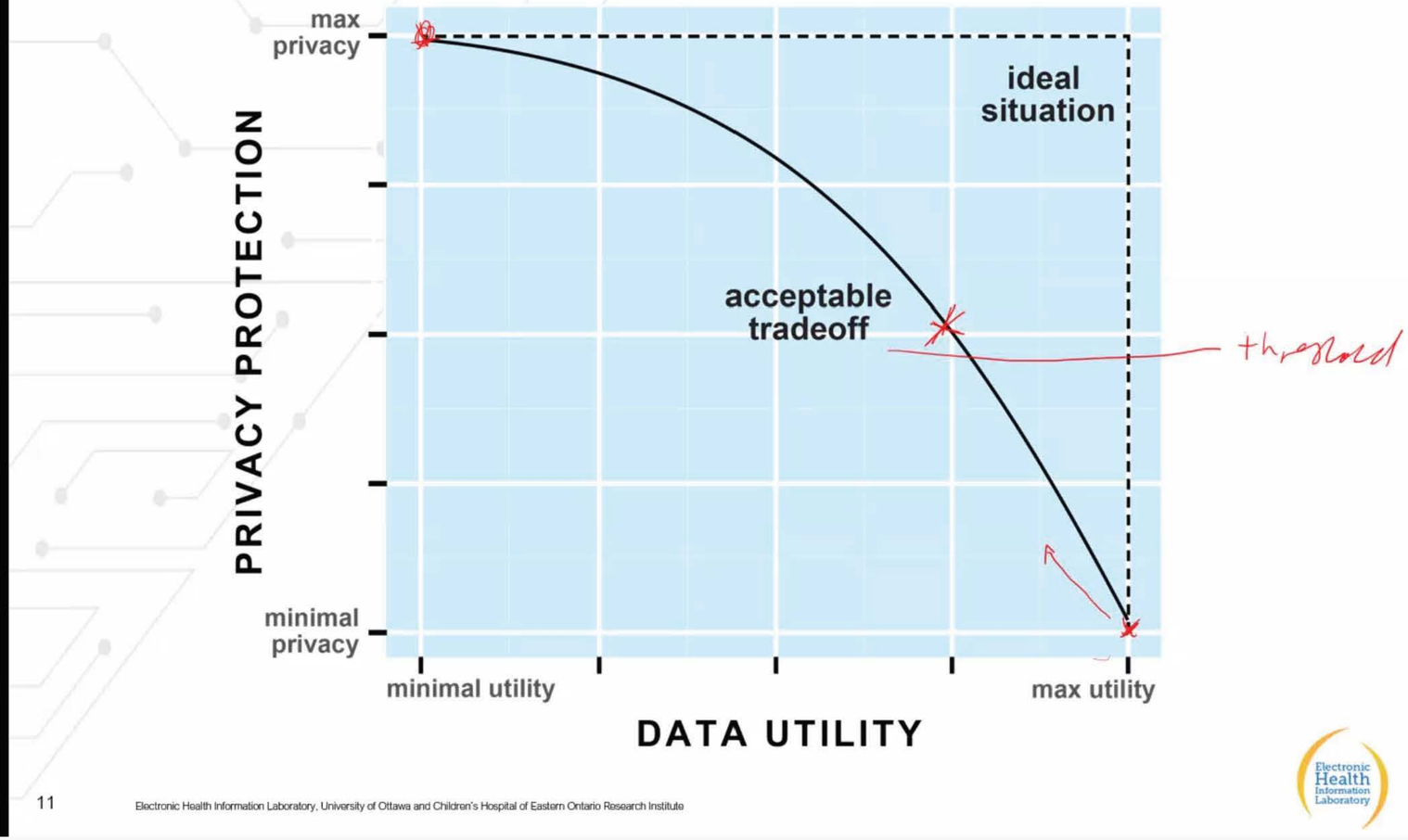

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A common approach that has worked well in practice is risk-based anonymization

Data Transformations

- Generalization
- Suppression
- Addition of noise
- Microaggregation

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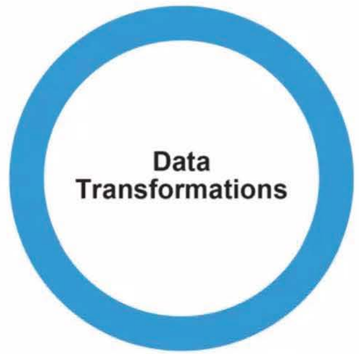
Controls

- Security controls
- Privacy controls
- Contractual controls

Non-public

A common approach that has worked well in practice is risk-based anonymization



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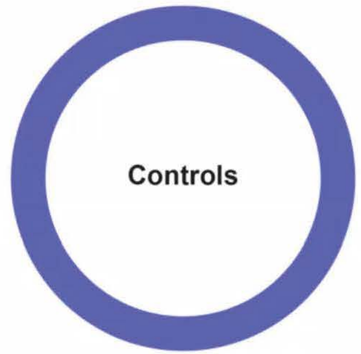

- Security controls
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