Using Big Data To Study Childhood Vision Disorders

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Big Data: a Hot Topic in the Health Care Arena

The NEW ENGLAND JOURNAL of MEDICINE

Learning from Big Health Care Data

Sebastian Schneeweiss, M.D., Sc.D.

Perspective

JUNE 5, 2014

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VIEWPOINT

Finding the Missing Link for Big Biomedical Data

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Big Data: Definition

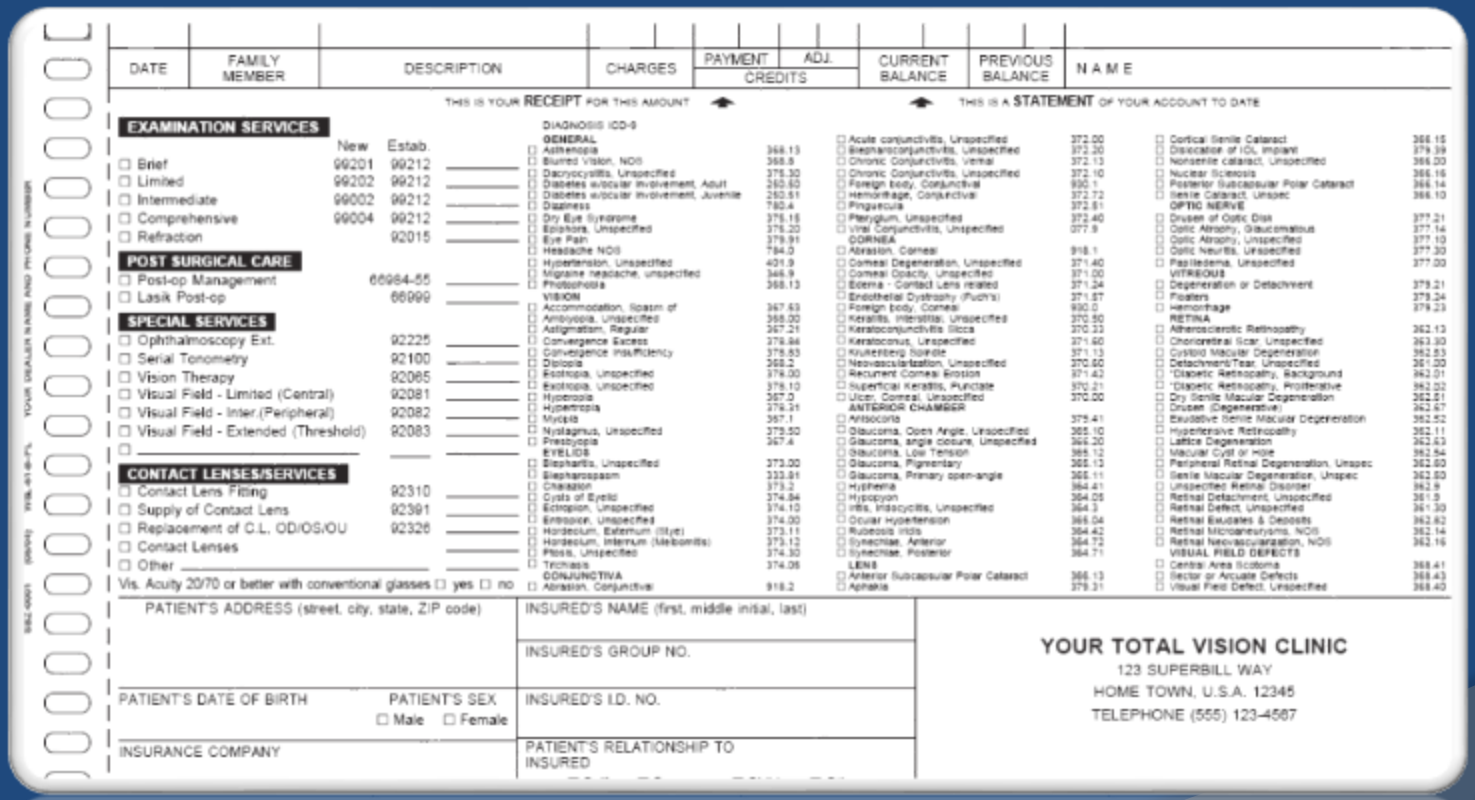
- **Big data** is a blanket term for any collection of data sets so large and complex that it becomes difficult to process using on-hand database management tools or traditional data processing applications.

