Alarms in ICU:
A study investigating how ICU nurses respond
to alarm limits for patient safety

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What is the problem – A simple introduction
**AIM:**
This research study is aimed to investigate the responses of ICU nurses to alarm limits in their ICU environment for patient safety.

**INTERNATIONAL:**

- National Patient Safety Goals
- Alarm Fatigue
  Emergency Care Research Institute Health devices - Top 10 health technology risks

**SOUTH AFRICAN CONTEXT:**

There is a need to identify alarm management challenges in South African ICU units, to revise and structure educational and training programmes to ensure ICU nurses utilise technological resources for patient safety and to deliver quality patient care.
Research Objectives

1. To identify how ICU nurses respond to alarm limits for patient safety
2. To describe how ICU nurses respond to alarm limits for patient safety

Research Questions

1. What human/ergonomical factors related to ICU nurses contribute towards a response to alarm limits for patient safety?
2. What patient factors contribute towards the response of ICU nurses to alarm limits for patient safety?
3. Are there any other factors in the ICU environment identified that impact negatively on ICU nurses responses to alarm limits for patient safety?
• Effective alarm management in an intensive care unit (ICU) can be influenced by various factors: Culture of the department, Nursing practice and Technology.

• The purpose of clinical alarms:
  ✓ Ensure that nurses are given an alert or warning that the patient is requiring urgent attention
  ✓ Alerting them that there is a change in patients’ condition (potential problem)

<table>
<thead>
<tr>
<th>Alarms:</th>
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<tr>
<td>Audible indicator on clinical patient monitoring devices to alert the health care workers of a patient or device problem.</td>
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<thead>
<tr>
<th>False/Nuisance Alarms:</th>
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<tr>
<td>A non-actionable alarm due to an artifact produces false data which is transmitted and displayed on the monitoring device (Welch, 2011).</td>
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<tr>
<th>Alarm Fatigue:</th>
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<tr>
<td>Failure to recognize &amp; respond to true alarms that require bedside clinical intervention due to the high occurrence of alarms (Welch, 2011).</td>
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<tr>
<th>Human Ergonomical:</th>
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<tbody>
<tr>
<td>Human factors &amp; ergonomics apply the knowledge of a persons Ability and limitations to the design of the devices.</td>
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</table>
ENVIRONMENT:
(Other minisystem/systems) - Internal & - External

FACILITY:
- Human Factors design
- Parts/Systems designs
  - Deterioration
  - Maintainer

DEVICE:
- Human factors design
- Parts/circuits designs
  - Deterioration
  - Maintainer

PATIENT:
- Active
- Passive

OPERATOR:
- Education/Training
  - "Use" Error
- Diverted attention
- Criminal intent

5 components
16 sub components

Interaction between user & device & Technology

Directly linked to human error

Noise, policies & procedures

Patient affects the outcome

Choice of framework?

Conceptual Framework:
Research Design:
• Quantitative research
• Descriptive non-experimental – “what is” the current situation
• Questionnaires
• Pilot study (Limitations)

Research Setting:
• Private hospital – 3 adult ICU’s and 1 neonatal ICU
• Total 80 ICU beds

Population and Sampling - Inclusion Criteria:
• N = 120 staff in total (UM, RN and EN only)
• Minimum 1 month in ICU
• ICU and non-ICU trained staff included.
• Agency staff that met the above criteria

Ethics:
• Approvals University and Institution
• Principles of confidentiality & anonymity maintained
Data Collection Tool:

- Questionnaire (Covering letter and declaration letters)
- 6 sections
  - A,B,C – demographic details
  - D – 21 questions to be answered on Likert Scale related to the conceptual framework
  - E – Ranking related issues in order of priority related to alarm management
  - F – 3 questions – opinion, recommendations and solutions

Validity/reliability:
Tool devised from existing tools, approval was granted from The Rhodes Island College, School of Nursing (2014), which designed and implemented the research questionnaire ‘Alarm Fatigue’ for their data collection and the ‘Clinical Alarms Survey’ as approved by the ACCE Healthcare Foundation (2006). Approvals from the Rhodes Island College were granted by Kieran Ayton, the Emerging Technologies Librarian, the Interim Head of Digital Initiatives and J Tobey Clark the President of HTF (Healthcare Technology Foundation).

