BRIGHAM HEALTH

BWH BRIGHAM AND WOMEN'S HOSPITAL

Improving Patient Safety with Population Health Informatics Decision Support

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**HARVARD MEDICAL SCHOOL TEACHING HOSPITAL**

A FOUNDING MEMBER OF **PARTNERS** HEALTHCARE

Agenda

- **About Partners / BWH / Emergency Medicine**

- Patient Safety and Medication Errors

- Whole population healthcare data analysis (SHAARP/PEC)

- Case studies

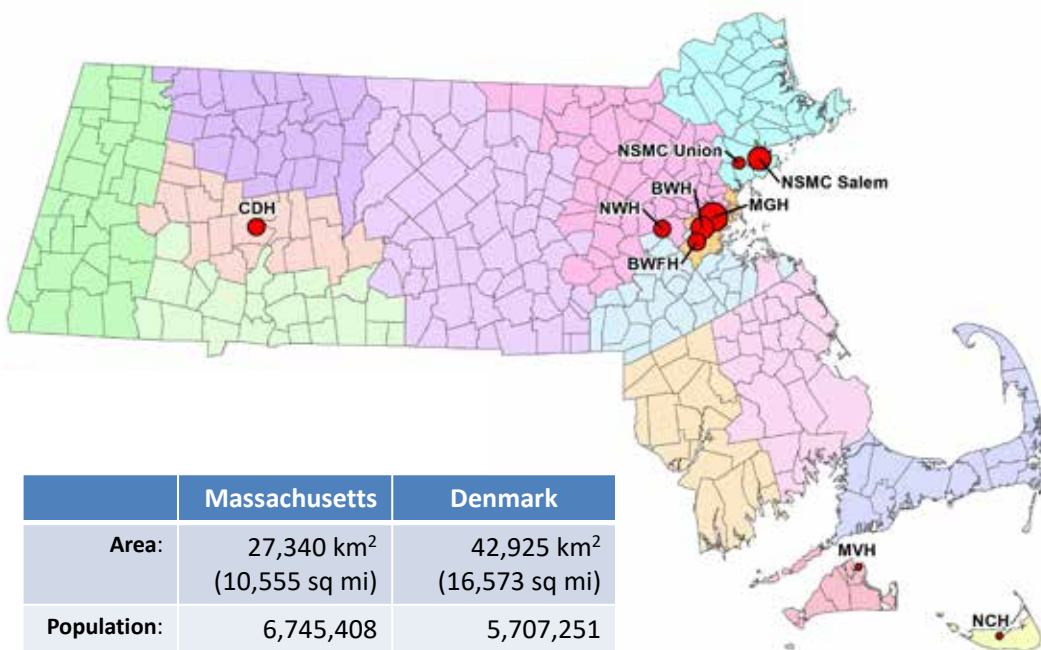**An integrated health system serving over 6 million patients in the Massachusetts and New England area:**

- 2 academic medical centers, 6 community hospitals, 1 psychiatric hospital

- Spaulding Rehabilitation Network (7 rehab hospitals, skilled nursing and long-term care facilities, 23 outpatient sites)

- Partners Community Physicians Organization (network of over 2,000 primary care physicians)

- Partners Urgent Care (outpatient clinics for minor problems)

- Partners HealthCare At Home (visiting nurses, home health aides)

- MGH Institute of Health Professions (graduate school for nursing and allied health professions)

- A principal teaching affiliate of Harvard Medical School

- Committed to patient care, research, teaching and service to the community

- Partners HealthCare is a non-profit organization
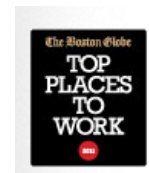
Partners Regional Acute Care Hospital Network

8 Partners Acute Care Hospitals with Emergency Departments

Name	Hospital beds	Hospital admits	ED volume
BWH	779	45,352	62,098
MGH	947	48,587	95,764
NSMC	411	18,695	90,933
NWH	216	16,405	50,522
BWFH	86	7,572	25,505
CDH	86	7,908	36,575
MVH	25	1,372	14,111
NCH	19	639	10,906
Total	**2,569**	**146,530**	**386,414**

	Massachusetts	Denmark
Area:	27,340 km^2 (10,555 sq mi)	42,925 km^2 (16,573 sq mi)
Population:	6,745,408	5,707,251

PARTNERS HEALTHCARE

BRIGHAM AND WOMEN'S HOSPITAL

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

EMI EMERGENCY MEDICINE INTERNATIONAL

Brigham and Women's Hospital Vital Statistics

Tertiary Care University Hospital Referral Center, Level 1 Trauma, Burn, Cardiac, Stroke Center

- **793-bed teaching affiliate of Harvard Medical School**

  - 47 operating rooms at Brigham and Women's Hospital

  - 150 ambulatory practices in the Greater Boston area

  - More than 15,000 employees, including 2,700 physicians, fellows and residents; 1,000 research MDs/PhDs; and 2,400 nurses.

- **Inpatient admissions totaled 49,723 in FY 2017**

  - More than 2.2 million ambulatory encounters.

  - Over 60,000 Emergency Department visits.

  - Largest birthing center in Massachusetts, approximately 7,000 babies born and NICU cares for over 900 infants annually.

- **126 graduate medical education programs**

  - Nearly 1,200 trainees in these programs

  - Clinical training ground for Harvard Medical School students

http://www.brighamandwomens.org/research/bri/default.aspx

- 10 disease-focused research centers, 5 resource and technology-based programs

- Clinical, translational and basic science research

- Over 1,000 research MDs/PhDs; 3,500 professional and technical staff

- 2nd largest recipient of National Institutes of Health (NIH) funding among independent hospitals

- 4 MacArthur Fellows and 3 Nobel Laureates

- An international leader in biomedical research

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Patient Safety and Medication Errors

- **Patient Safety = Prevention of Harm**
  - Harm = Adverse events
  - Medical errors (preventable or not)

  ["To Err is Human", IOM, 2000; James Reason; Harvard Medical Practice Study]

- **Medical errors**
  - Failure to choose an appropriate method of care
  - Improper execution of appropriate method of care

- **Medication errors most common source of harm**
  - **20% of all incidents of harm**   *[de Vries et. al. Qual Saf Health Care 2008; 17 3:216–223.]*
  - **Prescription (16%) and administration (50%) most common points of error in the UK**

  [National Patient Safety Agency. Safety in Doses: Improving the use of medicines in the NHS. 2009.]