(Wikipedia, accessed 11June 2014)

Examples of Big Health Care Data

- NEI: National Ophthalmic Disease Genotyping and Phenotyping Network (eyeGENE): e.g., genotyping on >1,000 retinitis pigmentosa subjects
- AAO: IRIS Registry: the nation's first electronic health record (EHR)–based comprehensive eye disease database. More than 20 million patient records will soon be available at the push of a button.
- Health care claims data

Use of Health Care Claims Data In Eye Care Practice



DATE	FAMILY MEMBER	DESCRIPTION	CHARGES	PAYMENT / ADJ. CREDITS	CURRENT BALANCE	PREVIOUS BALANCE	NAME

THIS IS YOUR **RECEIPT** FOR THIS AMOUNT ◄ ► THIS IS A **STATEMENT** OF YOUR ACCOUNT TO DATE

EXAMINATION SERVICES

	New	Estab.
☐ Brief	99201	99212
☐ Limited	99202	99212
☐ Intermediate	99002	99212
☐ Comprehensive	99004	99212
☐ Refraction		92015

POST SURGICAL CARE

☐ Post-op Management	66984-55
☐ Lasik Post-op	66999

SPECIAL SERVICES

☐ Ophthalmoscopy Ext.	92225
☐ Serial Tonometry	92100
☐ Vision Therapy	92065
☐ Visual Field - Limited (Central)	92081
☐ Visual Field - Inter.(Peripheral)	92082
☐ Visual Field - Extended (Threshold)	92083
☐ _____	

CONTACT LENSES/SERVICES

☐ Contact Lens Fitting	92310
☐ Supply of Contact Lens	92391
☐ Replacement of C.L. OD/OS/OU	92326
☐ Contact Lenses	
☐ Other _____	

Vis. Acuity 20/70 or better with conventional glasses ☐ yes ☐ no

DIAGNOSIS ICD-9

GENERAL
- ☐ Asthenopia 368.13
- ☐ Blurred Vision, NOS 368.8
- ☐ Dacryocystitis, Unspecified 375.30
- ☐ Diabetes w/ocular involvement, Adult 250.50
- ☐ Diabetes w/ocular involvement, Juvenile 250.51
- ☐ Dizziness 780.4
- ☐ Dry Eye Syndrome 375.15
- ☐ Epiphora, Unspecified 375.20
- ☐ Eye Pain 379.91
- ☐ Headache NOS 784.0
- ☐ Hypertension, Unspecified 401.9
- ☐ Migraine headache, unspecified 346.9
- ☐ Photophobia 368.13

VISION
- ☐ Accommodation, Spasm of 367.53
- ☐ Amblyopia, Unspecified 368.00
- ☐ Astigmatism, Regular 367.21
- ☐ Convergence Excess 378.84
- ☐ Convergence Insufficiency 378.83
- ☐ Diplopia 368.2
- ☐ Esotropia, Unspecified 378.00
- ☐ Exotropia, Unspecified 378.10
- ☐ Hyperopia 367.0
- ☐ Hypertropia 378.31
- ☐ Myopia 367.1
- ☐ Nystagmus, Unspecified 379.50
- ☐ Presbyopia 367.4

EYELIDS
- ☐ Blepharitis, Unspecified 373.00
- ☐ Blepharospasm 333.81
- ☐ Chalazion 373.2
- ☐ Cysts of Eyelid 374.84
- ☐ Ectropion, Unspecified 374.10
- ☐ Entropion, Unspecified 374.00
- ☐ Hordeolum, External (Stye) 373.11
- ☐ Hordeolum, Internum (Meibomitis) 373.12
- ☐ Ptosis, Unspecified 374.30
- ☐ Trichiasis 374.05

CONJUNCTIVA
- ☐ Abrasion, Conjunctival 918.2
- ☐ Acute conjunctivitis, Unspecified 372.00
- ☐ Blepharoconjunctivitis, Unspecified 372.20
- ☐ Chronic Conjunctivitis, Vernal 372.13
- ☐ Chronic Conjunctivitis, Unspecified 372.10
- ☐ Foreign Body, Conjunctival 930.1
- ☐ Hemorrhage, Conjunctival 372.72
- ☐ Pinguecula 372.51
- ☐ Pterygium, Unspecified 372.40
- ☐ Viral Conjunctivitis, Unspecified 077.9

