Outcomes of Infection in Nursing Home Residents with and without Early Hospital Transfer

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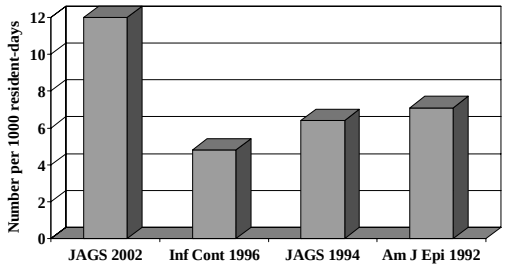
Overview

- Epidemiology and cost of NH-acquired infection
- Hospital use in NH-acquired infection
- Association between hospital triage and outcomes

Infection episodes in NH residents



Types of NH-acquired infection

Urinary tract	18-26%
Skin	18-25%
Pneumonia	11-36%
Upper respiratory	10-12%
Gastrointestinal	1-4%
Bloodstream	1-2%

Short-term infection outcomes

	Mortality	Hospital admission	Function decline
Pneumonia (Med Care 2004)	15%	14%	29%
Pneum + Dementia (JAGS 2002)	41%		
All infection types (Am J Epi 1992)	10%		

Infection care: incremental NH cost

Type	Mean ($)	Median (Range width)
Pneumonia	575	453 (1951)
Upper respiratory	229	43 (6613)
Urinary tract	186	89 (825)
Skin	131	129 (309)
Gastrointestinal	123	42 (882)

-Alessi et al., JAMDA 2003

Infection resource needs

- Provider evaluation
- Basic diagnostic testing (urine, blood)
- Basic radiology (x-ray)
- Antibiotics
- Intravenous therapy
- Oxygen
- Skilled nursing

NH-acquired pneumonia: total episode cost

With initial NH triage	With initial hospital triage
$3789	$10408

-Kruse et al., Med Care 2004

NH-acquired pneumonia: national cost

N (annual)	NH cost increment	Total cost (NH triage)	Total cost (hospital triage)
876,000	$400 million	$2.8 billion	$1.4 billion

Summary

- Infection is frequent in NH residents
- High morbidity and mortality
- High resource use and cost

- Study limitations:
  - small number of facilities and residents
  - study-specific definitions of infection

Is there hospital overuse in NH-acquired infection?

Judging appropriateness

- Advance directives
- Baseline health status (function, prognosis)
- Infection severity
- NH services available
- Response to NH treatment
- NH quality of care

-Saliba et al., JAGS 2000

Appropriateness of hospital triage

	Appropriate? (%)			
	Yes	No	Disagree	Kappa
ED transfer (n=88)	41	44	15	.70
Hosp admit (n=82)	44	45	11	.78

-Saliba et al., JAGS 2000

Reasons judged inappropriate

- Patient with poor baseline health
- Event did not mandate hospital transfer
- Event did not require immediate evaluation
- Event not life or function-threatening
- Reasonable NH interventions not tried first

-Saliba et al., JAGS 2000

Potentially preventable hospitalizations: Ambulatory care sensitive (ACS) conditions

- "Conditions for which hospitalization is preventable if appropriately managed on an ambulatory basis"
- Include: angina, asthma, cellulitis, COPD, CHF, dehydration, diabetes, gastroenteritis, hypertension, urinary tract infection, pneumonia, upper respiratory infection

ACS conditions in NH residents

Cohort: 54631 residents in 663 facilities in KS, ME, NY, SD; follow-up = 180 days after NH admission			
Hospitalized with ACS	Hospitalized non-ACS	Died (no hospital)	Hospitalized wACS/total hospitalized
3137 (5.7%)	5313 (9.7%)	2808 (5.1%)	37.1%

-Intrator et al., JAGS 2004

Factors associated with greater ACS admissions

	AOR	95% CI
On-staff physician	1.14	.99-1.3
Nurse staffing/30 residents	1.13	1.0-1.2
CNA staffing/total nurses	1.18	1.1-1.3
For profit facility	1.24	1.1-1.4

-Intrator et al., JAGS 2004

Factors associated with fewer ACS admissions

	AOR	95% CI
Any physician extender	.83	.70-.97
On-site IV therapy	.89	.78-1.0
CNA training program	.78	.68-.90
Percentage of residents with DNR	.97	.95-.99
Facility bed number < 100	.85	.71-1.0
Percent self-pay > 35%	.77	.63-.95

-Intrator et al., JAGS 2004

Summary

- There is probably hospital overuse in NH-acquired infection
- Economics favors hospital transfer
- Factors associated with hospital transfer are potentially modifiable

Would reducing hospital transfer improve outcomes of care?

