Objectives of this Value Analysis Brief

• To synthesize the published **clinical** and **economic** evidence for implementation of a Geriatric Fracture Program (GFP)

• To summarize real-world experience from the DePuy Synthes Geriatric Fracture Program
Methods for Literature Review and Analysis*

— Search Strategy
  • Key Words: Hip Fracture, Femoral Fracture, Integrated Delivery of Health Care, Patient Care Team, Quality Assurance
  • Databases: MedLine, PubMed, Embase

— Inclusion Criteria
  • Published between January 2000-October 2014
  • English language
  • Controlled trials (randomized, retrospective/prospective cohort, or non-concurrent controls)
  • Meta-analyses

— Meta-analysis
  • Delirium outcomes were pooled for all studies that reported statistical distributions for the Confusion Assessment Method (CAM)
  • Outcomes for length of stay (LOS) and time to surgery were aggregated for US studies

*For consistency, the fracture programs identified within published studies are referred throughout this document as ‘Geriatric Fracture Programs (GFPs)’
OSTEOPOROSIS FRACTURES ARE A MAJOR PUBLIC HEALTH BURDEN

2,000,000¹

~$17 BILLION¹

Hip fractures --> key driver of osteoporosis-related costs

~300,000

~$12 BILLION¹

The prognosis of hip fracture among the elderly is very poor:

↑Mortality²
↓Ambulation³
↑Delirium⁴
↑Institutionalization²
↑Fracture risk⁵

¹Burge et al., 2007 (2005 incident fracture and related cost estimates were based on a US patient population (50-99y). A Markov state-transition model was used to predict osteoporosis costs)
²Fransen et al., 2002; ³Morrison et al., 2003; ⁴Holmes et al., 2000; ⁵Emeric et al., 2003.
Hip-fracture guidelines support several key elements of an organized Geriatric Fracture Program, including:

- Early surgical intervention (day of or day after surgery);
- Early management of comorbidities;
- Evidence-based care pathways and care plans;
- Prevention of delirium;
- Early supported discharge; and
- Multidisciplinary fracture program:

“From admission, offer patients a formal, acute orthogeriatric or orthopaedic ward-based Hip Fracture Programme”…NICE ⁶

“Strong evidence supports use of an interdisciplinary care program in those patients with mild to moderate dementia who have sustained a hip fracture to improve functional outcomes”…AAOS ⁷

⁶NICE. Hip Fracture Guideline. CG 124; ⁷American Association for Orthopedic Surgeons.
Literature Review Findings
Literature Review Article Selection

Records identified through database searching (n = 565)

Records screened
35 comparative publications
14 systematic reviews

Full-text articles included in final abstraction:
29 comparative publications
1 meta analysis

- 4 randomized controlled trials 8, 9, 10, 11
- 4 prospective cohort studies* 12, 30, 34, 39, 13, 27, 31, 33
- 10 retrospective cohort studies 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
- 4 Prospective studies with historical controls 24, 25, 26, 35
- 1 Meta-analysis 28
- 3 Economic analyses 36, 37, 38

Geographic representation: 8 US, 17 Europe, 1 Canada, 1 Taiwan, 2 Israel, 1 Australia

*8 publications were identified for these 4 unique studies
## Elements of Reviewed Geriatric Fracture Programs

### Orthogeriatric collaboration
- Geriatricians/Internal Medicine
- Orthopedists
- Therapists
- Social workers/Case Managers
- Nursing

### Multifaceted interventions
- Process standardization
- Lead physician advocate
- Coordinator/Liaison
- Comprehensive geriatric assessment
- Delirium prevention and management
- Active fall-prevention strategies
- Discharge planning

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**Emphasis on coordinated, efficient, timely fracture management**
Benefits of early surgical intervention for patients with hip fractures

As reported in a systematic review and meta analysis published in 2010\textsuperscript{29}, early surgical intervention* versus late surgical intervention for hip fracture:

\begin{align*}
\text{Mortality Risk} & \quad \text{In-hospital Pneumonia Risk} & \quad \text{Pressure Sore Risk} \\
19\% \downarrow & \quad 41\% \downarrow & \quad 52\% \downarrow \\
(RR^* .81, 95\% CI 0.68-0.96);** & (RR .59, 95\% CI 0.37-0.93); & (RR 0.48, 95\% CI 0.34–0.69)
\end{align*}

*RR = Relative Risk

\textsuperscript{29}Simunovic N et al., 2010 (*Data were pooled for multiple cutoff periods (24, 48, and 72 hours;**Based on 5 studies that reported adjusted rates (hazard ratios) of death at 30 days, six months, or one year)
Time to surgery was shorter for GFP patients relative to usual care (UC) patients in 10/14 studies.

