

CRITICAL CARE NURSES' KNOWLEDGE OF ALARM FATIGUE AND ATTITUDES, PERCEPTIONS AND PRACTICES TOWARDS CLINICAL ALARMS

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<https://www.youtube.com/watch?v=WmpodEOXso8>



ALARM FATIGUE

The desensitisation of healthcare practitioners to alarms caused by sensory overload resulting from **over exposure to an excessive number of alarms.**

Alarm Fatigue

Clinicians become desensitized, overwhelmed or immune to the sound of an alarm.



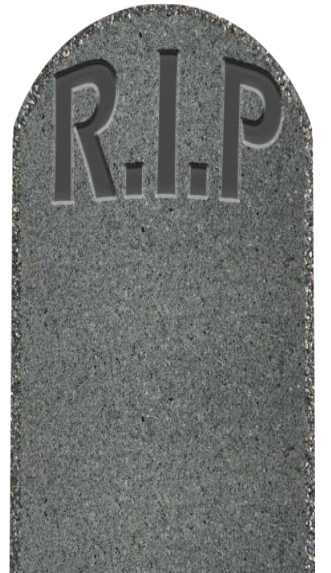
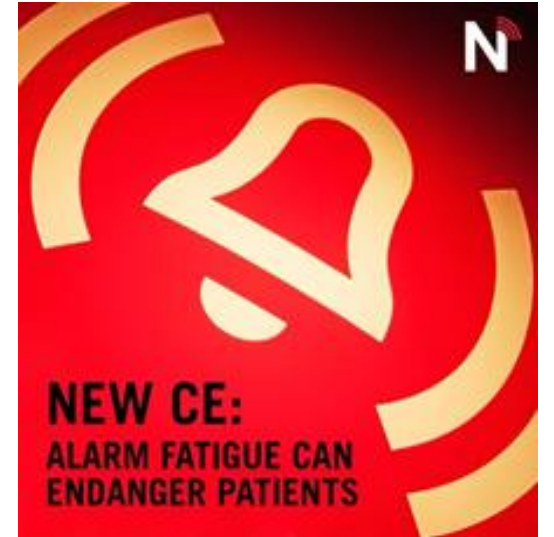
Fatigued clinicians may:

- Turn down alarm volume
- Turn off alarm
- Adjust alarm settings

These actions can have serious or fatal consequences.

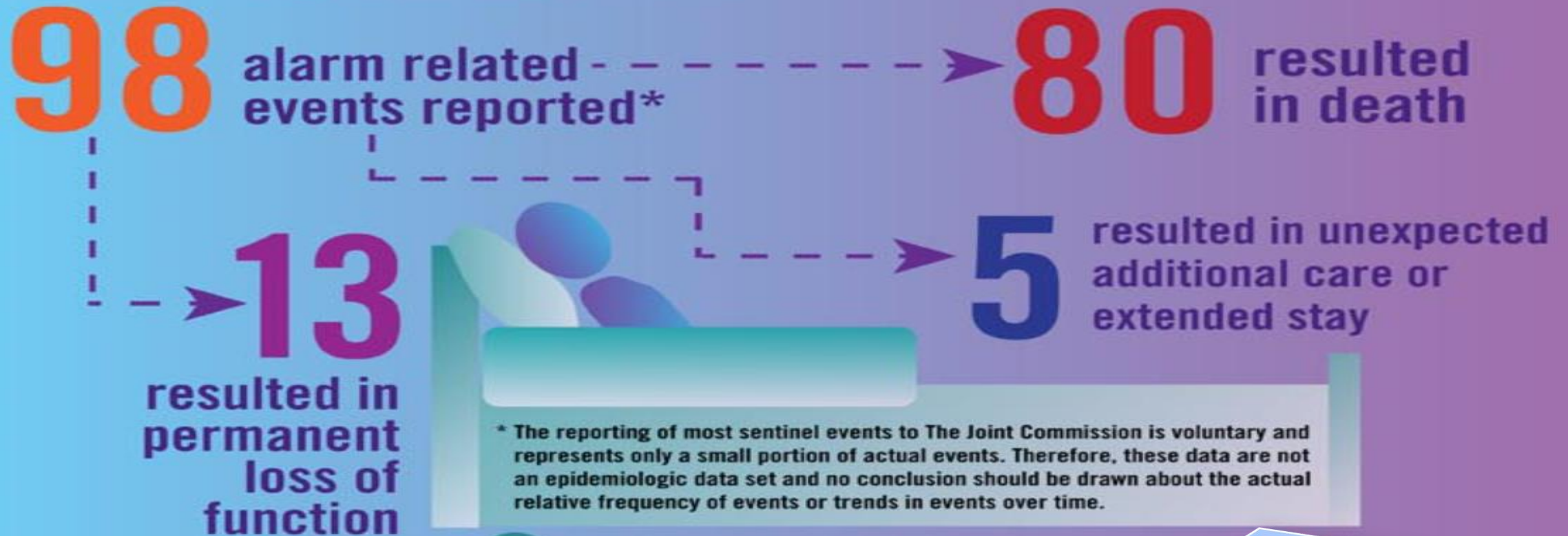
Significance

- The Alarm Fatigue phenomenon greatly compromises patient safety. **Numerous Deaths** and **Adverse Events** have been recorded in the US (FDA MAUDE database)
- **566 Deaths** related to Clinical Alarms between **2008 & 2011**
- **800 Adverse Events** in ventilated patients related to Clinical Alarms for **2010 alone**.
- **1 in 5 US Hospitals** reported Clinical Alarm Adverse Events (HTF 2011 survey)



The Joint Commission Sentinel Event Database

from January 2009-June 2012,



28 Alarm Related DEATHS PER ANNUM

VOLUNTARY REPORTING

The number of alarms is shocking!