		Medical Error	
		yes	no
Adverse Event	yes	Preventable Adverse Event	Non-preventable Adverse Event
	no	Near Miss	Adequate Care

Medication Error Rates

What we see

What we don't see
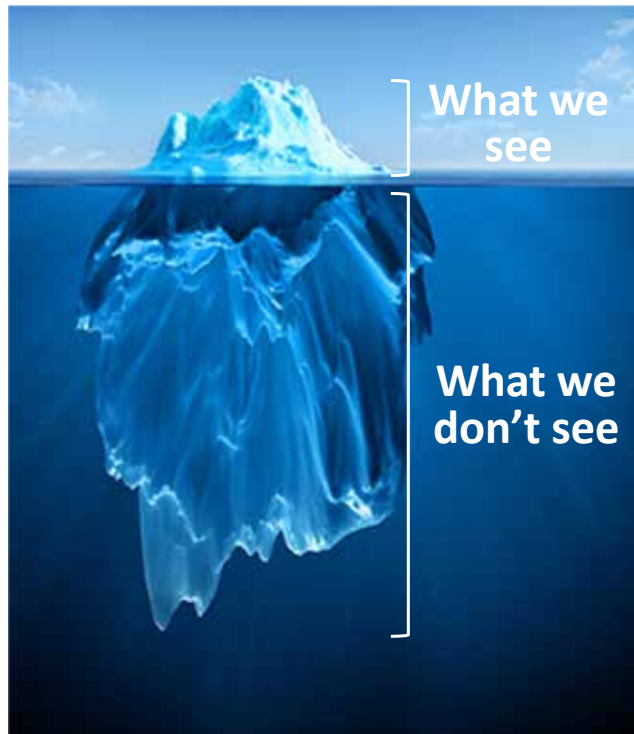
- Significant variability in reported estimates
  - Middle East (7% - 90%)
  - Southeast Asia (15% - 88%)

- Workplace cultural norms about errors and incident reporting affects data quality

- Reports suggest that up to 95% of medication errors are not reported

Hume M. *Qual Lett Healthc Lead* 1999; 11 3:2–9.

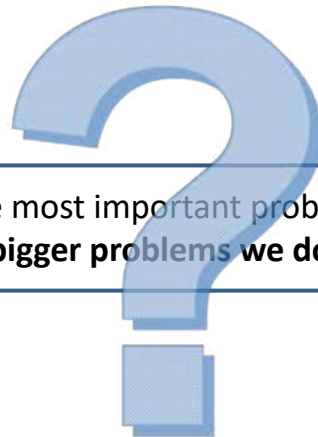Mayo AM, Duncan D. *J Nurs Care Qual* 2004; 19 3:209–217.

Westbrook JI, et al. *Int J Qual Health Care* 2015; 27 1:1–9.

Medication Error Rates

What we see

What we don't see
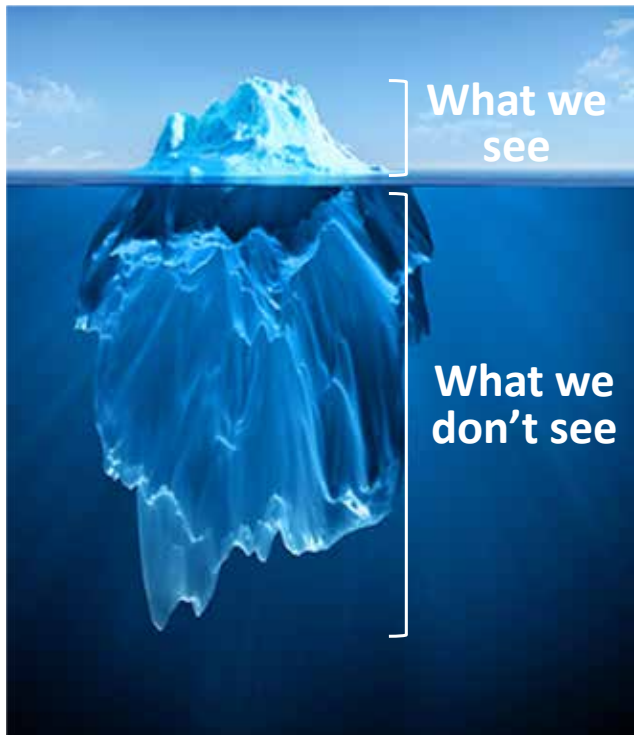
We focus on **the problems we know about** through inadequate reporting mechanisms.

Are these the most important problems to fix, or are there **other, bigger problems we don't know about**?