CORNEA
- ☐ Abrasion, Corneal 918.1
- ☐ Corneal Degeneration, Unspecified 371.40
- ☐ Corneal Opacity, Unspecified 371.00
- ☐ Edema - Contact Lens related 371.24
- ☐ Endothelial Dystrophy (Fuch's) 371.57
- ☐ Foreign body, Corneal 930.0
- ☐ Keratitis, Interstitial, Unspecified 370.50
- ☐ Keratoconjunctivitis Sicca 370.33
- ☐ Keratoconus, Unspecified 371.60
- ☐ Kuruenberg Ispelate 371.13
- ☐ Neovascularization, Unspecified 370.60
- ☐ Recurrent Corneal Erosion 371.42
- ☐ Superficial Keratitis, Punctate 370.21
- ☐ Ulcer, Corneal, Unspecified 370.00

ANTERIOR CHAMBER
- ☐ Anisocoria 379.41
- ☐ Glaucoma, Open Angle, Unspecified 365.10
- ☐ Glaucoma, angle closure, Unspecified 365.20
- ☐ Glaucoma, Low Tension 365.12
- ☐ Glaucoma, Pigmentary 365.13
- ☐ Glaucoma, Primary open-angle 365.11
- ☐ Hyphema 364.41
- ☐ Hypopyon 364.05
- ☐ Iritis, Iridocyclitis, Unspecified 364.3
- ☐ Ocular Hypertension 365.04
- ☐ Rubeosis Iridis 364.42
- ☐ Synechiae, Anterior 364.72
- ☐ Synechiae, Posterior 364.71

LENS
- ☐ Anterior Subcapsular Polar Cataract 366.13
- ☐ Aphakia 379.31
- ☐ Cortical Senile Cataract 366.15
- ☐ Dislocation of IOL implant 379.39
- ☐ Nonsenile cataract, Unspec 366.00
- ☐ Nuclear Sclerosis 366.16
- ☐ Posterior Subcapsular Polar Cataract 366.14
- ☐ Senile Cataract, Unspec 366.10

OPTIC NERVE
- ☐ Drusen of Optic Disk 377.21
- ☐ Optic Atrophy, Glaucomatous 377.14
- ☐ Optic Atrophy, Unspecified 377.10
- ☐ Optic Neuritis, Unspecified 377.30
- ☐ Papilledema, Unspecified 377.00

VITREOUS
- ☐ Degeneration or Detachment 379.21
- ☐ Floaters 379.24
- ☐ Hemorrhage 379.23

RETINA
- ☐ Atherosclerotic Retinopathy 362.13
- ☐ Chorioretinal Scar, Unspecified 363.30
- ☐ Cystoid Macular Degeneration 362.53
- ☐ Detachment/Tear, Unspecified 361.00
- ☐ *Diabetic Retinopathy, Background 362.01
- ☐ *Diabetic Retinopathy, Proliferative 362.02
- ☐ Dry Senile Macular Degeneration 362.51
- ☐ Drusen (Degenerative) 362.57
- ☐ Exudative Senile Macular Degeneration 362.52
- ☐ Hypertensive Retinopathy 362.11
- ☐ Lattice Degeneration 362.63
- ☐ Macular Cyst or Hole 362.54
- ☐ Peripheral Retinal Degeneration, Unspec 362.60
- ☐ Senile Macular Degeneration, Unspec 362.50
- ☐ Unspecified Retinal Disorder 362.9
- ☐ Retinal Detachment, Unspecified 361.9
- ☐ Retinal Defect, Unspecified 361.30
- ☐ Retinal Exudates & Deposits 362.82
- ☐ Retinal Microaneurysms, NOS 362.14
- ☐ Retinal Neovascularization, NOS 362.16

VISUAL FIELD DEFECTS
- ☐ Central Area Scotoma 368.41
- ☐ Sector or Arcuate Defects 368.43
- ☐ Visual Field Defect, Unspecified 368.40

PATIENT'S ADDRESS (street, city, state, ZIP code)

INSURED'S NAME (first, middle initial, last)

INSURED'S GROUP NO.