Galway University Hospital experienced **30,000 Monitor Alarms** per week between ICU and HDU (17 beds) = approx one alarm every 20 seconds.

Scope of problem

100s → 1,000s → 10,000s

100s of alarm signals per patient, per day = 1,000s
of alarm signals on each unit = tens of thousands
of alarm signals throughout a hospital per day

85-99% of alarm signals
don't require
clinical
intervention

Explosion in Medical Devices & Alarms

- The exponential growth of medical device alarms from a variety of **6 alarms in ICU in 1986** (Kerr & Hays, 1986), to in excess of **40 different alarms by 1999** (Borowski et al., 2011).
- Alarm algorithms **prioritise sensitivity over specificity** increasing the number of nonactionable and nuisance alarms.
- The AAMI, American Association for the Advancement of Medical Instrumentation, **2011 Clinical Alarms summit** concluded that

“Medical alarm systems are out of control”



Nurses are inundated with multiple alarms, the majority are

False or Non-actionable Alarms (72% to 99.4%)

SETTING	FALSE ALARM RATE	SOURCE
PICU	95%	Lawless, 1994
PICU	86%	Tsien & Fackler, 1997
5 Adult ICUs	72%	Chambrin et al., 1999
ED	99%	Atzema et al., 2006
MICU	77%	Görges et al., 2009
MICU	85%	Siebig et al., 2010

Adapted from Cvach and Funk 2012

Aims and Objectives

- To highlight the Alarm Fatigue phenomenon and discover the extent to which the antecedents prevail in the Irish healthcare system.
- To determine critical care nurses' knowledge of Alarm Fatigue
- To illuminate critical care nurses' Attitudes, Perceptions and Practices towards Clinical Alarms.

Methods

- A **concept analysis framework** guided an extensive review of the literature **identifying the antecedents, attributes and consequences** of alarm fatigue.
- **The Health Technology Foundation (HFT) 2011, Clinical Alarms Survey** was identified as the most appropriate test instrument
- **Author approval** was granted to use the instrument and make adaptations where necessary.
- Assurances of **content validity** were offered by the authors, and while there was no reported **reliability**, the instrument had been **used in 7 other studies** to date. The responses show **consistency across samples internationally** demonstrating a degree of scale reliability.
- **A reliability analysis** of the scale was conducted using SPSS demonstrating **internal consistency** for the current study with a **Cronbach's Alpha of 0.73**

Ethical approval was obtained from each of the hospitals.