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Region Halland – Sweden

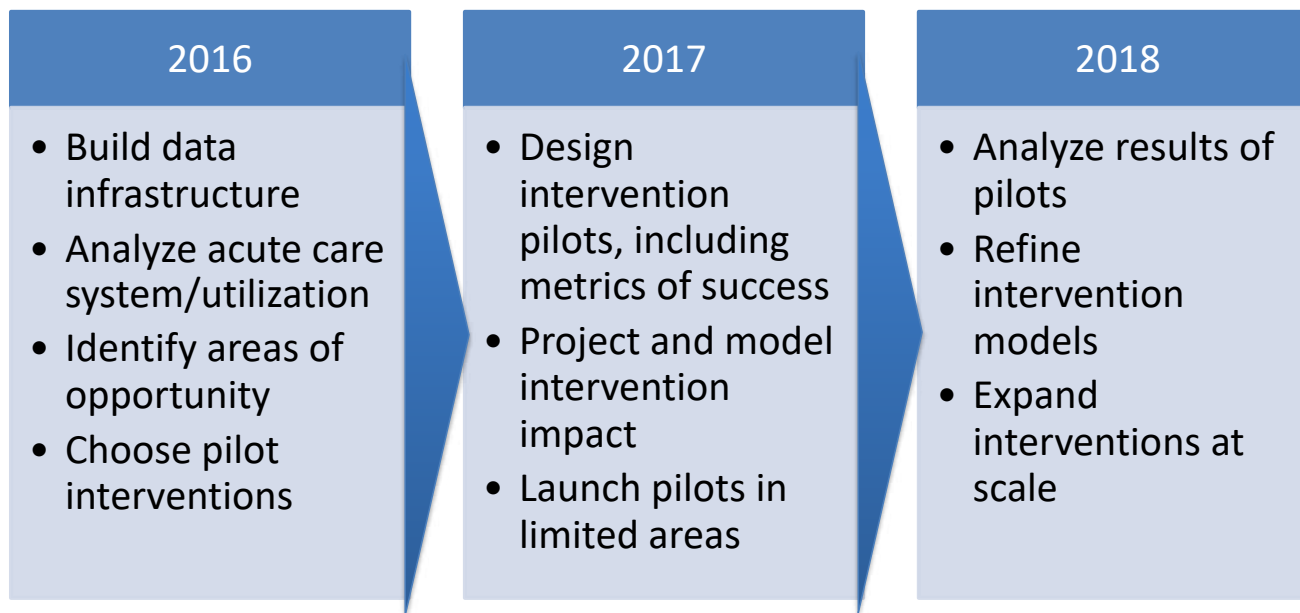Located in southern Sweden

Population = 300,000

2 Acute care hospitals, 50 primary care centers, 6 municipal social care institutions

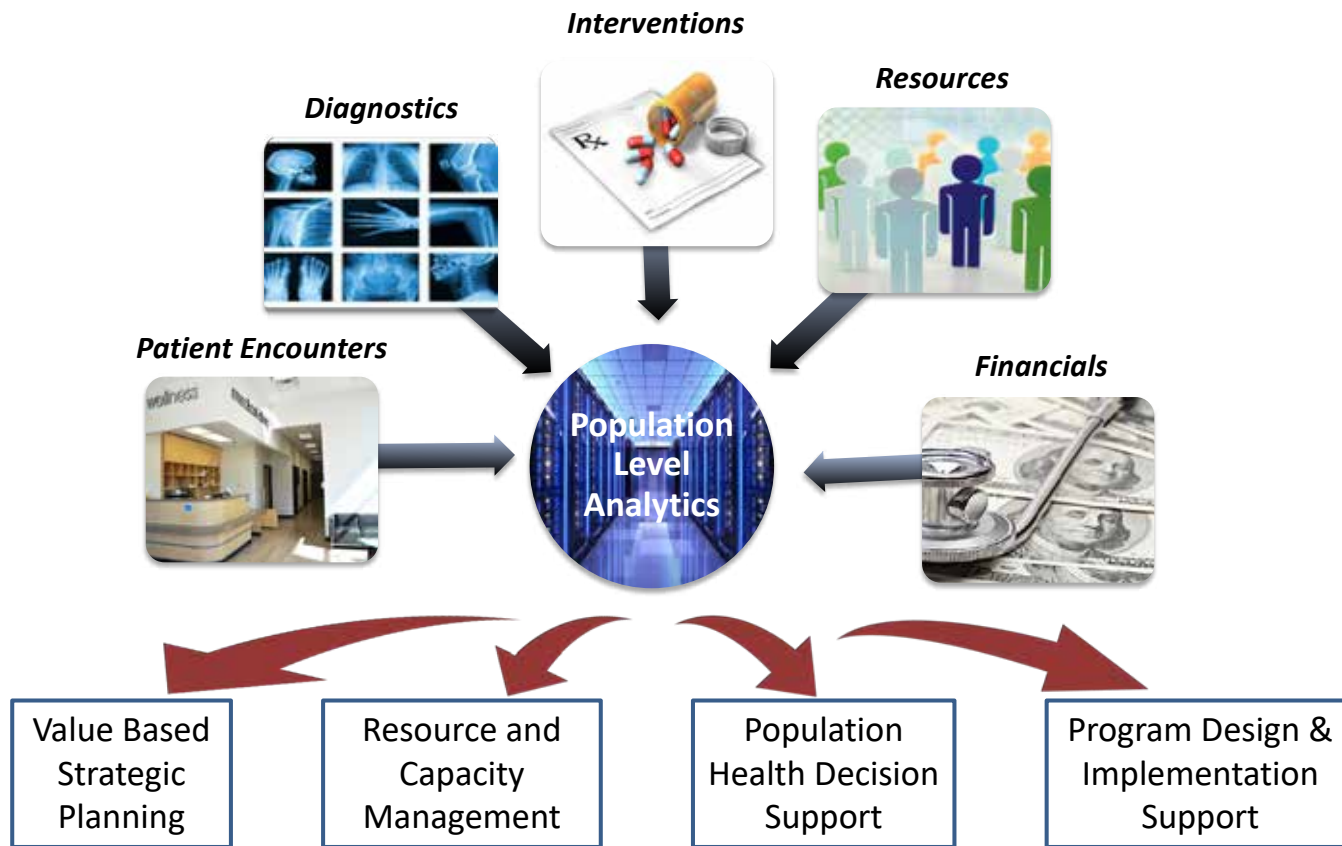**Healthcare System Challenges:**

- Increased demand for acute care

- Silo structure driving costs holding back quality improvement

- Sub-optimized workflow within and between hospitals

- No system level data synchronization

# Analytics were first step in a multi-year plan to improve acute care

2016	2017	2018
• Build data infrastructure • Analyze acute care system/utilization • Identify areas of opportunity • Choose pilot interventions	• Design intervention pilots, including metrics of success • Project and model intervention impact • Launch pilots in limited areas	• Analyze results of pilots • Refine intervention models • Expand interventions at scale

System Wide Data Integration Allows System-Level Thinking

Interventions

Diagnostics

Resources

Patient Encounters

Population Level Analytics

Financials

Value Based Strategic Planning	Resource and Capacity Management	Population Health Decision Support	Program Design & Implementation Support

SHAARP Toolbox
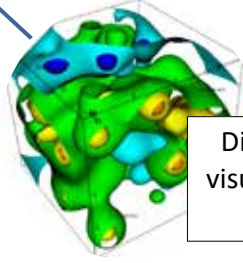
Strategic Healthcare Analytic and Research Platform

Analytic tool set provides quantitative insights to support value-based policy and decision making
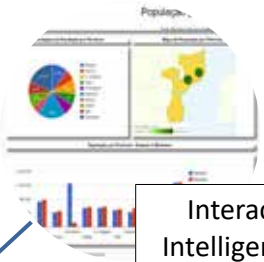


Interactive Business Intelligence Dashboards

SHARP Database (Microsoft SQL)

Analytic tools (variability/ROI analysis)

