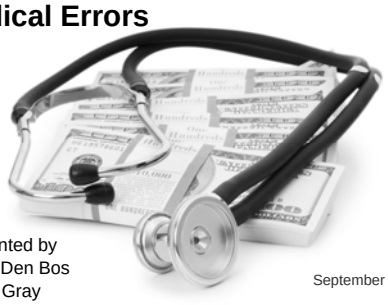
The Economic Measurement of Medical Errors



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Milliman

THANK YOU

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Harvard Medical Practice Study

Costs of Medical Injuries in Colorado and Utah

Comparison of Results

	Colorado and Utah	Harvard Medical Practice
Injury / Adverse Event Rate	2.9 percent	3.7 percent
Error / Preventable Adverse Event Incidence Rate	1.8 percent	1 percent
Total Cost of Errors / Preventable Adverse Events to US	$17 billion (1996)	$50.3 billion (1984)
Percentage of Cost Relating to Healthcare	52 percent	47 percent
Deaths in US	44,000	98,000

To Err is Human: Building a Safer Health System

- Institute of Medicine Report, 2000
- Estimated total national costs of preventable adverse events at between $17 and $19 billion
- Attributed as many as 98,000 deaths to medical errors that occur in hospitals (based on NY study)
- Medical errors would be the 8th leading cause of death

Medical Injury Identification Using Hospital Discharge Data

Medicare Never Events

Wrong Site Surgeries

Blood type incompatibility

Pressure Ulcers

Object left in body

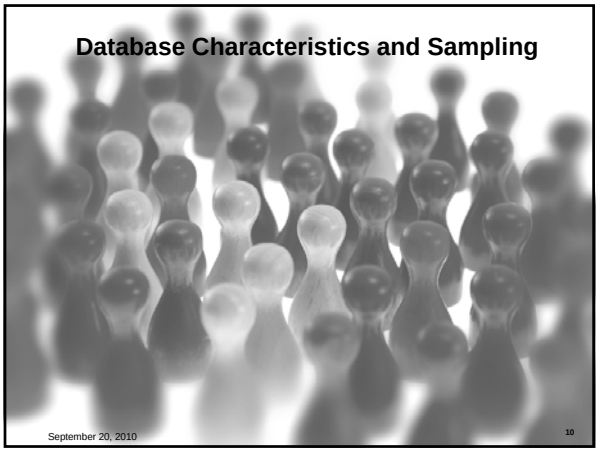
Air Embolism

Catheter-associated urinary tract infection

ICD-9 Examples

Injury Type	ICD-9 Code(s)
Accidental cut, puncture, perforation, or hemorrhage	E870.1, E870.3, E870.4, E870.5, E870.6, E870.8, E870.9
Air embolism	999.1
Hemorrhage complicating a procedure	998.11
Infection following infusion, injection, transfusion, vaccination	999.3
Mechanical complication of device, implant, or graft	996.1, 996.2, 996.4, 996.40, 996.49

Database Characteristics and Sampling



Steps in the process

Step 1	Identify injuries in claim database
Step 2	Calculate injury and error rates and extrapolate to the U.S. population
Step 3	Establish a control group for each error group
Step 4	Measure the cost difference per injury for medical, mortality, and disability
Step 5	Calculate total error cost

Step 1 – Identify injuries in claim database

Mechanical complication of device implant or graft	
ICD-9 Code	Description
996.1	Mechanical complication of other vascular device, implant, and graft
996.2	Mechanical complication of nervous system device, implant, and graft
996.4	Mechanical complication of internal orthopedic device, implant, and graft
996.40	Unspecified mechanical complication of internal orthopedic device, implant, and graft
996.49	Other mechanical complication of other internal orthopedic device, implant, and graft

Step 2 – Calculate Injury and Error Rates and Extrapolate to U.S. population

A preventable adverse outcome of medical care that is a result of improper medical management

Step 2 – Error Rates

< 10 %

10 – 35 %

35 – 65 %

65 – 90 %

> 90 %

Step 2 – Example Converting Injury Counts to Error Counts

Injury Type	Percent Error
Pressure ulcer	> 90 %
Postoperative infection	> 90 %
Mechanical complication of device, implant, or graft	10 – 35 %
Postlaminectomy syndrome	10 – 35 %
Hemorrhage complicating a procedure	35 – 65 %

Step 2 – Example

Mechanical complication of device, implant, or graft

	Male		Female	
Age	**Incidence Rate (IP)**	**# Errors in U.S.**	**Incidence Rate (IP)**	**# Errors in U.S.**
0 – 7	0.002 %	891	0.002 %	703
18 – 44	0.002 %	1,160	0.002 %	1,320
45 – 64	0.006 %	2,373	0.006 %	2,474
65 - 74	0.014 %	1,339	0.013 %	1,410
Over 75	0.019 %	1,372	0.017 %	1,923
Total (Both Genders)	**0.005 %**	**14,965**		