PATIENT'S DATE OF BIRTH

PATIENT'S SEX ☐ Male ☐ Female

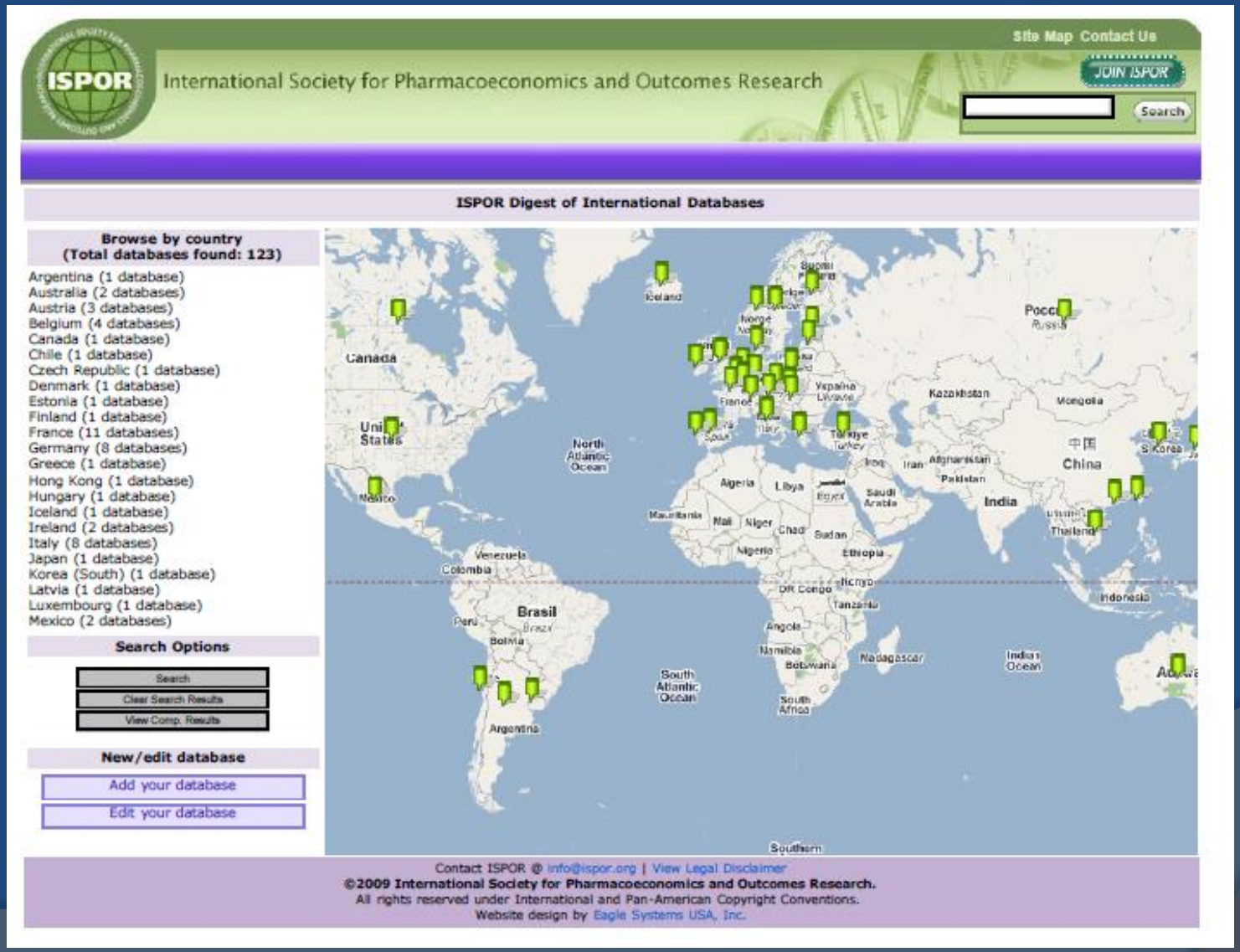
INSURED'S I.D. NO.