**Outcomes: Time to Surgery**

*Difference in time from admission to surgery was statistically significant (p < 0.05)*
On average, time to surgery was ~11 hours lower for GFP patients relative to UC patients.

### Outcomes: Time to Surgery

<table>
<thead>
<tr>
<th>Author Year*</th>
<th>Mean Difference (hours) 95% CI**</th>
<th>Mean (95% CI) Difference</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-10.5 [-20.63,-0.29]</td>
<td>-10.5 [-20.63,-0.29]</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Only US studies were included within this analysis, given that time to surgery is likely to be influenced by factors related to healthcare system organization.

**A random effects model was used to generate a pooled mean difference in time to surgery for the 4 comparative studies.

x This study reported the range rather than standard deviation for time to surgery, thus standard deviation was approximated by dividing the range by 6.

Test for overall effect Z = 2.02 (P = 0.0438)

Heterogeneity: Tau2 = 88.22; Chi2 = 22.82, df = 3 (P < .0001); I2 = 83%
In-hospital mortality was lower for GFP patients relative to UC patients in 7/11 studies.

Percentage of patients who died in the hospital after hip surgery (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>GFP</th>
<th>Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.6%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Australia</td>
<td>0.9%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Spain</td>
<td>2.0%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>5.5%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Sweden</td>
<td>20.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Ireland</td>
<td>1.1%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Belgium</td>
<td>1.1%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Denmark</td>
<td>2.0%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

*Difference in in-hospital mortality between groups was statistically significant (p < 0.05)
As reported in a recent meta-analysis, GFPs were associated with a 40% reduction in hospital mortality relative to usual care. RR=0.60; (95% CI, 0.43-0.84)

Outcomes: Mortality

Orthogeriatric Care Models and Outcomes in Hip Fracture Patients: A Systematic Review and Meta-Analysis

Konstantin V. Grigoryan, MS,* Houman Javedan, MD,† and James L. Rudolph, MD, SM‡†

Reduction of 40% in in-hospital mortality for GFP relative to usual care [28]
Consequences of delirium

High or moderate quality evidence indicates that delirium increases the risk of multiple adverse clinical and economic consequences[32]

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NICE, Delirium: Diagnosis, prevention and management; 2010. NICE clinical guideline 103.
The incidence of delirium was lower for GFP patients relative to UC patients in 10/10 studies. The difference in post-op delirium between groups was statistically significant (p < 0.05).

Stenvall et al., 2012 reported the impact of a multi-disciplinary intervention on post-op delirium for a subset of patients who had dementia within an RCT.
Geriatric fracture program patients were 24% less likely to experience post-op delirium relative to UC patients

<table>
<thead>
<tr>
<th>Author Year</th>
<th>Relative Risk 95% CI**</th>
<th>Risk Ratio 95% CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deschodt 2012 [33]</td>
<td>0.70</td>
<td>0.7[0.5-0.98]</td>
<td>23%</td>
</tr>
<tr>
<td>Marcantonio 2001 [8]</td>
<td>0.65</td>
<td>0.65[0.42-1]</td>
<td>17%</td>
</tr>
<tr>
<td>Milisen 2001 [27]</td>
<td>0.86</td>
<td>0.86[0.43-1.7]</td>
<td>16%</td>
</tr>
<tr>
<td>Vidan 2005 [11]</td>
<td>0.84</td>
<td>0.78[0.63-1.11]</td>
<td>43%</td>
</tr>
<tr>
<td>Overall Difference</td>
<td>0.76</td>
<td><strong>0.76[0.63-0.91]</strong></td>
<td>100%</td>
</tr>
</tbody>
</table>

** A random effects model was used to generate a pooled relative risk for post-op delirium for the 4 studies for GFP patients relative to UC patients

Test for overall effect: Z = 2.92 (P = 0.0034)

Heterogeneity: Tau2 = 0; Chi2 = 1.33, df = 3 (P = 0.7215); I2 = 0%
The incidence of pressure sores was lower for GFP versus UC patients in 2/2 studies.