Step 3 – Establish a Control Group for Each Error Group

4:1

Step 3 - Matching Results

Conditions Matched	IP Sample	OP Sample
Year, DRG/Procedure, 3 chronic conditions, age group, gender	52 %	84 %
Year, DRG/Procedure, 3 chronic conditions, age group	7 %	3 %
Year, DRG/Procedure, 3 chronic conditions	17 %	6 %
Year, DRG/Procedure, 2 chronic conditions	11 %	3 %
Year, DRG/Procedure, 1 chronic condition	9 %	2 %
Year, DRG/Procedure	4 %	1 %

Step 3 - Specific Chronic Conditions Used in Matching
Cancer (specific types)
Renal Failure
Congestive Heart Failure
Stroke
Coronary Artery Disease
Anemia
Hepatitis
Chronic Obstructive Pulmonary Disease
Arthritis (Osteo- or Rheumatoid)
Diabetes Mellitus
Osteoporosis
Hypertension
Back Sprain
Psychosis, Neurosis, Depression
Asthma

Step 4- Measure Cost Difference per Injury

- Measured statistically significant differences in
  - Healthcare costs
  - IP hospital mortality
  - Short term disability

Step 4- Example Medical Cost Calculation

Mechanical complication of device, implant, or graft Significance Testing – Medical Cost of Inpatient Injuries

Period	N (cases)	N (controls)	Difference in means	P-value
1st three months	29,373	100,896	$ 16,271	0.000
Next 9 months	25,754	86,703	$ 9,469	0.000
Year 2	17,308	59,380	$ 6,693	0.000
Year 3	11,824	40,319	$ 4,878	0.000
Year 4	8,022	27,196	$ 4,434	0.000
Year 5	5,027	17,059	$ 6,084	0.000
All Periods (present value)			**$45,764**	

Step 5 – Calculate Total Medical Cost

Mechanical complication of device, implant, or graft – Measurable Medical Costs in the U.S.

Place of Error	Errors	Cost per error	Total Cost ($ millions)
Inpatient	14,965	$ 45,674	$ 685
Outpatient	45,415	$ 8,464	$ 384
Total	**60,380**	**$ 17,709**	**$ 1,069**

Step 4- Example Mortality Cost Calculation

Mechanical complication of device, implant, or graft Significance Testing – Mortality Cost of Inpatient Injuries

Period	1st 3 Months	Next 9 months
N (Cases)	29,393	25,754
N (Controls)	100,896	86,703
Difference in death rate	-0.353 %	0.265 %
P-value	N/A	0.003
Probability of survival to start of period	1.0	0.97
Excess deaths	0	39
Cost per death	N/A	$ 666,472
Cost of excess deaths (millions)	**$ 0**	**$ 26**

Step 4- Example Mortality Cost Calculation

Cost of Future Lost Productivity (2008)

Age	Male	Female
0 – 7	$1,461,049	$1,184,349
18 – 44	$1,676,546	$1,300,783
45 – 64	$745,067	$625,382
65 - 74	$239,994	$251,141
Over 75	$105,169	$119,066

Source: Grosse, Krueger, Mvundra, Economic Productivity by Age and Sex: 2007 Estimate for the United States

Step 5 – Calculate Total Mortality Cost

Mechanical complication of device, implant, or graft
Measurable Inpatient Mortality Costs

Place of Error	Errors	Excess deaths	Cost per error	Cost per death	Total Cost ($ millions)
Inpatient	14,965	39	$ 1,718	$ 666,472	$ 26
Outpatient	45,415	0	$ 0	N / A	$ 0
Total	**60,380**	**39**	**$ 1,718**	**$ 666,472**	**$ 26**

Step 4- Example Disability Cost Calculation

Mechanical complication of device, implant, or graft
Significance Testing – STD Cost of Inpatient Errors

	Inpatient	Outpatient	Total
N (Cases)	589	1,923	
N (Controls)	1,923	6,170	
Mean excess missed days	7.08	6.01	
P-value	0.049	0.001	
Cost per error	$ 682	$621	$636
Total Cost (millions)	**$ 10**	**$ 28**	**$38**

Step 4- Example Disability Cost Calculation

Daily Productivity Value (2008)

Age	Male	Female
0 – 7	-	-
18 – 44	$ 172.81	$139.06
45 – 64	$ 183.86	$ 114.58
65 - 74	$ 74.13	$ 64.53
Over 75	$ 44.91	$ 44.33

Source: Grosse, Krueger, Mvundra, Economic Productivity by Age and Sex: 2007 Estimate for the United States

Step 5 – Calculate Total Disability Cost

Mechanical complication of device, implant, or graft
Measurable Short Term Disability Costs

