Measuring the impact of technology on nursing work: a systematic review of the literature

Associate Professor Bernice Redley$^{1,2,3}$
Ms Kimberley Coleman$^1$
Alfred Deakin Professor Mari Botti$^{1,3}$

$^1$ Epworth-Deakin Centre for Clinical Nursing Research
$^2$ Centre for Nursing Research – Deakin University and Monash Health Partnership
$^3$ School of Nursing and Midwifery, Faculty of Health, Deakin University

contact: Bernice.redley@deakin.edu.au
Technology impact on nursing work

• Expected to improve quality & safety: improved accuracy, access to information
• Efficiency: workflows, release administration time for patient care
• To date adoption has been variable - future is inevitable
• Technology needs to support nursing work in the ‘real world’
The problem

Much of nursing work is complex, difficult to capture

Nursing work expected to be impacted by technology is ill defined

Comprehensive strategy to measuring the impact of technology on nursing work needed to guide future intervention studies

Research questions

1. How is nursing work defined when measuring the impact of technology on nursing practice? (conceptual)

2. How is the impact of technology on nursing work measured? (methodological)

3. What outcomes of nursing work are measured in relation to technology impact?
Search strategy

- Databases
  - CINAHL Complete,
  - Medline Complete (EBSCO),
  - Embase (OVID),
  - ScienceDirect,
  - Nursing @ OVID

**Keywords:** Nurses’ work; Time and motion; Nursing; Methodology; Measure; Measurement

**MeSH terms:** Workload Measurement Outcome assessment; Motion analysis systems; Descriptive statistics; Process assessment (health care); Workload; Validity; Triangulations; Surveillance (Omaha); Respondent validation; Research instruments; Reliability and validity; Reliability; Quantitative studies; Quality patient care scale; Multitrait-multimethod; Multiple time series; Instrument construction; Instrument validation; Time and Motion Studies Motion; Time; Time Management; Time Factors; Workload; Longitudinal Studies; Computer Storage Devices; Task performance; Working time; Time series analysis; Time perception; Real time tracking system Time; Reaction time; Tracking task
### Inclusion/Exclusion Criteria

<table>
<thead>
<tr>
<th>Included</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary research, meta-analysis or systematic literature review</td>
<td>Editorial, opinion, theoretical or conceptual papers, abstract only available and non-systematic literature review</td>
</tr>
<tr>
<td>Examines nursing work (+/- other health professions)</td>
<td>Examines work of health professions other than nursing or excludes nurses</td>
</tr>
<tr>
<td>Acute care setting</td>
<td>Professional development focus</td>
</tr>
<tr>
<td>Full text available in English</td>
<td>Methodology only papers</td>
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<tr>
<td></td>
<td>Student or education focused papers</td>
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<tr>
<td></td>
<td>Full-text not available in English</td>
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</tbody>
</table>
Search results

**Question 1. Concept of work**
624 papers located
- Excluded 403
  - Duplicates 20
  - Excluded* 383
- Title Review excluded* 170
- Abstract Review excluded* 24
- Full text retrieved* 27

Data extracted from 110 papers included in the review

**Question 2. Measuring**
454 papers located
- Excluded 166
  - Duplicates 53
  - Excluded* 113
- Title Review excluded* 216
- Abstract Review excluded* 21
- Full text retrieved* 51

**Question 3 Outcomes**
612 Papers located
- Excluded 388
  - Duplicates 106
  - Excluded* 282
- Title Review excluded* 158
- Abstract Review excluded* 34
- Full text retrieved* 32

*see exclusion criteria

QPS
Centre for Quality and Patient Safety Research
Data extraction

• Two independent reviewers (BR & KC) screened title and abstract: agreement was 93.81% (Kappa= 0.871, CI=95%).
• Disagreements resolved by discussion with MB
• Extraction guided by questions and PRISMA¹
• Data extracted by KC; verified independently by MB & BR

¹http://www.prisma-statement.org/
# Study characteristics

<table>
<thead>
<tr>
<th>Countries</th>
<th>Sites and participants</th>
<th>Participants</th>
</tr>
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<tbody>
<tr>
<td>USA (55%)</td>
<td>Single site 75%</td>
<td>Patient (27% studies; up to 833)</td>
</tr>
<tr>
<td>Canada (16%)</td>
<td>Multi-site 25%</td>
<td>Nurses (94% studies; 3-767)</td>
</tr>
<tr>
<td>Australia (10%)</td>
<td></td>
<td>Physicians and other professions (19% studies, 6-34)</td>
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<tr>
<td>UK (6%)</td>
<td></td>
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</tr>
<tr>
<td>Others: Netherlands, Sweden, Italy, Taiwan, France, Brazil, HK, Turkey, NZ, Korea, Germany</td>
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</table>
Q1. What is nursing work?