A cross sectional survey targeted

250 critical care nurses working in

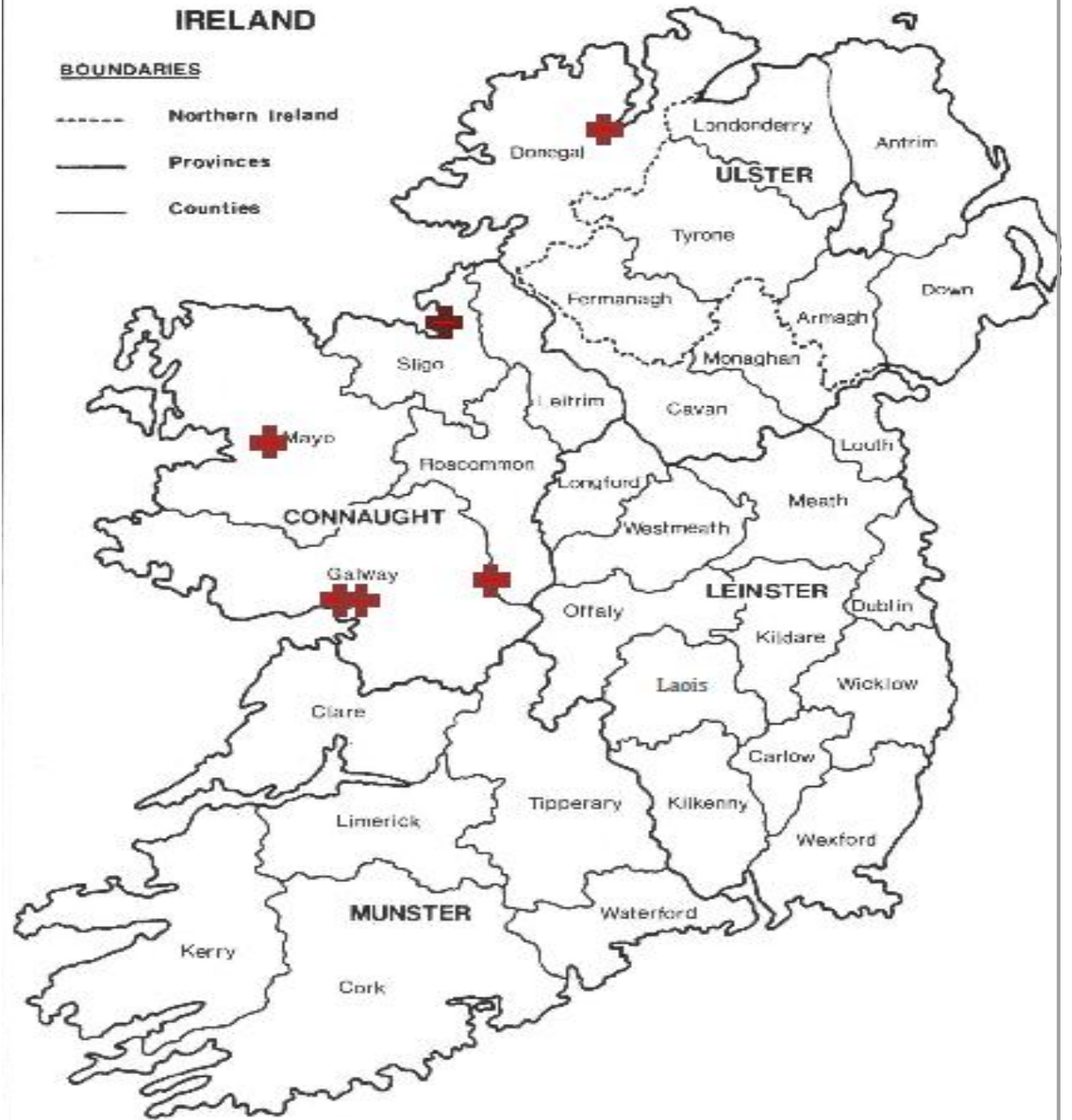
ICU/HDU/PACU across

10 various departments

in **6 Hospitals** (Level 3 & 4)

in the **West of Ireland.**

A self administered paper based adaptation of the **HTF 2011 Clinical Alarms Survey** was utilised