Discrete event visual simulation modeling

Strategic Healthcare Analytic and Research Platform (SHAARP)

- Whole population healthcare data set

- All healthcare encounters for all patients

- All diagnoses for encounters

- Labs, diagnostic studies, medications given, procedures

- Outpatient prescriptions, meds picked up at pharmacy

- Care delivery system capacity information

- Patient encounter level cost information

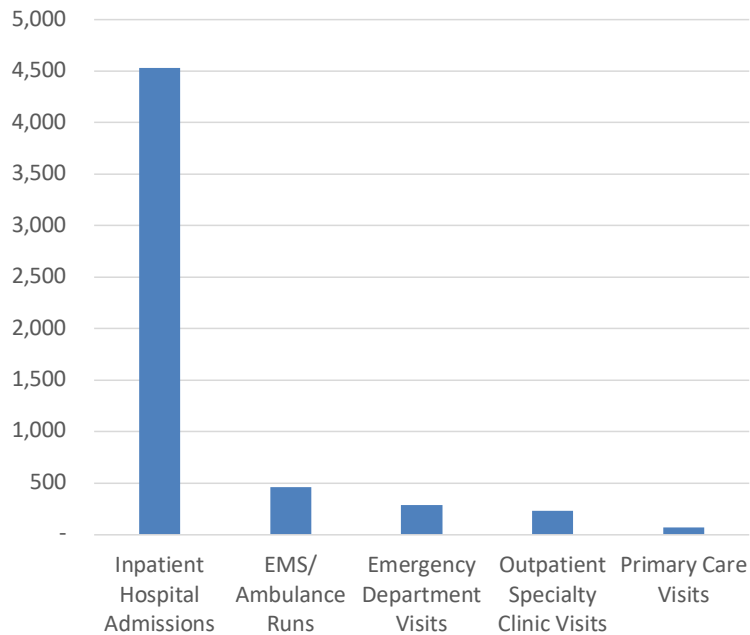- All data crosslinked using unique patient identifier
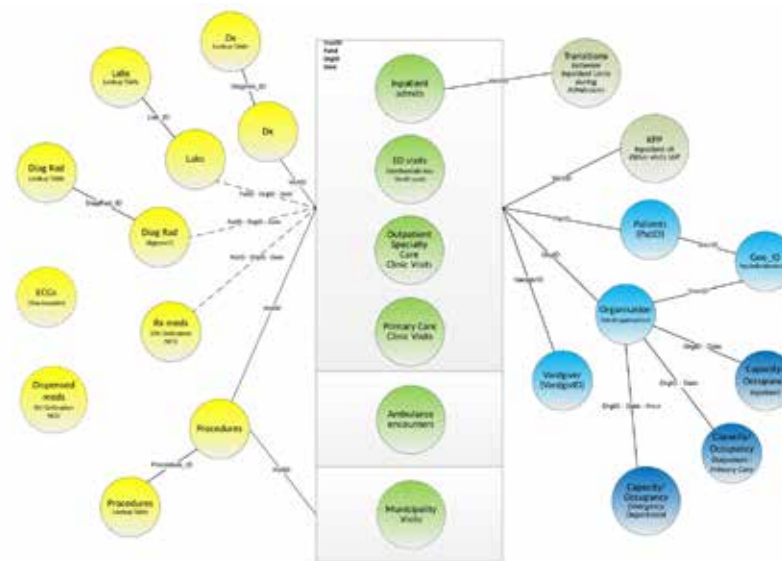
Patient Encounter Costing (PEC) provides insight into cost drivers at the clinical encounter level

- Based on principles of Time Driven Activity Based Costing (TDABC)

- Calculates Capacity
  - Resource availability data (beds, personnel, etc.)
  - Productivity assumptions
  - Calculates and incorporates unused capacity

- Major categories of healthcare encounters
  - Inpatient admissions
  - Emergency department visits
  - Primary care visits
  - Outpatient specialty clinic visits
  - Ambulance runs