Place of Error	Errors	Cost per error	Total Cost ($ millions)
Inpatient	14,965	$ 682	$ 10
Outpatient	45,415	$ 621	$ 28
Total	**60,380**	**$ 636**	**$ 38**

Step 5 – Calculate Total Cost

Mechanical complication of device, implant, or graft
Summary of Measurable Costs

	Number of Errors	Cost per error	Total cost (millions)
Medical cost		$ 17,709	$ 1,069
Mortality cost		$ 426	$ 26
Disability cost		$ 636	$ 38
Total	**60,380**	**$ 18,771**	**$ 1,133**

Pressure Ulcers

Discharge Status	Error Group	Control Group
Home self-care	37.6 %	58.6 %
Transfer to SNF	20.9 %	10.6 %
Transfer to short-term hospital	9.1 %	5.3 %
Home under care	12.6 %	9.2 %

Pressure Ulcers

Medical costs in year prior to Index Date

Location of error occurrence	Error Group	Control Group	Difference
Inpatient	$ 40,751	$ 30,749	$ 10,271
Outpatient	$ 32,949	$ 25,079	$ 7,871

Pressure Ulcers

Period (IP)	Significant Excess Average Cost	Adjusted for differences in pre-index period
1st three months	$ 26,737	$ 24,169
Next 9 months	$ 16,178	$ 8,474
Year 2	$ 11,397	$ 1,126
Year 3	$ 8,356	$ 0
Year 4	$ 5,859	$ 0
Year 5	$ 5,902	$ 0
All Periods (present value)	**$ 71,634**	**$ 33,476**

Total Medical Injuries and Errors

Group	Injury Count	Error Count
> 90 %	810,898	770,353
65 – 90 %	9,949	7,710
35 – 65 %	345,838	172,919
10 – 35 %	1,684,003	378,901
< 10 %	3,468,799	173,440
Total	**6,319,486**	**1,503,323**

Most common errors

Error	Count of errors (2008)
Pressure ulcer	374,964
Postoperative infection	252,695
Postlaminectomy syndrome	113,823
Hemorrhage complicating a procedure	78,216
Accidental puncture or laceration during a procedure	63,378

Cost of Medical Injuries and Errors

Group	Injury Cost (millions)	Error Cost (millions)
> 90 %	$ 11,271	$ 10,707
65 – 90 %	$ 92	$ 71
35 – 65 %	$ 4,211	$ 2,105
10 – 35 %	$ 20,293	$ 4,566
< 10 %	$ 42,430	$ 2,121
Total	**$ 78,297**	**$ 19,571**

Most costly errors – Total Cost

Error	Total Error Cost ($ millions)
Pressure ulcer	$3,858
Postoperative infection	$3,676
Mechanical complication of device, implant, or graft	$1,133
Postlaminectomy syndrome	$1,123
Hemorrhage complicating a procedure	$ 960

Most costly errors – Per Error Cost

Error	Cost per error
Postoperative shock	$ 93,682
Infection due to central venous catheter	$ 83,365
Infection following infusion, injection, transfusion, vaccination	$ 78,083
Gastrostomy complications – infection	$ 66,765
Complications of transplanted organ	$ 66,658

Excess Measurable Inpatient Deaths

Error	Excess Deaths
Pressure ulcer	1,393
Hemorrhage complicating a procedure	302
Infection following infusion, injection, transfusion, vaccination	151
Gastrostomy Complications (Mechanical)	117
Iatrogenic cerebrovascular infarction or hemmorrhage	103
Catheter-associated urinary tract infection	83
. . .	. . .
Total	**2,861**

Average Excess Work Days Missed

Error	Average Excess Days Missed
Amputation stump complication	29.0
Complication of prosthetic joint	26.7
Persistent postoperative fistula	24.4
Pneumothorax	20.0
Tracheostomy complications	19.1
. . .	. . .
Total	**7.1**

Limitations

- Identifying injuries/errors using claim data
- False negatives represent an additional 14 percent of claims, which would triple our estimate
- Mortality costs limited to in-hospital deaths
- Limited data for disability costs

Comparison of Results

	Our Study	Colorado and Utah	Harvard Medical Practice
Injury / Adverse Event Rate	7 percent	2.9 percent	3.7 percent
Error / Preventable Adverse Event Incidence Rate	1.7 percent	1.8 percent	1 percent
Total Cost of Errors / Preventable Adverse Events to US	$19.5 billion (2008)	$17 billion (1996)	$50.3 billion (1984)
Percentage of Cost Relating to Healthcare	87 percent	52 percent	47 percent
Deaths in US	2,861	44,000	98,000

Implications

Contact Info

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The Economic Measurement of Medical Errors can be found at
http://www.soa.org/research/health/research-econ-measurement.aspx