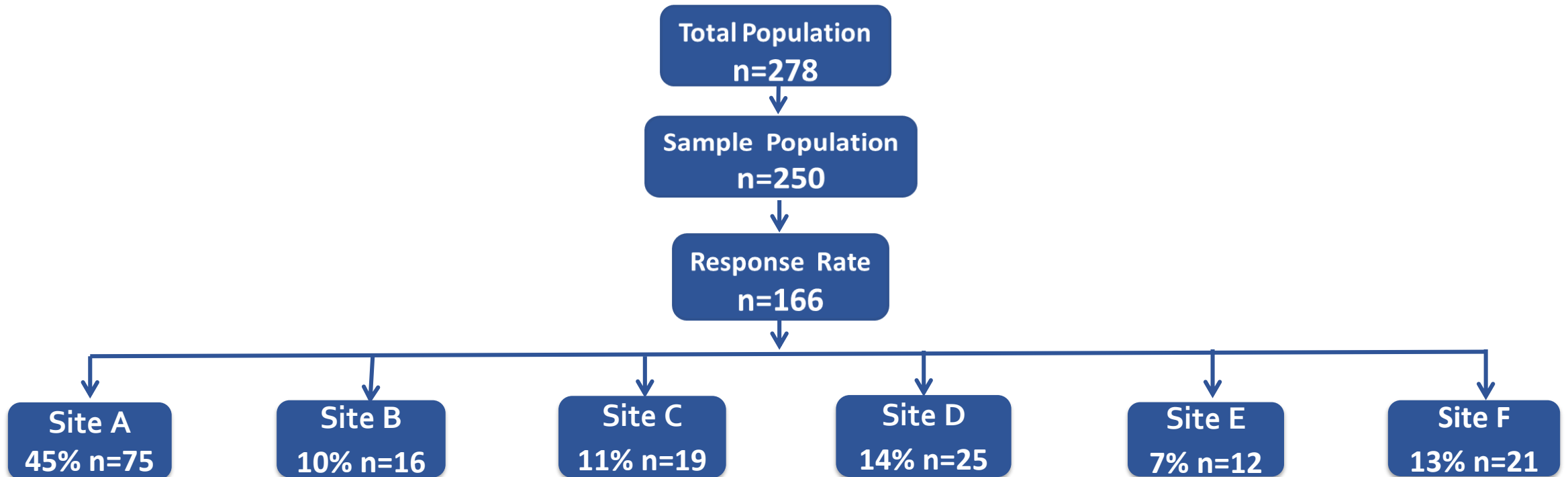


Data Analysis

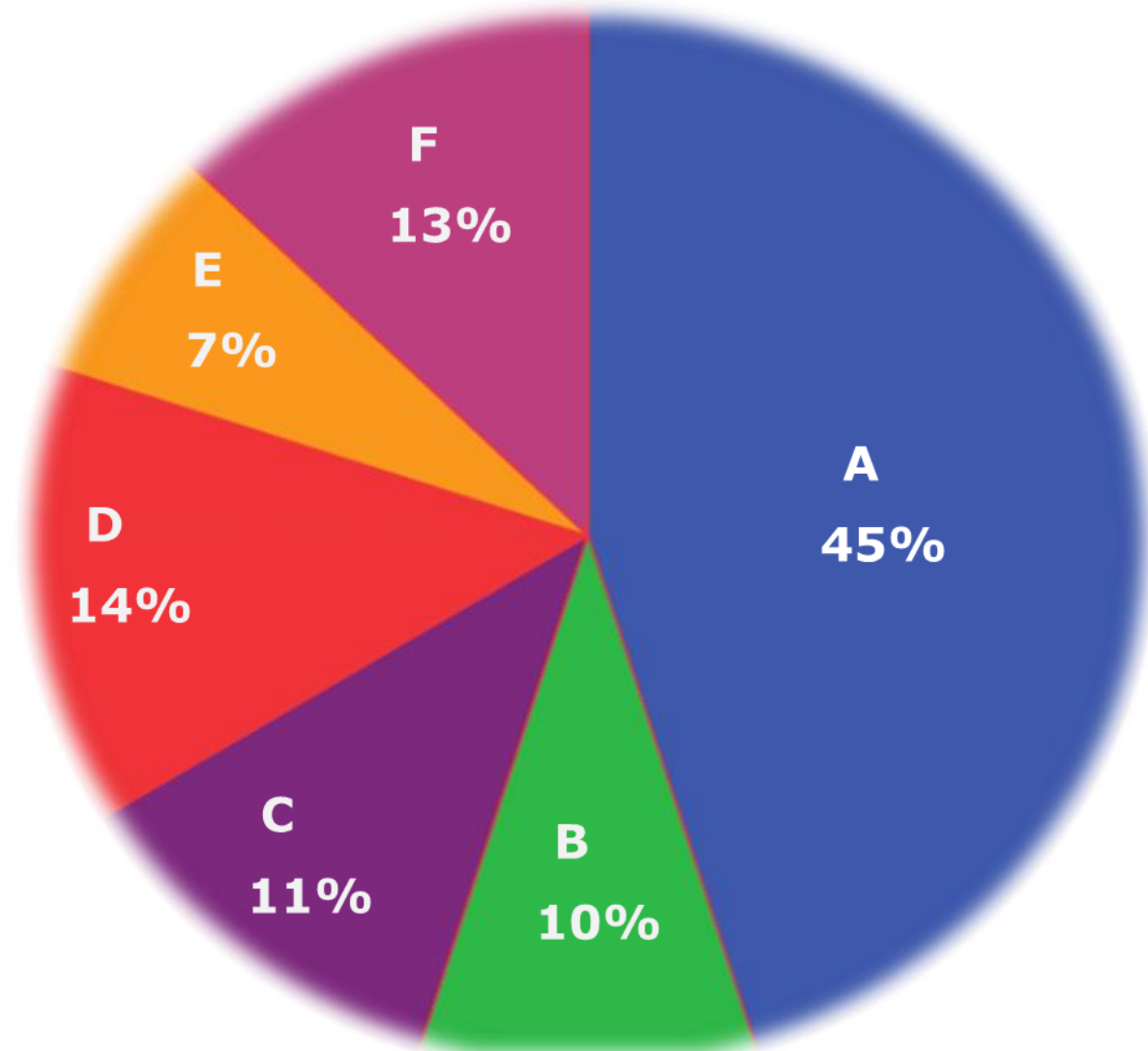
- IBM **SPSS version 22** used.
- The analysis was based on an **alpha value of 0.05** and a *confidence interval of 95%*.
- The **Chi-square test for independence** was used to determine if there was a relationship between variables.
- The **Mann-Whitney U** test was used to compare the means between two independent groups
- Data was **compared** against the **HTF 2011, 2006** studies and **Cho et al's 2015** South Korean study
- Qualitative data from the open ended question was analysed using **inductive qualitative content analysis** (Elo and Kyngäs, 2007).