Process: Ethics, Unit Managers, Staff appointments, Distribution and Collection of Surveys

Analysis: Descriptive statistical analysis IBM SPSS Statistics23 and Tables and graphs.
### Research Findings

#### Survey response rate

<table>
<thead>
<tr>
<th>Information</th>
<th>No of Questionnaires’ N = 120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaires’ returned</td>
<td>91 (75.8%)</td>
</tr>
<tr>
<td>Questionnaires' not returned</td>
<td>29 (24.1%)</td>
</tr>
</tbody>
</table>

#### Nursing Categories response rates

<table>
<thead>
<tr>
<th>Nursing category</th>
<th>Number of participants</th>
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</thead>
<tbody>
<tr>
<td>Perm RN ICU trained</td>
<td>25 (27.5%)</td>
</tr>
<tr>
<td>Perm RN Non ICU trained</td>
<td>37 (40.7%)</td>
</tr>
<tr>
<td>Permanent EN</td>
<td>12 (13.2%)</td>
</tr>
<tr>
<td>Unit Managers</td>
<td>3 (3.3%)</td>
</tr>
<tr>
<td>Sess RN ICU trained</td>
<td>2 (2.2%)</td>
</tr>
<tr>
<td>Sess RN Non ICU trained</td>
<td>4 (4.4%)</td>
</tr>
<tr>
<td>Sess Enrolled nurses</td>
<td>8 (8.8%)</td>
</tr>
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</table>

#### Years of experience of participants

<table>
<thead>
<tr>
<th>Information</th>
<th>Number of participants n = 91</th>
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</thead>
<tbody>
<tr>
<td>0–3 years of experience</td>
<td>21 (23.1%)</td>
</tr>
<tr>
<td>4–6 years of experience</td>
<td>15 (16.5%)</td>
</tr>
<tr>
<td>7–11 years of experience</td>
<td>25 (27.5%)</td>
</tr>
<tr>
<td>12 years/&gt; experience</td>
<td>30 (33%)</td>
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## Operator Causes:

<table>
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<tr>
<th>Causes</th>
<th>Agreed</th>
<th>Disagreed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose of alarms - awareness</td>
<td>97.8%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Setting of alarms is complex</td>
<td>35.2%</td>
<td>53.4%</td>
</tr>
<tr>
<td>Confidence in setting alarms</td>
<td>84.1%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Experienced alarm fatigue</td>
<td>24.7%</td>
<td>48.4%</td>
</tr>
<tr>
<td>Feel overwhelmed by number of alarms</td>
<td>21.3%</td>
<td>57.3%</td>
</tr>
<tr>
<td>Frequent instances alarms not heard and were missed</td>
<td>24.5%</td>
<td>63.3%</td>
</tr>
<tr>
<td>Many devices, confusing determining which is in alarm</td>
<td>32.3%</td>
<td>61.1%</td>
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### Setting alarms is complex - Agreed

- Permanent ICU RN: 22
- Permanent non ICU trained RN: 4
- Permanant EN: 14

- 14 that agreed were between 0 to 3 years experience,
- 7 that strongly agreed were between 7 to 11 years experience

### Training/IT

- Causes desensitization

### Nil environmental factors: Noise, policies & practices

- Frequency of non-actionable alarms causes desensitisation
## Patient Causes:

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<tr>
<th></th>
<th>Agreed</th>
<th>Disagreed</th>
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<tbody>
<tr>
<td>Nuisance alarms occur frequently</td>
<td>55.8%</td>
<td>14.8%</td>
</tr>
<tr>
<td>Nuisance alarms disrupt patient care</td>
<td>60%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Nuisance alarms reduce trust in alarms (Turn it off)</td>
<td>55.6%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Nuisance alarms contribute to lack of responses</td>
<td>69.2%</td>
<td>20.9%</td>
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Based on patient movement or activity not related to an actual physiological or clinical need

**IMPACT ON PATIENT SAFETY?**
Significance:
- Nursing education - training
- Nursing administration – managing patient safety
- Nursing research

Limitations:
- Study only in one hospital
- Pilot study limited to post basic students that had just completed their course.
- Additional experts could have been involved and to advise on validity in the South African context e.g., Clinical engineers, the college ICU lecturers and facilitators.
- Likert scale was used – suitable for data collected but potential to affect quality of the data collected.

Recommendations:
- Nursing education – specific to alarm management and equipment
- Administration and practice – policies and standards with setting and managing alarms.
- Research – affect on patient outcomes in the ICU & qualitative research
Acknowledgments

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L Lomax – Nursing Manager Ahmed Al Kadi
Family and Friends – Support & Guidance

Thank You

Amy Maharaj