INSURANCE COMPANY

PATIENT'S RELATIONSHIP TO INSURED

YOUR TOTAL VISION CLINIC
123 SUPERBILL WAY
HOME TOWN, U.S.A. 12345
TELEPHONE (555) 123-4567

Claims Databases



Claims Databases

United States (41 databases)

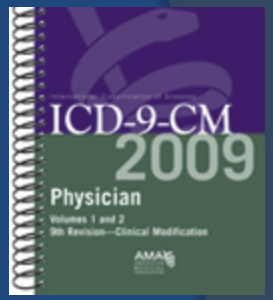
Anceta Collaborative Patient Data Warehouse
Behavioral Risk Factor Surveillance System
Cancer of the Prostate Strategic Urologic Research Endeavor
Centers for Medicaid and Medicare Services
CMS National Coverage Decisions (NCDs) Database
Cost-Effectiveness Analysis Registry
GE Healthcare Centricity Database
Health Data Interactive
Health Facts
HIV/AIDS Medical Record & Case Mgmt Database
i3 InVision Data Mart (LabRx)
IMS LifeLink Health Plan Claims Database
IMS LifeLink LRx
Incidence and Prevalence Database
Inpatient acute rehab patient data
Kids' Inpatient Database
KIMS (Pfizer International Metabolic Database)
MarketScan Claims Databases
MarketScan Hospital Drug Database
MedMining (Geisinger Health System)
National Center for Health Statistics
National Health and Wellness Survey, US
Nationwide Inpatient Sample
Pediatric Inpatient and Outpatient Rehab
Pharmacist PBN Database
Premier Perspective Hospital Database
Saint Louis University Center for Outcomes Research
SDI Patient-Level Data
Slone Survey
State Ambulatory Surgery Databases
State Emergency Department Databases
State Inpatient Databases (SID), United States
State Tobacco Activities Tracking and Evaluation System
Syndicated Select, HIV
Syndicated Select, Psoriasis
Syndicated Select, Schizophrenia
United States Transplant
Varian Medical Oncology

Database Sample Size

Database	Years	Total covered lives
GE Healthcare	1996-2008	6.3 million
Market Scan	1992-2008	29.1 million
i3 Data Mart	2000-2008	39 million
5% Medicare	1991-2008	1.3 million / y (approx.)
100% Medicare	–	34 million
Pharmetrics	2000-2008	50 million

What's In These Databases?

- Demographics (e.g., age, sex, race)
- Socioeconomic data (e.g., education, income)
- Diagnoses (ICD-9CM codes)
- Procedures (CPT-4 codes)
  - Office visits, diagnostic procedures, therapeutic procedures
- Outpatient prescriptions
- Outpatient laboratory data



What's in These Databases?

- Some additional variables
  - Insurance Type
    - Medicare, Medicaid, Commercial
  - Plan Type
    - HMO, PPO, POS
  - Charges
  - Copays
  - Deductibles

Advantages of Using Claims Data

- Large (huge) sample size
- Longitudinal data
- Permits community-based comparisons
- Avoids some common biases
- Allows for study of uncommon conditions and outcomes
- Accurate information (mostly)
- Good for comparative effectiveness
- De-identified

i3 Data Mart Database (2001–2008)

Unique individuals receiving eye care	8,296,518
Encounters (eye or non-eye)	688,457,278
Outpatient prescriptions	353,764,159
Outpatient lab tests	248,559,262
OAG patients	230,371

Uncommon Conditions In Databases

Uncommon Condition	i3 Data Mart Database	Observational Series in the Literature
Endophthalmitis	In 2001 alone: **424** unique pts.	All PPVs, BPEI ,1984–2004: **598** cases
Central retinal artery occlusion	**14,397** unique pts.	Single institution, CRAO/ HRAO/ BRAO: **416** pts.
Angle recession glaucoma	**2,318** unique pts.	U.S. Eye Injury Registry, 1988–2003: **97** pts.
Granular corneal dystrophy	**433** unique pts.	Mostly case reports; largest series: **10** pts.