Response

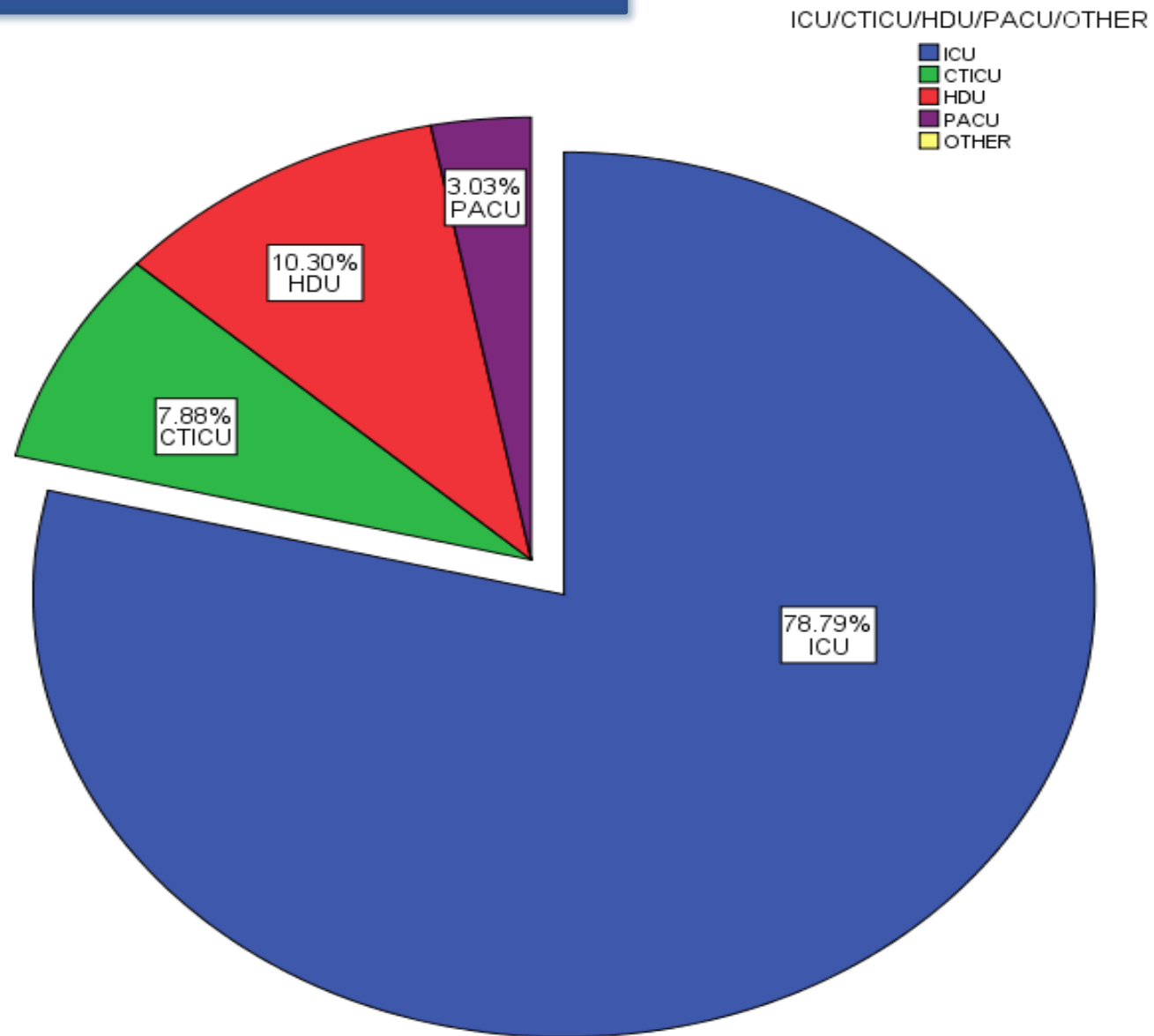
- The **total population** consisted of **278** critical care nurses, following exclusion criteria, the **target sample population** was **250**
- A **response rate** of **66.4% (n=166)** was achieved representing **12%** of the total HSE critical care nursing workforce in Ireland.
- Critical Care Census: Whole time equivalent critical care nurses = **1381.025** (HSE, 2014)