Financial data

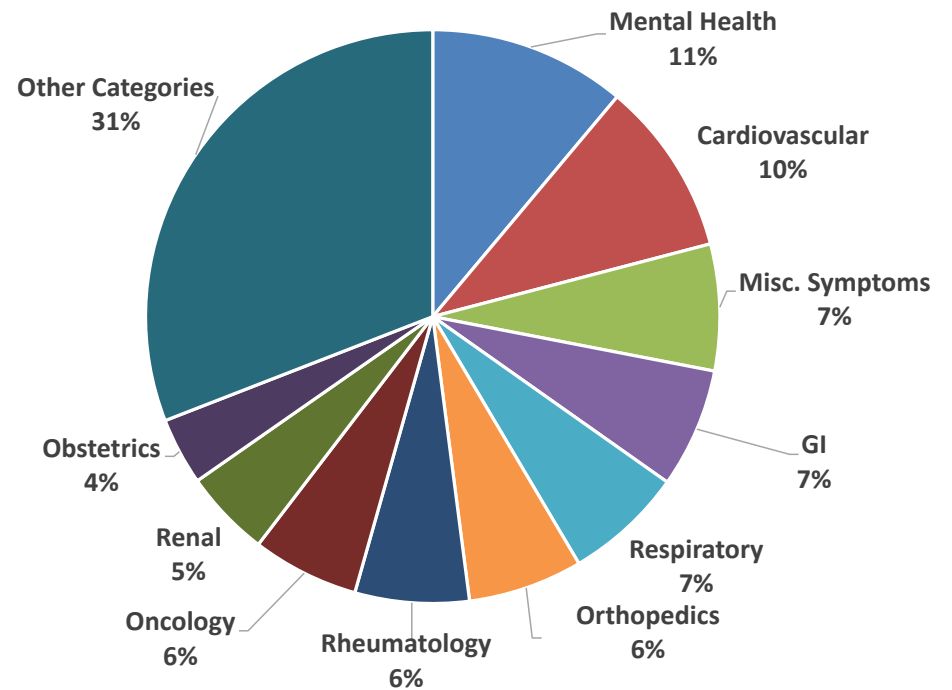Human Resource data

Operational data

PEC
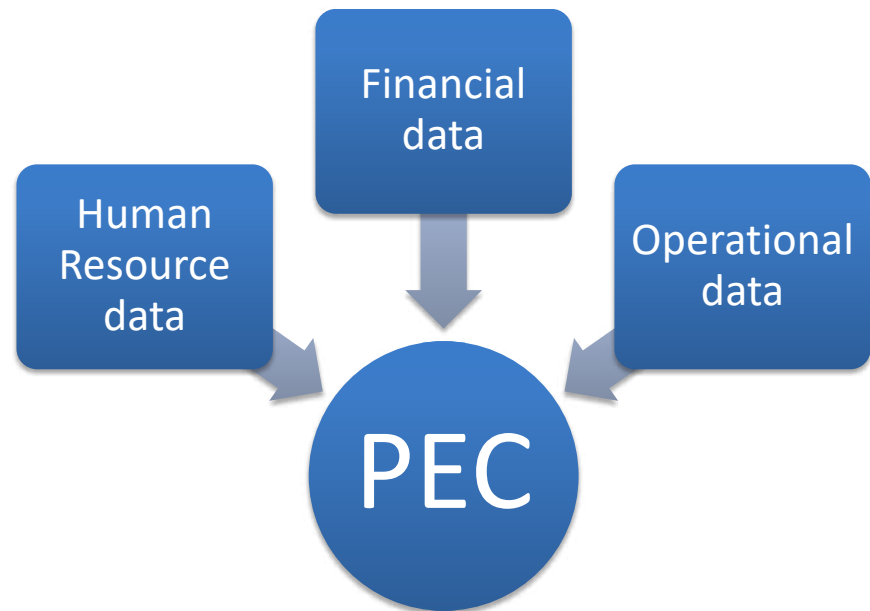
Patient Encounter Costing (PEC) provides complete insight into the drivers of cost at the clinical encounter level