Hospitalization

Benefits	Harms
Better access to:	Iatrogenic:
Providers	Delirium
Specialists	Falls
Diagnostic testing	Pressure sores
Procedures	Adverse drug events
Treatment options	Procedure complications
Close monitoring	Mental health problems
	Fragmentation of care

Positive outcomes of NH-acquired infection

- Disease cure
- Survival
- Maintenance of physical function
- Harm avoidance: falls, pressure sores, delirium, drug or procedure adverse events

Hospital transfer and mortality from NH-acquired pneumonia

Author, Year	Design	N (NHs/ episodes)	Unadj RR	P-value
Degelau, 1995	Retrosp	31 / 198	1.4	.37
Fried, 1995	Retrosp	1 / 316	.92	.85
Mehr, 1998	Prospect	10 / 141	3.2	<.05
Mylotte, 1998	Retrosp	2 / 158	.87	.66
Loeb, 1999	Prospect	5 / 272	3.0	.02
Total		**49 / 1085**	**1.6**	**.002**

Hospital transfer and function in NH-acquired pneumonia

Author, Year	Design	N (NHs/ episodes)	RR or *AOR	P-value
Fried, 1997	Retrosp cohort	1 / 240	1.46	.12
Mehr, 2003	Prospec cohort	36 / 781	1.90*	<.05

*Adjusted for age, number of ADL impairments, and presence/absence of memory impairment, dyspnea, pressure sore, and feeding tube

Summary

- Benefit/harm calculation in the balance for hospital triage
- Studies demonstrate higher short-term mortality for hospital triage

Study limitations

- All studies observational
- All x-ray-confirmed pneumonia
- Small sample sizes
- Outcomes not adjusted for differences between hospital and NH-triage groups
- Little data on outcomes other than survival

Objective and hypothesis

- To compare outcomes of infection in nursing home residents with and without hospital transfer
  - Outcomes of infection are worse with hospital transfer

Research question

- What is the relative risk of 30-day mortality and pressure sores in NH residents with infection transferred to the hospital compared with those who are not – controlling for differences in infection, individual, and facility characteristics?

Maryland Long-Term Care Project (PI: Magaziner)

- Prospective observational study examining association between dementia and outcomes
- Individuals admitted to 59 NHs (of 221) in Maryland between 1992-1995
- Included those older than 65 that had not resided in a NH in the previous year
- Followed for 2 years or to NH discharge

Sample size

- 3283 admissions eligible
- 2285 (70%) consented
- 2153 with follow-up data

Baseline measures

- Age, sex, race, education
- Function in bathing, dressing, toileting, transferring, feeding, and continence
- Chronic medical conditions (14)
- Dementia by expert panel
- Body mass index
- Pressure sore

Facility measures

- Number of beds
- For profit (yes/no)
- Urban location (yes/no)
- Distance to hospital
- Nurse staffing/100 beds
- Available medical services: intravenous therapy, respiratory therapy, tracheostomy care, tube feeding (0-4)

Incident events

- Infection
- Hospitalization
- Death
- Pressure sores

Infection definition

- Documentation of infectious diagnosis in any part of medical record OR
- Receipt of antibiotics except if for infection prophylaxis

Strengths and weaknesses of data

- Large sample
- Prospective data
- Individual and facility variables
- Multiple infection diagnoses
- Includes non-mortal outcomes
- Single-state
- Observational
- Secondary analysis

Infection characteristics

- Anatomical location
- Fever (yes/no), and highest level (1 degree categories)
- Physician visit in NH within 3 days of onset

Comparison groups

- Hospital triage group = transferred to the hospital within 3 days of infection onset
- Nursing home triage group = no transfer
- Not included = died within 3 days of infection onset