Percentage of patients who experienced pressure sores in the hospital (%)

- Vidan 2005 [11*]: 5% (GFP) vs. 17% (Usual Care)
- Fisher 2006 [24*]: 2% (GFP) vs. 5% (Usual Care)

*Difference in pressure sores between groups was statistically significant (p < 0.05).
As reported in a prospective controlled trial, the incidence of in-hospital, postoperative falls was 62% lower for GFP patients relative to UC patients.

<table>
<thead>
<tr>
<th>Cumulative time</th>
<th>Patients who fell/total sample</th>
<th>Number of falls</th>
<th>Incidence of falls (per 1000 days)</th>
<th>Incidence Rate Ratio (95% CI)*</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study</td>
<td>Control</td>
<td>Study</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>In-hospital falls [39]</td>
<td>12/102</td>
<td>26/97</td>
<td>18</td>
<td>60</td>
<td>6.29</td>
</tr>
</tbody>
</table>

*An incidence rate ratio of 0.38 indicates a 62 percent decrease in the incidence of falls among geriatric fracture patients relative to usual care patients

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39Stenvall et al., 2007
Average length of stay for fixation of hip fractures ranges from 4 days to >6 days across the US

Average Length of Stay (ALOS) by State for Hip Fixation Procedures (2013)*

*Source: DePuy Synthes Analysis of 2013 MedPer data for primary procedure codes 79.55, 79.15, 79.35, 81.52
Average hospital length of stay was lower for GFP patients relative to UC patients in 12/16 studies.

Results from Marcantonio 2011 were excluded since LOS was pre-specified per protocol to be the same for each cohort. Results from studies that did not report mean hospital length of stay were also excluded: (Gregorson 2012, Fisher 2006, Vidan 2005, Montalvo 2010)

*Difference in LOS between groups was statistically significant (p < 0.05)
On average, hospital length of stay was ~1.9 days lower for GFP patients relative to UC patients.

### Outcomes: LOS

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Mean Difference (days) 95% CI**</th>
<th>Mean (95% CI) Difference</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collinge 2013</td>
<td>[18]</td>
<td>-0.9 [-2.1137,0.3137]</td>
<td>-0.9 [-2.1137,0.3137]</td>
<td>27.2%</td>
</tr>
<tr>
<td>Dy 2012</td>
<td>[19]</td>
<td>-0.16 [-2.489,2.0889]</td>
<td>-0.16 [-2.489,2.0889]</td>
<td>12.4%</td>
</tr>
<tr>
<td>Muira 2009</td>
<td>[26]</td>
<td>-1.5 [-2.0987,-0.9013]</td>
<td>-1.5 [-2.0987,-0.9013]</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

**Overall difference 95% CI**

-1.86 [-2.938,-0.7849]

Test for overall effect $Z = 3.9$ ($P = 0.0007$)

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* Only US studies were included within this analysis, given that hospital length of stay is likely to be influenced by factors related to healthcare system organization

** A random effects model was used to generate the pooled mean difference between GFP and UC for tor average LOS among the 4 studies
Relative to UC, GFPs provided statistically significant reductions in hospital costs in 2/3 studies.

*Difference in costs between groups was statistically significant (p < 0.05).
In two published economic models, GFPs were shown to be cost-effective relative to UC; GFP patients had lower costs and superior outcomes relative to UC patients.

“The use of a multi-component delirium prevention intervention in older people undergoing surgical repair of hip fracture is cost-effective. It reduced cost and led to better health-related quality of life.” [37]

“A comprehensive ortho-geriatric care modality is more cost-effective, providing additional quality-adjusted life years (QALY) while using fewer resources compared with standard of care approach.” [38]
Depuy Synthes Geriatric Fracture Program: Case Studies
**About the DePuy Synthes Geriatric Fracture Program**

**Mission:** Our goal is to improve care of elderly Fragility Fracture Patients by enabling a standard, team-based approach to treating these patients from the time they arrive in the emergency department through discharge.

<table>
<thead>
<tr>
<th>OPPORTUNITY ASSESSMENT</th>
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<tbody>
<tr>
<td>Tools and insights to determine a facility’s readiness to implement the Geriatric Fracture program.</td>
</tr>
</tbody>
</table>

- Cost-savings Analysis
- Multi-disciplinary needs analysis

<table>
<thead>
<tr>
<th>PROGRAM MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>An array of program materials to assist in all aspects of implementing a Geriatric Fracture Program.</td>
</tr>
</tbody>
</table>

- Order sets & Nursing care plans
- Data Collection Tools
- Patient & Family Education