Average Cost per Encounter (EUR)
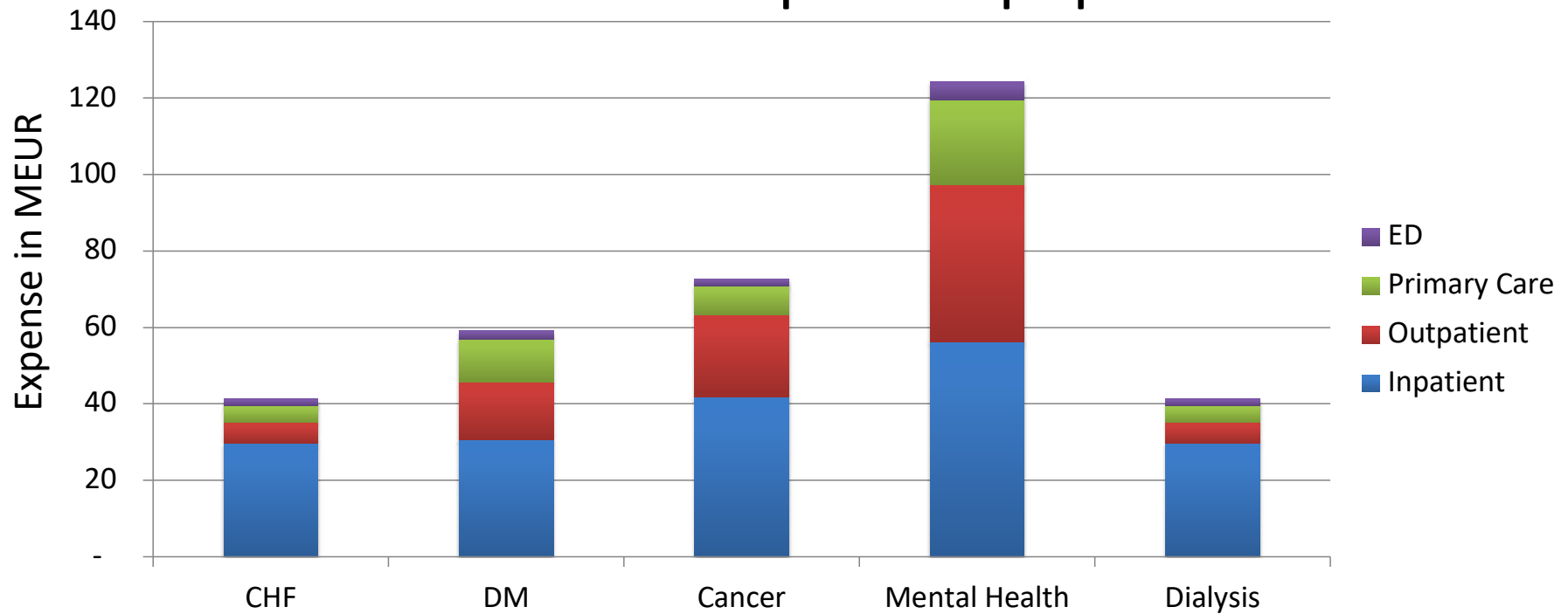

Total Healthcare Costs by Diagnostic Group

- Mental Health 11%
- Cardiovascular 10%
- Other Categories 31%
- Misc. Symptoms 7%
- GI 7%
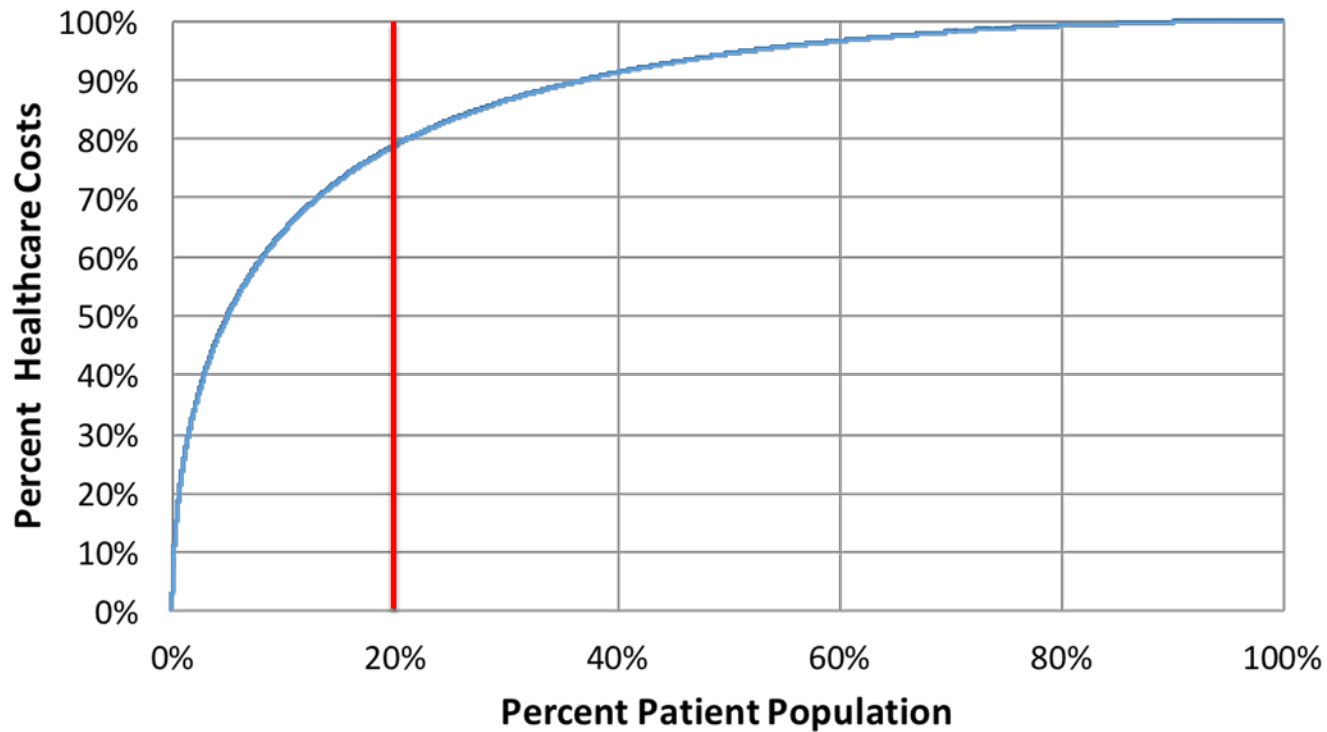- Respiratory 7%
- Orthopedics 6%
- Rheumatology 6%
- Oncology 6%
- Renal 5%
- Obstetrics 4%

PEC allows decision-makers to understand costs and utilization across patient populations

# 20% of the patient population generates 80% of the healthcare costs (N = 282,246 patients)

By connecting costs to visit diagnoses, we can see what clinical areas to focus on

- Cardiopulmonary and psychiatric disease typically dominate readmission diagnoses

- Leaders can focus readmission prevention activities on these patient cohorts and clinical conditions

Readmissions, 30-day all cause

Cost (thousand €)   count
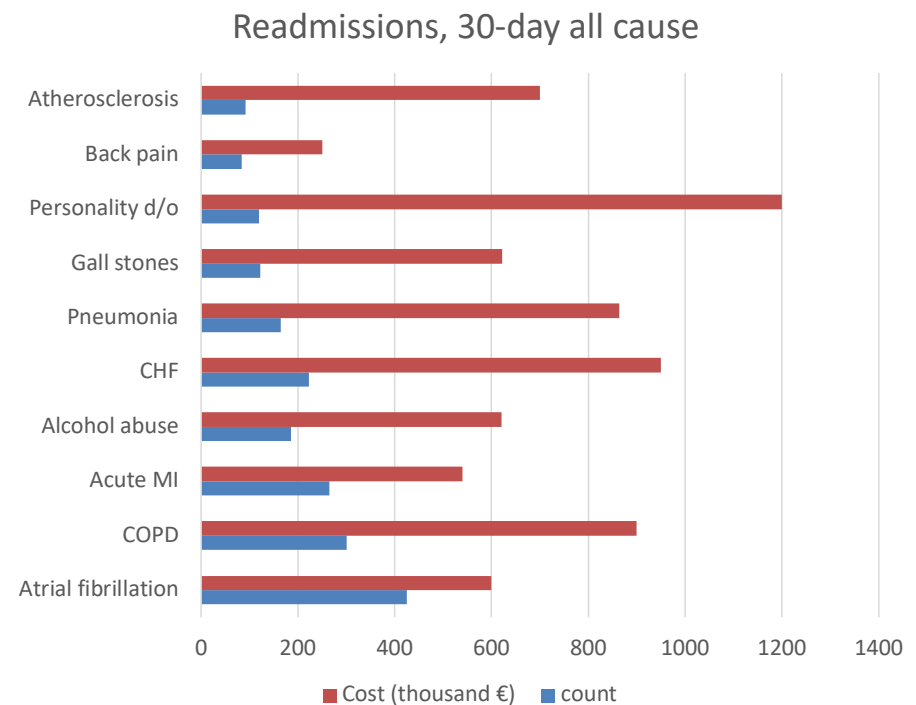
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Anticoagulation for Atrial Fibrillation

- National evidence based guidelines

- Based on CHADS2VASC score

- Goal: reduce preventable strokes in patients with Afib

- To what degree are these guidelines followed at the population level?

Many patients with atrial fibrillation have incorrect anticoagulation, leading to preventable strokes