Purpose/Aims of Studies

- Professional autonomy
- Work environment
- Value of nursing work
- Contributors to error (interruptions, nurse sensitive indicators)
- Time distributed (workload, time at bedside, waste)
Q1. What is nursing work?

Classification of characteristics of Nursing Work

1. Direct Care***
   - Physical care at the bedside
     • Assessment
     • Interventions

2. Indirect care
   - Processes related to direct care
     • Planning
     • Review of results

3. Communication
   - Professional
   - Documentation

4. Co-ordination

5. Supervision
Q2. How is nursing work measured?

- Real time continuous direct observation of time and motion (workflow)
- Real time observation: intermittent, activity or work sampling
- Electronic real time capture
- Self Report
- Multi-method

**Design**

- Systematic review (2)
- Quasi-experimental (1)
- Pre-post with intervention and matched groups or control (1)
- Pre-post with intervention and non-matched groups (10)
- Repeated measures time series, no intervention (4)
- Comparative cross-sectional, no intervention (3)
- Cross-sectional (30)
<table>
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<tr>
<th>Focus</th>
<th>Examined Intervention</th>
<th>Describe an Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing tasks, frequency and/or duration, time distribution (37%)</td>
<td>Nurse process improvements; Change from nursing model</td>
<td>Senior hospital nurses work; Haematology &amp; Oncology; Medical/ surgical [X4] and paediatric; Surgical only [X2]; PICU &amp; ICU; acute care [X3]; Acute Mental Health; Telemetry unit; Advanced nursing practice; Burns unit;</td>
</tr>
<tr>
<td>Electronic health records (18%)</td>
<td>EDIS; NIS; CCIS including vital signs; ICU information system; EHR; integrated investigation results and capture of physiologic data, introduction to the OT</td>
<td>Electronic vs non-electronic health records; Vital signs documentation using electronic vs non-electronic records in General medicine</td>
</tr>
<tr>
<td>Medication management (19%)</td>
<td>CPOE [X2]; Bar coded [X2]; Electronic medication monitoring</td>
<td>Medication round interruptions; Medication related tasks in renal, vascular, geriatric and ICU; Nurse tasks in medical/ surgical and ICU; medication rounds</td>
</tr>
<tr>
<td>Specific nursing processes (+/- costs)(14%)</td>
<td>End of life care for patients with and without DNR orders</td>
<td>Blood glucose monitoring protocol in ICU; Specific cancer treatments; Immediate postoperative care; Unoccupied beds; management of postoperative nausea and vomiting in PACU; acute care-Clinical Demand Index [X1]</td>
</tr>
<tr>
<td>Other (2%)</td>
<td>Wireless communication</td>
<td></td>
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<tr>
<td>Tool development (10%)</td>
<td></td>
<td>Clinical Demand Index to calculate nurse intensity in acute care; nurse practitioner role; WOMBAT; Electronic time and motion mapped to Omaha System classification; STAMP</td>
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</tbody>
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Q2. How is nursing work measured?

• Tasks were the main focus, but inconsistent reporting
  – Frequency
  – Duration
  – Proportion of nurse time
  – Categories, groupings

• Limited capture of holistic workflow/patterns or complexity
  – Multi-tasking, task switching
  – Interruptions and distractions
  – Location
  – Team interactions
  – Information use; input and retrieval
  – Intent of nurses work activities- more than tasks
Q3. What outcomes are measured?

• Categories and tasks of nursing work (variable)
  – Time allocation
  – Frequency
• Processes of nursing work
  – Medication management
  – Symptom, treatments, specialist roles, interventions
• Costs of nursing work
• Value vs non-value add work (e.g. documenting, telephone calls)
• Impacts on nursing work
  – Interruptions, distractions, multi-tasking, missed care
• Quality ↔ Time at bedside- lacks granularity
• Few guided by theory
Future research

• Nurse work patterns are highly variable and context dependent
• Inconsistent reporting
• Capture complexity
  – Information input and output
  – Interactions with care team and patient
  – Sequences and patterns:
  – High and low frequency care activities
  – Intent or purpose associated with the work
  – Quality of nurses’ work: more than time
• Multi-method research: complementary
• Guided by theoretical frameworks
Acknowledgments

Bernice.Redley@Deakin.edu.au