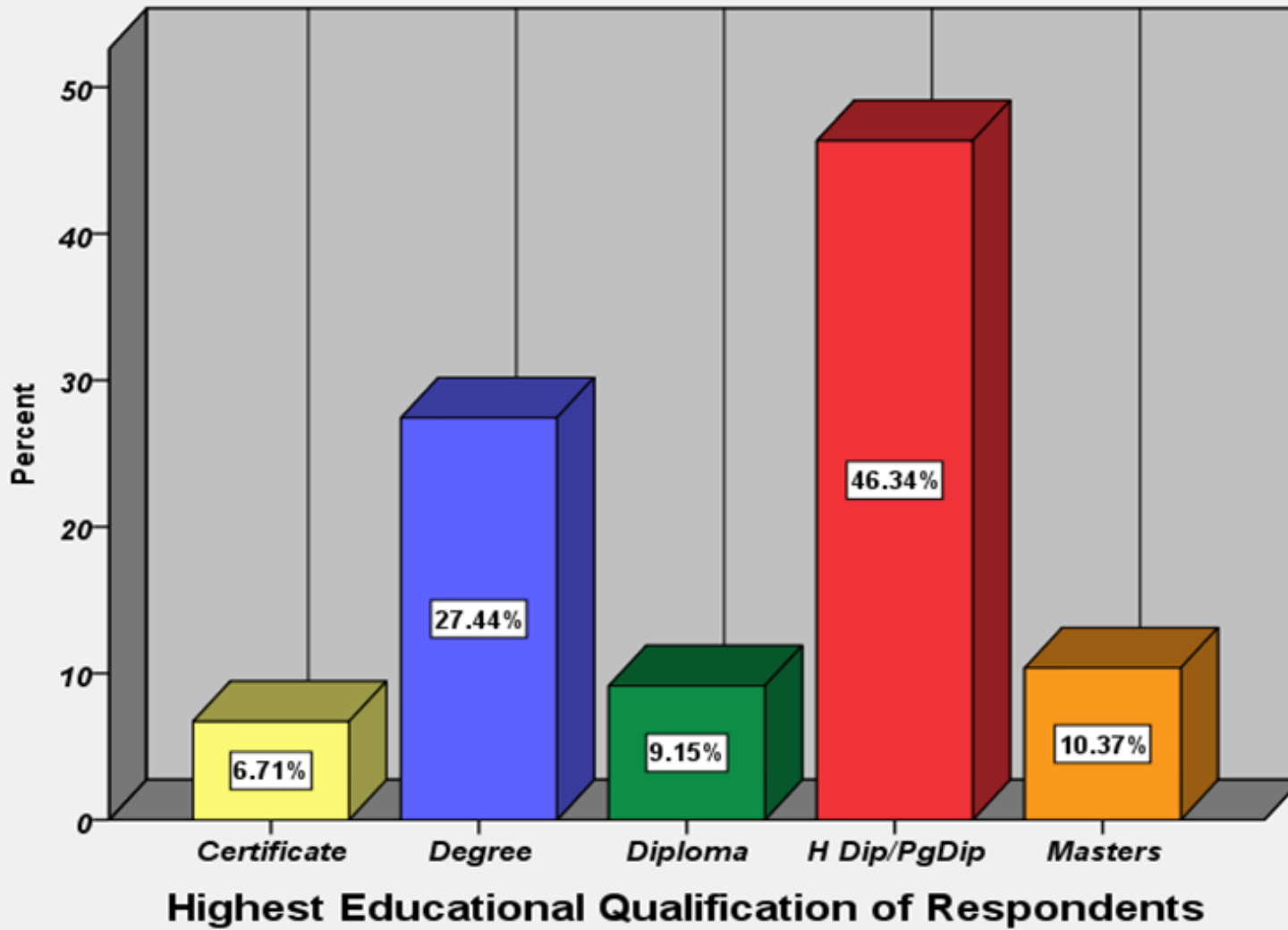
Sample Configuration: % per Site



Critical care areas %



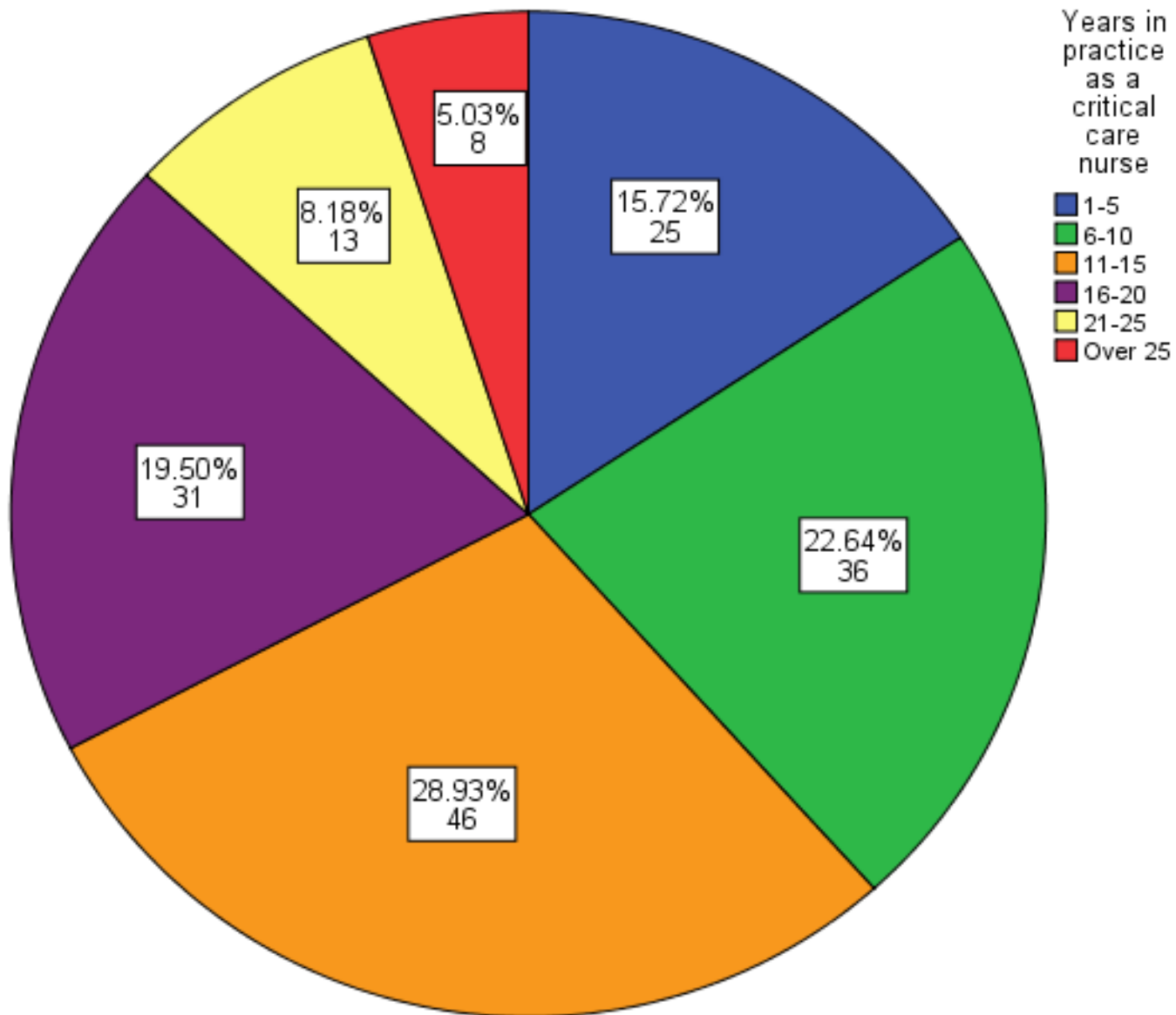
Educational Profile of Respondents



Masters	n=17
H Dip	n=76
Diploma	n=15
Degree	n=45
Certificate	n=11

66% (108) Educated to Post Graduate Level

Critical Care Experience Percentage/Count



Experience:

38%(61) < 10 years

Sample Majority:

61.6% (93) 11 + years

32 % (52) 16+ Years

Results

Nurses' Knowledge of Alarm Fatigue (AF)

- **88% (n=146)** familiar with the term AF
- **83.1% (n=138)** knew what caused AF
- **47.9% (n=79)** knew how to prevent AF

51.6% (n=86) of Nurses **did not know or were unsure** how to prevent Alarm Fatigue

There was '*no association*' between nurses' knowledge of how to prevent alarm fatigue and:

- * Years of Experience
- * Education Level
- * Overseas Experience
- * Job Title
- * Department
- * Gender
- * Joint Commission Hospital Experience

Strong statistical significance (p= < 0.001) for those working in **Site A** & knowledge of AF prevention

Perceptions & Practices towards Clinical Alarms

Nurses Perceive that Nuisance Alarms are:

Frequent	90% n=148
Disruptive to patient care	91% n=145
Reduce trust in alarms causing nurses to disable alarms	81% n=132

- **88% (n= 145)** of nurses indicated that their practice is to **customise patient alarm parameters** on shift commencement and accordingly throughout the day
- Nurses who claimed to know how to prevent alarm fatigue customised patient alarm parameters at the beginning of a shift and adjusted accordingly throughout the day **p= 0.037**
- Only **31% n=50** believed clinical policy and procedures were used effectively

Alarm Related Adverse Events

Clinical Alarm Adverse Events were reported from all Hospital Sites

- **54% (n=88)** of nurses reported Adverse Events in the past 5 years related to clinical alarms.
- **(44%, n=71)** of those reporting adverse events were from the largest study (**Site A**) with the remaining **10% (n=17)** from the other sites (**p=0.000**)