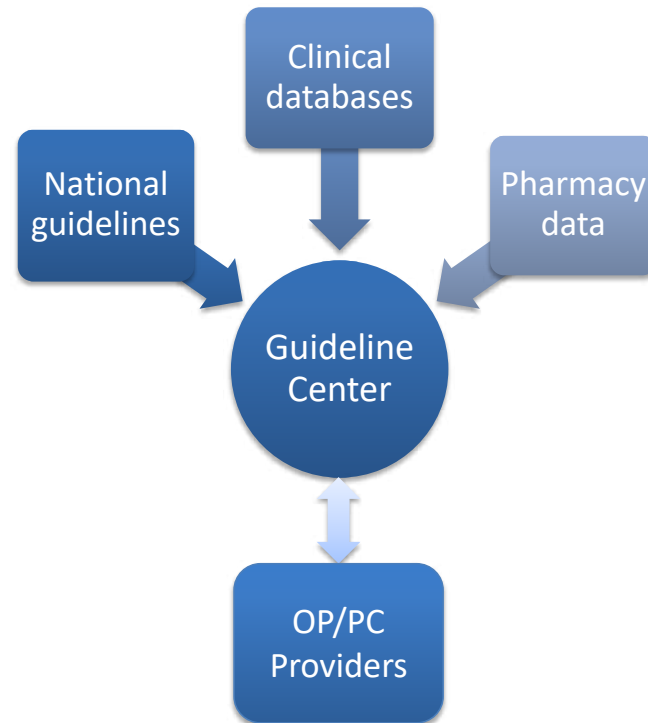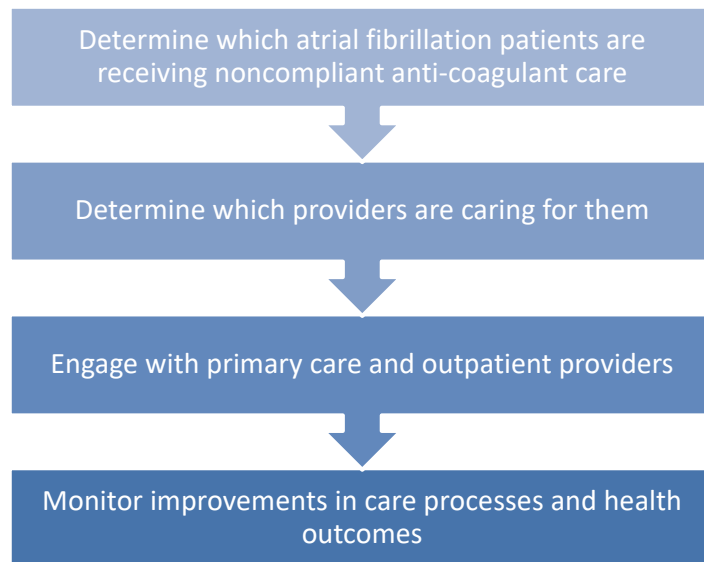| CHADS 2Vasc	Prescribed any anticoagulation (%)	Not prescribed anticoagulation (%)
0	175 (46%)	148 (54%)
1	482 (70%)	207 (30%)
>=2	4 856 (73%)	**1 752 (27%)**

- May cause up to **54 additional strokes /year***, or 8% of total

- These strokes cost the healthcare system **€2.7M** per year (€51K ea)

According to risk models in original CHADS2Vasc data

Population Decision Support: Atrial Fibrillation Anticoagulation

Problem: 27% of high risk atrial fibrillation patients had incorrect anticoagulation, causing preventable **strokes**

SHAARP supports evidence-based feedback to clinicians:

- Determine which atrial fibrillation patients are receiving noncompliant anti-coagulant care
- Determine which providers are caring for them
- Engage with primary care and outpatient providers
- Monitor improvements in care processes and health outcomes

Clinical databases

National guidelines

Pharmacy data

Guideline Center

OP/PC Providers

Opportunities for closed loop feedback

- Reporting compliance by
  - Geography (heat maps)
  - Primary care practice
  - Individual providers
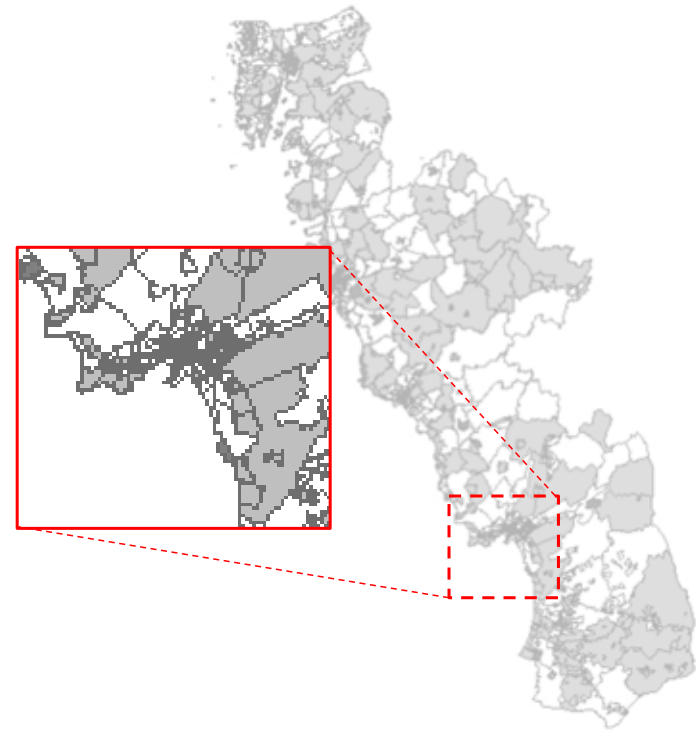
Primary care doctors get specific feedback on their patients

Atrial Fibrillation anticoagulation report (SAMPLE DRAFT)   Goal: if CHADS2VASC >=2, pt should have prescription written and picked up within

| Vårdcentral: Fem Hjärtan | | | | | | | Prescription goal: | | 365 days | | | | | |
| Date: | 2018-01-01 | | | | | | Pickup goal: | | 100 days | | | | | |

Data description: all patients living in Halland on this date with a prior diagnosis of atrial fibrillation, registered to this vårdcentral

Patient name	Personnummer	CHADS2Vasc score	Age	Gender	Most recent anticoagulation prescription	Prescribing physician	Last Written date	Last Pickup date	Days since last prescribed	Days since last picked up	Prescription written in last 100 days	Presctiption picked up in last 100 days
Svensson, Sven	123456789	1	65	M	NA	NA	NA	NA	NA	NA	Compliant	Compliant
Petersson, Peter	234567890	2	87	M	Apixaban	Dr. Schubertsson	2017-10-06	2017-06-02	87	213	Compliant	Noncompliant
Fredricksson, Fredrick	345678901	4	76	M	Rivaroxaban	Dr. Ibrahimovich	2017-07-07	2017-09-02	178	121	Compliant	Noncompliant
Davidsson, David	456789012	5	56	M	Warfarin	Dr. Valizadeh	2017-11-12	2017-11-16	50	46	Compliant	Compliant
Karlsson, Karl	567890123	3	89	M	Dabigatran	Dr. Kristofferson	2017-12-08	2017-12-12	24	20	Compliant	Compliant
Anderson, Ann	678901234	7	92	F	Apixaban	Dr. Ibrahimovich	2017-10-14	2017-11-17	79	45	Compliant	Compliant
Bjornson, Brita	789012345	2	73	F	None	NA	NA	NA	NA	NA	Noncompliant	Noncompliant
Bergquist, Bengt	123456789	3	54	M	Apixaban	Dr. Ibrahimovich	2017-10-09	2017-12-09	84	23	Compliant	Compliant
Karlsson, Katarina	890123456	4	87	F	Warfarin	Dr. Schubertsson	2017-04-05	2017-06-02	271	213	Compliant	Noncompliant

