

## The impact of nursing staff levels on in-hospital cardiac surgery mortality: analysis of administrative data

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## Content

- Problem statement
- Nurse staffing & patient safety:
  - North-American evidence
  - the Belgian study:
    - Partial replication of Aiken-study
    - Nurse staffing and patient safety at the nursing unit level
    - Business case
- Conclusion



## Problem statement

- Patient safety problems reported around the globe
- Is there a close **connection between nurse staffing levels and patient safety?**
- Conclusion **IOM report 1996**
  - “**No systematic evidence** that nurse staffing levels affect hospital outcomes” Wunderlich et al. (1996).



## Nurse staffing and patient safety: Recent meta-analysis

- **96 studies** examining associations of nurse staffing levels and patients outcomes in hospital practice from **US and Canada**, 1990-2006
- **Evidence for a relationship** between nurse staffing levels, mortality, failure-to-rescue and adverse events
- Most consistent results for **surgical and intensive care**



Kane R.L., Shamian T.A., Mueller C., et al. 2007. Nursing Staffing and Quality of Patient Care. *Medical Care* 45, 1195-1204.

## Nurse staffing, education, & work environment are important individually and together in determining hospital mortality

- Surgical patients in hospitals with better nurse work environments have 13% lower odds on dying;
- Patients in hospitals with better staffing (two fewer patients per nurse) have 11% lower odds on dying;
- Patients in hospitals with better educated nurses (20% more BSNs) have 8% lower odds on dying.
- Surgical patients in hospitals that are better on all three have roughly 30% lower odds on dying.

Source: Aiken et al., JONA, 2008



## And in Belgium?



## Belgium: country of healthcare data

- Two routinely collected administrative databases:
  - Belgian Hospital Discharge Dataset:**
    - ≈international hospital discharge databases:
      - Patient demographics, Medical diagnoses & interventions (ICD-9), length-of-stay
  - Belgian Nursing Minimum Dataset:**
    - Unique because of its size and level of detail:
      - One of the largest nursing datasets in the world (19 million nursing records since 1988)
      - Link nurse staffing data & nursing interventions
      - Link nurse staffing data & B-HDDS



## Partial replication US-study (Aiken et al., 2002, 2003)

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| <ul style="list-style-type: none"> <li>US (Pennsylvania)                     <ul style="list-style-type: none"> <li>168 hospitals</li> <li>Outcomes (HDDS 1999):                             <ul style="list-style-type: none"> <li>Patients aged 20-85</li> <li>232,342 patients (Popn 12.3 mil)</li> <li>Failure-to-rescue &amp; 30-day mortality</li> </ul> </li> <li>Staffing (survey data)                             <ul style="list-style-type: none"> <li>10,184 nurses</li> <li>52% response rate</li> <li>Measure – question:                                     <ol style="list-style-type: none"> <li>How many patients were you responsible for during last shift?</li> <li>Proportion of RN's with a bachelors degree</li> </ol> </li> </ul> </li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Belgium                     <ul style="list-style-type: none"> <li>115 hospitals</li> <li>Outcomes (B-HDDS 2003):                             <ul style="list-style-type: none"> <li>Patients aged 20-85</li> <li>260,293 patients (Popn 10.4 mil)</li> <li>Failure-to-rescue, 30-day mortality &amp; 8 adverse events</li> </ul> </li> <li>Staffing (B-NMDS 2003)                             <ul style="list-style-type: none"> <li>1,403 units</li> <li>583,429 inpatient days</li> <li>Measure:                                     <ol style="list-style-type: none"> <li><math>NHPPD = \frac{\text{Hours worked by nurses}}{\text{Number of inpatient days}}</math></li> <li>adjusted for nursing care intensity</li> <li>Proportion of RN's with a bachelors degree</li> </ol> </li> </ul> </li> </ul> </li> </ul> |
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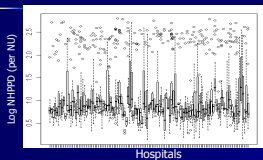
## Do we find the SAME results also in Belgian hospitals?