- Among the **71 respondents from Site A** who affirmed that their hospital had experienced adverse patient events due to alarms, **37% (n=26)** did not know or were unsure how to prevent alarm fatigue.
- Among the **10 respondents from Site D** who reported adverse events, only **one** of those respondents stated they knew how to prevent alarm fatigue (**p=0.004**).

Ranking of the Means: Issues that Inhibit Effective Alarm Management

Question	W/Ireland 2016		HTF 06/111 ICU Nurses		S/Korea 2016		HTF 2011		HTF 2006	
	Mean ^A	Rank ^B	Mean ^A	Rank ^B	Mean ^A	Rank ^B	Mean ^A	Rank ^B	Mean ^A	Rank ^B
Q1. Difficulty in setting alarms properly.	4.14	8	5.53	7	6.39	9	5.15	7	5.46	7
Q2. Difficulty in hearing alarms when they occur.	3.80	5	4.90	5	4.94	4	4.70	4	5.06	6
Q3. Difficulty in identifying the source of an alarm.	3.81	6	4.60	3	5.22	5	4.61	2	4.79	4
Q4. Difficulty in understanding the priority of an alarm.	3.69	4	4.84	4	3.53	2	4.63	3	4.51	3
Q5. Frequent false alarms, which lead to reduced attention or response to alarms when they occur.	2.43	1	3.46	1	2.75	1	4.21	1	2.88	1
Q6. Inadequate staff to respond to alarms as they occur.	2.66	2	4.93	6	4.86	3	4.87	6	5.01	5
Q7. Over reliance on alarms to call attention to patient problems.	3.40	3	4.56	2	5.35	6	4.86	5	4.50	2
Q8. Noise competition from non- clinical alarms and pages.	4.31	9	5.71	8	5.74	7	5.66	9	6.09	8
Q9. Lack of training on alarm systems.	3.86	7	5.79	9	6.21	8	5.55	8	6.13	9
^A Mean Ranking of the item	n=166		n=1027		n=77		n=1327		n= 4278	
^B Ranking of the Means										

Ranking Agreement Level Across Study Samples

West Ireland n=166	South Korea n=77	HTF 06/11 ICU Nurses n=1027	HTF 2006 n=1327	HTF 2011 n=4278
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*Alarm sounds and/or visual displays should differentiate the **priority of alarm**.*

1	1	1	1	1
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Non-actionable/Nuisance alarms occur frequently.