Summary statistics	Your clinic	Average Region Halland
# of patients with atrial fibrillation	63	75
# afib patients with recent anticoagulation prescription	54%	78%
# afib patients with recent anticoagulation prescription picked up	50%	70%

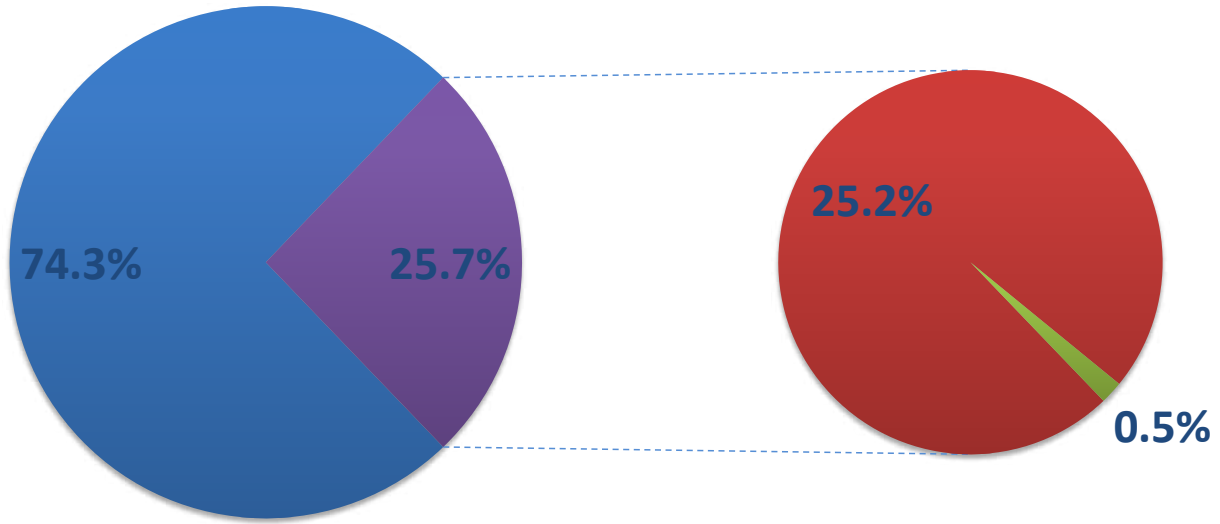# Contraindicated Medications for Patients over 75yrs old

- National consensus guidelines

- 14 contraindicated medications

- Goal: reduce side effects associated with adverse events

- To what degree are these guidelines followed at the population level?

11% of elder patients received contraindicated medications
(1.0% of the overall population)

90.8%   9.2%

8.2%   1.0%
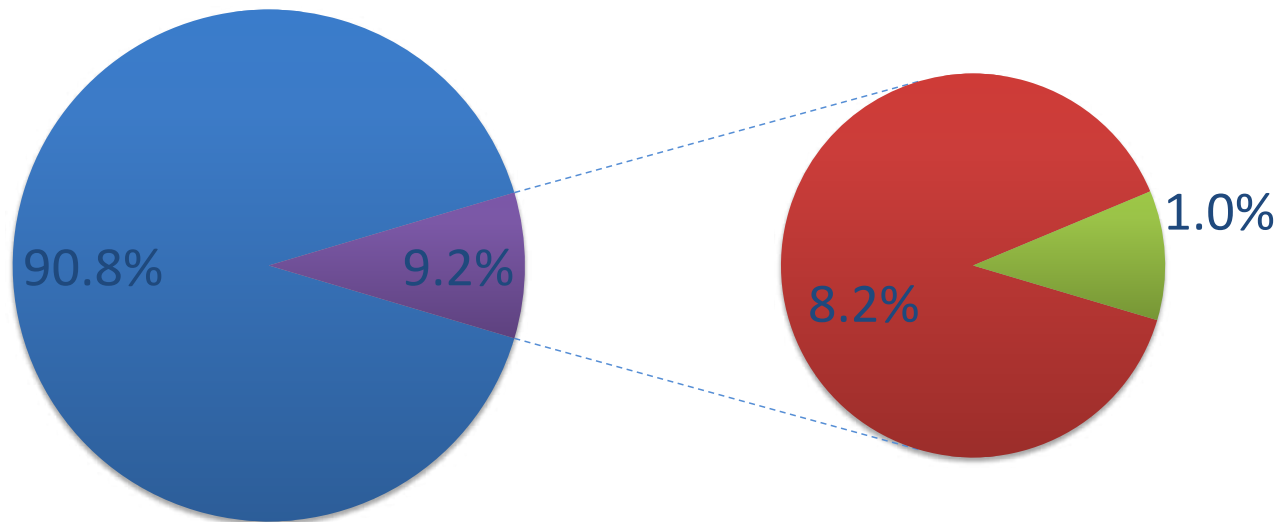
Patients >= 75 yrs old
= 25,947

2% of prescriptions written for elder patients are contraindicated (0.5% of all prescriptions written)

74.3%

25.7%

25.2%

0.5%

tions for patients >= 75 yrs old
= 332,596

Five medications account for 80% of contraindicated prescriptions to elders

ATC_Text	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Tramadol	1351	21.27%	1351	21.27%
Propiomazin	1177	18.53%	2528	39.80%
Hydroxizin	1129	17.78%	3657	57.58%
Flunitrazepam	819	12.90%	4476	70.48%
Diazepam	696	10.96%	5172	81.44%
Tolterodin	443	6.98%	5615	88.41%
Solifenacin	285	4.49%	5900	92.90%
Fesoterodin	255	4.02%	6155	96.91%
Nitrazepam	136	2.14%	6291	99.06%
Oxybutynin	19	0.30%	6310	99.35%
Kombinationer	17	0.27%	6327	99.62%
Darifenacin	16	0.25%	6343	99.87%
Klozapin	7	0.11%	6350	99.98%
Dimenhydrinat	1	0.02%	6351	100.00%

Summary

- True extent of medication errors is poorly understood with current data gathering and analytic strategies

- Whole population health system level data aggregation and analysis provides opportunity to monitor appropriate medication use at population level

- Further refinement of these techniques is necessary to improve their precision