Using Claims Data: Research Issues

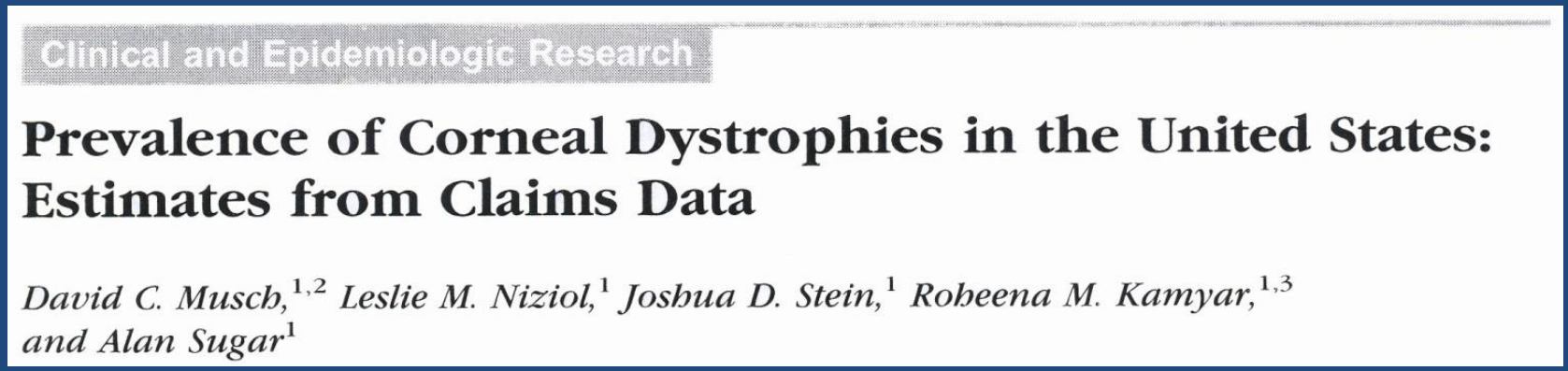
- Retrospective
- Drawing inferences about other populations
- Data accuracy: proper identification/billing of condition
- Only conditions with ICD-9/CPT codes
- Lack of eye laterality information
- De-identified
- Need for validation of ICD-9/CPT codes

Validation of Eye-Related ICD-9 Codes

Condition	No. of Providers	No. of charts reviewed	Correctly documented at visit
Ocular HTN	17	97	86%
Pre-glaucoma	13	98	93%
POAG	22	100	97%
Cataract	14	102	96%
Dry AMD	21	101	93%
NPDR	10	109	92%
PDR	8	109	92%
CSME	9	104	91%

Examples of Studies Performed Using Claims Data

- Incidence & prevalence studies:



Clinical and Epidemiologic Research

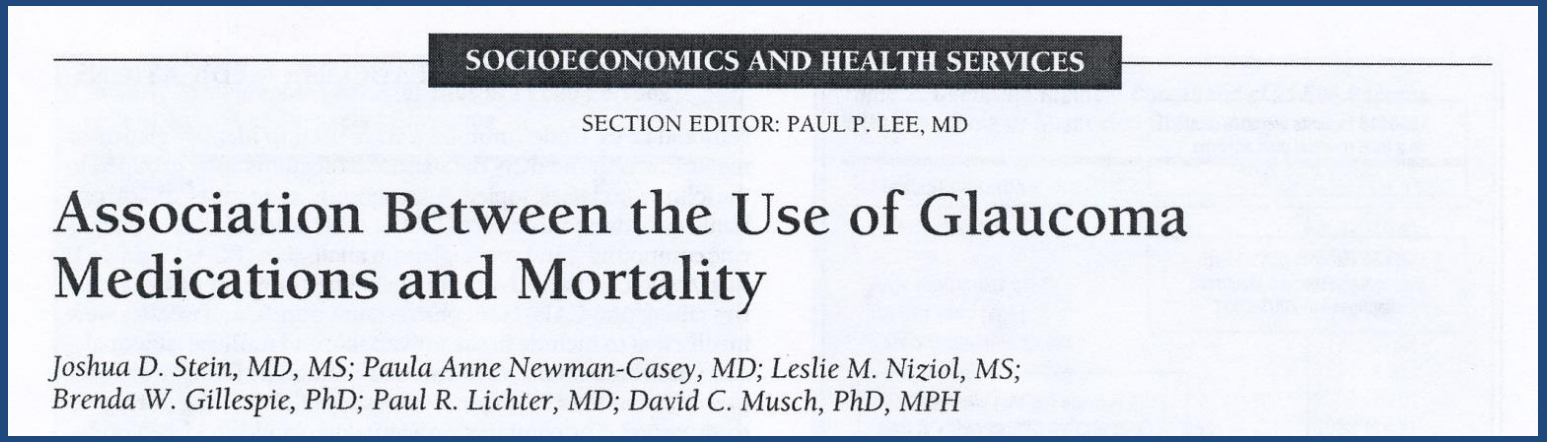
Prevalence of Corneal Dystrophies in the United States: Estimates from Claims Data