- Conclusions US study Aiken et al. (2002):
  - Higher nurse staff levels imply less deaths, failure-to-rescue
- Covariates of interest available at the nursing unit level, but aggregated at the hospital level (comparability)
- Conclusion:
  - NO significant effect of nurse staffing levels on mortality, failure-to-rescue & 8 adverse events (Pressure Ulcer, Deep Venous Thrombosis, Shock or Cardiac Arrest, Post-operative Respiratory Failure, Postoperative complications & infections, Urinary Tract Infections, Hospital-acquired Pneumonia, Hospital-acquired sepsis)



Van den Heede, K., Smeets, W., Divo, L., Clarke, S., Lesaffre, E., Weugels, A., Aiken, L. (2008). Nurse staffing and patient outcomes in Belgian acute hospitals. Cross-sectional analysis of administrative data. *International journal of nursing studies*.

## Why are Belgian and US results different?



**Within & between hospitals variability**  
 % Variance:  
 Hospital level: 3.86%  
 Nursing unit level: 96.14%

- In Belgium Hospital financing systems allocates budgets for staffing by:
  - Absolute minimal staffing norms (e.g. 12 FTE per 30 surgical beds: equivalent of a 11 nurse to patient ratio)
  - Supplementary budgets based on nursing intensity
- Nursing unit variability is much larger than hospital variability
- Neglecting a (nursing unit) level may lead to invalid inference



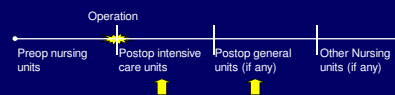
## Research question, re-phrased

- To evaluate the association between nurse staffing levels (number and education) and adverse events taking the nursing unit level into account



## Nurse staffing & patient safety nursing unit level

- Multi-level analysis taking the nursing unit level into account
- Sample: 29 hospitals; 18,490 patients aged 20 to 85 years admitted for elective cardiac surgery (Heart valve procedures & CABG)
- Adjustment for differences in patient characteristics (age, gender, DRG, ROM); nursing intensity; Volume procedures



- Significant consistent association between NHPPD of post-op general nursing units & mortality

Van den Heede et al., IJNS, 2009

## Clinical impact?

- **Simulating the impact of setting NHPPD of postoperative general units to the 75th percentile** for all hospitals below the 75th percentile and all other variables were kept constant.
- **109 patients would not have died** if all general postoperative cardiac nursing units had NHPPDs on the level of the 75th percentile.
- This corresponds to **5.9 fewer deaths per 1000 patients admitted** for elective cardiac surgery.



## Is there a business case for nursing?

- Increasing NHPPD to the level of the 75th percentile:
  - Total cost: 893,160 Euro
  - Cost per saved life: 16,239 Euro
  - Cost per life-years gained: 1,322 Euro
- Cost per life-years gained for the implementation of **5 new technologies** in the cardiovascular patient population:
  - 5,650 to 66,399 Euro (Califf et al., 2000)



Van den Heede et al., 2008

## Thus ...

- International body of evidence suggests a relationship between nurse staffing levels (number & educational) and patient safety
- **Also in Belgium Nurse staffing (number) is identified as one of the variables influencing patient safety**



## What's next?

- RN4CAST: Nurse Forecasting in Europe :
  - Project funded by the EU, FP7 (2009-2011)
  - 15 partners
    - Coordinator: Walter Sermeus (KUL, Belgium)
    - Vice-coordinator: Linda Aiken (Upenn, USA)
    - 10 other EU countries
    - Botswana, China, South Africa
  - Build scenario's for the future need for nurses, based on information about the links between various aspects of the nursing work environment and patient safety
- [WWW.RN4CAST.EU](http://WWW.RN4CAST.EU)



## Some references

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