Outcomes

- Death
- Pressure sore stage 2 or greater
- Outcome interval: Days 4 – 34 after infection onset (30 days)

Analysis plan

- 2 x 2 tables for unadjusted relative risk
- Logistic regression models to adjust for infection, individual, and facility covariates
- Generalized estimating equations to calculate robust confidence intervals

Results: residents with infection

N	1301 (60.4%)
Age (mean)	82 years
Female (%)	72
White (%)	79
Impaired ADLs (mean)	4.1
Dementia	55

Results: Infections and location

N	4990
Urinary tract	1397 (28%)
Skin	948 (19)
Upper respiratory	649 (13)
Lower respiratory	599 (12)
Gastrointestinal	200 (4)
Bloodstream	100 (2)
Undetermined*	1049 (21)

*Antibiotics for ambiguous diagnosis or lack of medical record documentation

Facility characteristics

N	59
Beds (mean (s.d.))	146 (77)
For profit (%)	59
Urban location (%)	90
< 5 miles from hospital (%)	70
Nurses/100 beds (mean (s.d).)	33.4 (6.7)
Medical services available (mean (s.d.))	2.9 (1.2)

-Boockvar et al., JAGS 2005

Hospital triage and overall outcomes

N (survived Day 3/total)	4903/4990 (98.3%)
Hospital transfer (Day 0-3)	375 (7.6%)
Mortality (Day 4-34)	364 (7.4%)
Pressure sore (Day 4-34)	420 (8.6%)

-Boockvar et al., JAGS 2005

Outcomes by triage group

	Hospital triage	NH triage	RR (95% CI)
Mortality	56 (14.9%)	308 (6.8%)	2.2 (1.7-2.9)
Pressure sore	56 (14.9%)	364 (8.0%)	1.9 (1.4-2.4)

-Boockvar et al., JAGS 2005

Adjusted outcomes

RR (95% CI) adjusted for:	Mortality	Pressure sore
Unadjusted	2.2 (1.7-2.9)	1.9 (1.4-2.4)
Infection type + fever	1.8 (1.3-2.5)	1.7 (1.2-2.3)
Infection + individual characteristics	1.6 (1.2-2.3)	1.8 (1.4-2.4)
Inf + indiv + facility characteristics	1.6 (1.1-2.3)	1.8 (1.3-2.6)

Other outcome predictors

Mortality

- Fever grade (+)
- GI infection (+)
- Skin infection (-)
- Comorbidity (+)
- ADL impairment (+)
- Dementia (-)
- Number of beds (+)

Pressure sore

- GI infection (+)
- ADL impairment (+)
- Pressure sore on NH admission (+)

Propensity analysis

- Estimated logistic regression model
  Dependent variable = triage group (hospital or NH)
  Independent variables = infection, individual, facility
- Propensity score from model coefficients
- Examined association between hospital triage and outcomes, controlling for propensity score
  - As continuous variable
  - Stratified by quintiles

Variables with major difference	Hospital triage	NH triage	Stand Diff
Upper respiratory (%)	7	13	-20%
Skin (%)	13	20	-17
Pneumonia (%)	28	11	46
Bloodstream (%)	4	2	14
Fever (# degrees > 100)	.61	.24	37
White (%)	72	80	-20
Education (years)	9.4	10	-25
Comorbidity (count)	2.9	2.6	14
Dementia (%)	52	57	-10
Hospitalized past yr (%)	87	82	13
Facility beds (count)	142	153	-18
For profit facility (%)	73	62	22
Urban facility (%)	99	96	15
Medical services (count)	3.0	3.1	-8

Italics = $p < .05$ for association with hospital triage in multivariable logistic regression.