<table>
<thead>
<tr>
<th>IMPLEMENTATION SUPPORT</th>
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</thead>
<tbody>
<tr>
<td>Experienced program support team and a standardized pathway.</td>
</tr>
</tbody>
</table>

- 150 implementations
- Subject Matter Experts
- “Ask-The-Expert Webinars”

<table>
<thead>
<tr>
<th>PERFORMANCE DASHBOARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software solution and support to track and collect data on outcomes and metrics.</td>
</tr>
</tbody>
</table>

- Secure portal
- Trending analysis
- Hospital comparisons
**Case Study 1**

**Bon Secours St. Francis Health System**

236 bed – Level II trauma center

### STRUCTURE / PROCESS

**Streamline Admission Process**
- Standardized orders for elderly patients
- Hospitalists served in admitting service

**Reduce door to OR time**
- Work-up protocols reduced unnecessary consults
- Coordination with anesthesiology
- Prioritization of cases

**Interdisciplinary care**
- Lead advocate/surgeon champion
- Dedicated fracture team reduced room turnover and case set-up time
- Nurse navigator coordinated care with patient/family from admission to discharge

### OUTCOMES

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Pre-GFP</th>
<th>Post-GFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>n/a</td>
<td>19%</td>
</tr>
<tr>
<td>Delirium</td>
<td>75%</td>
<td>2%</td>
</tr>
<tr>
<td>Patient Satisfaction</td>
<td>n/a</td>
<td>100%</td>
</tr>
</tbody>
</table>

**ALOS (in days)**

- Pre-GFP: 7.3 days
- Post-GFP: 4.7 days

**ED to Floor time (hours)**

- Pre-GFP: 6 hours
- Post-GFP: 3.9 hours

**ED to incision time (hours)**

- Pre-GFP: 17 hours

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Value Analysis Brief—Geriatric Fracture Programs (DSUS/TRM/0415/0560)
**Mission Hospitals**

800 bed – Level II trauma center

**STRUCTURE / PROCESS**

- **Reduce door to OR time**
  - Physician champion provided education and streamlined process to rapidly stratify risk
  - Hospitalist coordinated additional consults
  - Standardized plan for safe reversal of international normalized ratio (INR)
  - Hospital consult and options began in ED

- **Improve pain management**
  - Implemented elderly-specific analgesia regimen
  - Initiated in field at initial transport
  - Continued in PACU and post-operatively

- **Reduce Delirium**
  - Orthopedic nurses completed delirium prevention education
  - Measured delirium with Confusion Assessment method
  - Revised medication plans

- **Reduce LOS**
  - Streamlined discharge process
  - Tracked LOS by unit, educated staff
  - Hospitalist managed care throughout stay
  - Worked with community team to smooth transition
  - Rehab staff prioritized orthopedic patients

**OUTCOMES**

Mortality rates and readmission rates were reduced post-GFP implementation

- **Readmission**
  - Pre-GFP: 10%
  - Post-GFP: 8%

- **Mortality**
  - Pre-GFP: 2.30%
  - Post-GFP: 0.80%

**Value Analysis Brief**

- **Geriatric Fracture Programs (DSUS/TRM/0415/0560)**

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- **Net income**
  - Pre-GFP: ($2,000)
  - Post-GFP: $750
Scottsdale Healthcare

337 bed – Level I trauma center

**STRUCTURE / PROCESS**

Reduce Healthcare Acquired Pressure Ulcers (HAPU)

- Pressure-reducing surfaces were used
- Skeletal traction was avoided
- Patients were mobilized earlier

Reduce door to OR time and LOS

- Geriatric fracture nurse practitioner was added
- Education provided for nursing, administration, surgeons, anesthesia, and internal medicine
- Bundle and geriatric-specific order sets were implemented

**OUTCOMES**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Post - GFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAPU</td>
<td>0%</td>
</tr>
</tbody>
</table>

Proportion of patients who were moved from ED to OR within 48h and mobilized within 24h after surgery increased post-GFP implementation.

Average length of stay reduced post-GFP implementation.

Pre-GFP: 5.9
GFP implementation: 5.7
Post GFP Year 3: 4.5

ALOS
Citations


Citations


Citations


Citations


Citations


Study Limitations

• Only 7 of the 30 comparative studies were prospective in design.

• Retrospective comparative studies, particularly those with non-concurrent controls, are subject to biases related to risk, patient indications, and temporal factors.

• Neither patients nor assessors were blinded in any of the studies, introducing risks of performance biases.

• Few studies controlled for baseline differences in potentially important risk factors.