David C. Musch,[1,2] *Leslie M. Niziol,*[1] *Joshua D. Stein,*[1] *Roheena M. Kamyar,*[1,3] *and Alan Sugar*[1]

Invest Ophthalmol Vis Sci 2011; 52:6959-63

Examples of Studies Performed Using Claims Data

- Association of treatment with serious adverse events:



SOCIOECONOMICS AND HEALTH SERVICES

SECTION EDITOR: PAUL P. LEE, MD

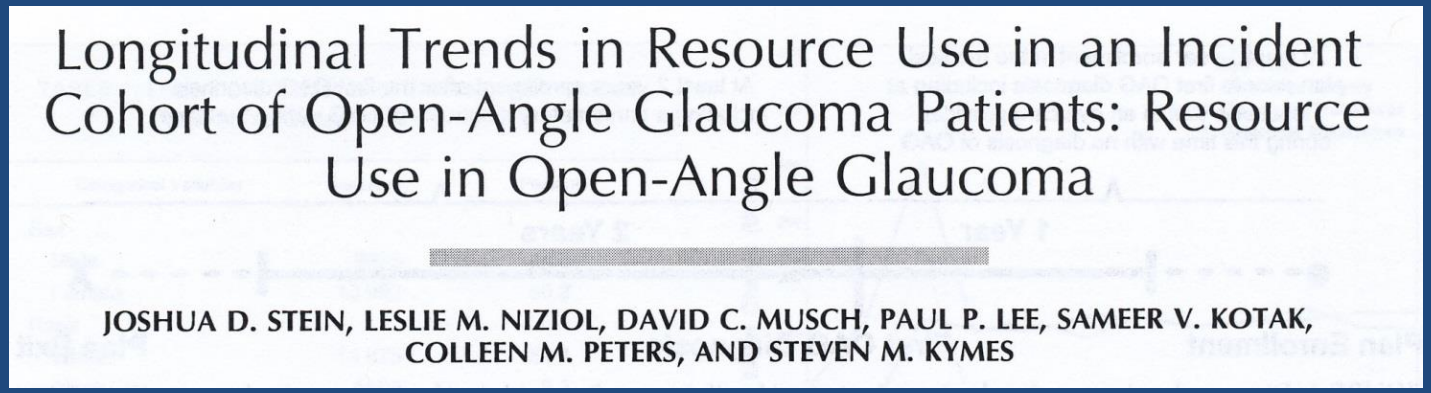
Association Between the Use of Glaucoma Medications and Mortality

Joshua D. Stein, MD, MS; Paula Anne Newman-Casey, MD; Leslie M. Niziol, MS; Brenda W. Gillespie, PhD; Paul R. Lichter, MD; David C. Musch, PhD, MPH

Arch Ophthalmol 2010; 128:235-40

Examples of Studies Performed Using Claims Data

- Utilization of services:



Longitudinal Trends in Resource Use in an Incident Cohort of Open-Angle Glaucoma Patients: Resource Use in Open-Angle Glaucoma

JOSHUA D. STEIN, LESLIE M. NIZIOL, DAVID C. MUSCH, PAUL P. LEE, SAMEER V. KOTAK, COLLEEN M. PETERS, AND STEVEN M. KYMES

Am J Ophthalmol 2012; 154:452-9

Summary

- Gold mine of information present in health care claims databases
- Claims data can be used to study outcomes of patients being treated for an array of ocular conditions
- Important to understand the advantages and limitations when using claims data for research purposes

Acknowledgments

Research Collaborators

University of Michigan

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- Paul P. Lee, MD, JD
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- Taylor Blachley, MS
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