Propensity score by triage group

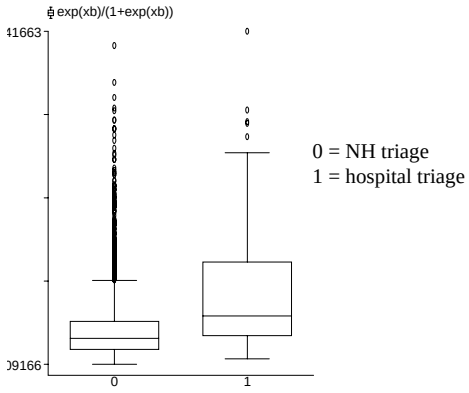
Model c-statistic = .719

Triage group	N	Missing N (%)	Mean (s.d.)	Median (range)	Variance
NH	4528	1277 (28)	.077 (.065)	.058 (.009-.61)	.0042
Hospital	375	85 (23)	.14 (.10)	.10 (.02-.64)	.01

Difference in mean=.066

Variance ratio=.39

Logit propensity score by triage group



Adjusted outcomes

RR (95% CI) adjusted for:	Mortality	Pressure sore
Unadjusted	2.2 (1.7-2.9)	1.9 (1.4-2.4)
Infection type + fever	1.8 (1.3-2.5)	1.7 (1.2-2.3)
Infection + individual	1.6 (1.2-2.3)	1.8 (1.4-2.4)
Inf + indiv + facility	1.6 (1.1-2.3)	1.8 (1.3-2.6)
Propensity score	1.4 (1.0-2.0)	1.6 (1.2-2.2)

-Boockvar et al., JAGS 2005

Standard diffs	All	1	2	3	4	5
N (hosp/NH)	375/ 4528	14/ 674	29/ 681	42/ 659	64/ 650	141/ 587
Upper respiratory	-20%	19	-43	7	0	6
Skin	-17	-63	8	5	11	-9
Pneumonia	46	**	**	18	-21	28
Bloodstream	14	**	**	-11	9	3
Fever	37	-22	1	7	5	18
White	-20	30	10	17	-7	-4
Education	-25	-22	-19	19	-11	3
Comorbidity	14	14	9	-12	7	-6
Dementia	-10	-26	34	-13	4	0
Hospital past yr	13	72	-11	-4	0	-5
Facility beds	-18	1	11	-6	-1	0
For profit facility	22	16	12	0	10	3
Urban facility	15	-22	-16	16	16	5
Medical services	-8	-51	-13	-21	2	12

Outcomes by propensity quintile

RR (95% CI):	Mortality	Pressure sore
Quintile 1	2.4 (.72-8.3)	1.1 (.27-4.5)
2	1.5 (.40-5.8)	2.0 (.79-5.2)
3	2.8 (1.4-5.5)	.97 (.34-2.8)
4	1.5 (.75-2.9)	1.6 (.80-3.0)
5	1.3 (.81-2.0)	1.8 (1.1-3.2)

-Boockvar et al., JAGS 2005

Summary

- Hospital triage is associated with higher rates of mortality and pressure sores in 30 days of follow-up, unadjusted and adjusted for differences between hospital and NH triage groups
- Propensity analysis suggests an association that is similar in direction and magnitude

Strengths and limitations

- Large sample/ 59 NHs
- Prospective data
- >1 infection type
- Non-mortal outcome
- Infection, individual and facility variable adjustment
- Practical perspective
- Large measured differences between comparison groups
- ? unmeasured differences
- Propensity score adjustment imperfect
- 3-Day survivor sample

Propensity score-specific questions

- Missing data
- ? Adequate model discriminatory power (c-statistic = .72)
- ? Adequate score overlap between comparison groups
- ? Adequate correction of standardized differences in key variables

Another perspective

- Kruse et al., Medical Care 2004
- 1406 episodes of lower respiratory infection in 36 NHs in Missouri between 1995-98
- Patient, provider, facility data
- Hospitalized within 24 hours vs. not
- Outcome = 30-day mortality
- Stratified by quintiles of propensity score and mortality risk

Outcomes by propensity quintile

RR (95% CI):	Mortality
Quintile 1&2	0*
3	1.2
4	1.4
5	.92
All	.89 (.52-1.52)

* No deaths in the initial hospitalization group

Implications

- On average NH is as good as or better than hospital for residents with infection
  - Need to develop tools to help NH providers make appropriate triage decisions (e.g., validated prognostic indices)

Implications

- Factors that predispose to hospital transfer are modifiable
  - Increase acute care resources in NHs (e.g., nurse practitioner)
  - Align financial incentives (e.g., capitation with care management: Evercare, PACE)

Implications

- Patients with poor prognosis or their families may choose to decline hospital transfer if given the choice
  - Complete advance directives

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