2	4	3	3	5
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Non-actionable/Nuisance alarms disrupt patient care

3	5	4	7	7
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I always customise patient alarm parameters at the beginning of a shift and adjust accordingly throughout the day.

4	NA	NA	N/A	N/A
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*Alarm sounds and/or visual displays should be **distinct** based on the parameter (e.g. heart rate) or source (device type).*

5	2	2	2	2
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There is a requirement in my institution to document that the alarms are set and appropriate for each patient.

6	NA	10	8	7
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Non-actionable/Nuisance alarms reduce trust in alarms and cause caregivers to turn alarms off at times other than setup or procedural events.

7	3	5	6	4
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Ranking of Agreement Level Across Study Samples	West Ireland n=166	South Korea n=77	HTF 06/11 ICU Nurses n=1027	HTF 2006 n=1327	HTF 2011 n=4278
<i>Newer monitoring systems (less than three years old) have solved most of the problems we experienced with clinical alarms.</i>	19	NA	16	15	13
<i>Clinical policies and procedures regarding alarm management are effectively used in my facility.</i>	18	NA	12	11	10
<i>Properly setting alarm parameters and alerts is overly complex in existing devices.</i>	17	11	17	17	14
<i>There have been frequent incidences where alarms could not be heard or were missed.</i>	16	12	15	16	13
<i>Alarm management practices within my area incorporate best available evidence to prevent patient adverse events.</i>	15	NA	NA	N/A	N/A
<i>When a number of devices with alarms are used with a patient, it can be confusing to determine which device is in alarm.</i>	14	9	13	13	11

Conclusions

- * Critical Care Nurses are experiencing Alarm Fatigue
- * The alarm fatigue phenomenon has **serious consequences for patient safety** with the worst case scenario resulting in death or serious patient harm.
- * The burden of answering numerous non-actionable alarms **drains nursing resources** affecting the quality of patient care and reducing patient satisfaction.
- * An environment of excessive alarms is conducive to error.
- * **Alarm floods** are defined by the American National Standards Institute as **excesses of 10** annunciated alarms per operator **in a 10 minute period** (ANSI/ISA 18.2)



Study Limitations

- **Site A**, was the largest and only **Model 4 Hospital** included in the study, hence staff from this site were **over represented** in the sample.
- **Site A** had introduced **ECRI alarm management recommendations** locally, consequentially, Site A is distinctly different from all other sites.
- The study was limited to the West of Ireland and excluded ED, CCU and Neonatal ICU.

Recommendations

- Instigate measures to counteract the number of false/non-actionable alarms. e.g. using **alarm delays, customisation** and **switching off** non essential alarms.
- **Customising Alarm Parameters** to Patients reduces alarm loads but is not a panacea.
- **Education and training on alarm management** and the functioning of technological devices is called for.
- Evidence based alarm management **policies and procedures** need to be introduced.
- **Alarm Fatigue** needs to be recognised as potential contributory factor in **sentinel event analysis and near miss incidents** and documented accordingly.
- **Alarm loads** need to be **monitored** and alarm data utilised
- **Educate** staff regarding the dangers of alarm fatigue.
- Device manufacturers and need to contribute to resolving the problem and **new devices properly tested** in the field.



Questions?



**Thank you for
listening**



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CONNACHT TRIBUNE

Woman died in hospital after alarm not heard

“It took 23 minutes before attention was drawn to this patient’s condition, by which time she was dead... The patient was in serious danger, and her condition should have been made known to staff immediately, irrespective of what was being done on the ward. There was a ward round going on at the time, there were numerous doctors around – there is something not right with that.”

.....a recording of the same alarm was played for the Coroner, after which he noted: “It doesn’t seem to inspire any degree of urgency ... you would be oblivious to it.

However, Dr MacLoughlin was not satisfied. “You can make all the excuses – but why didn’t you see it or hear it,” the Coroner responded

Pensioner dies amid concerns over hospital bells being ignored

www.gloucestershirelive.co.uk Pensioner dies amid concerns over hospital bells being ignored

By [The Citizen](#) | Posted: November 07, 2011

PENSIONER Margaret Vaughan died trying to reach a hospital toilet unaided – with a coroner saying he is having too many complaints about patient alarm bells being ignored

Nurse who silenced baby's heart alarm struck off May 20, 2009

A Great Ormond Street Hospital nurse has been struck off after ignoring an alarm on a six-month-old's heart monitor.

A disciplinary panel of the [Nursing and Midwifery Council](#) heard that Nicola Waterfall, 31, silenced the emergency alarm while working on the high-dependency section of a ward at the London hospital so that she could talk to the parents of a child in another bed. The **alarms only sound if the baby's heart level falls to a dangerously low level.**

The baby did not die but the panel ruled that Miss Waterfall was a 'danger to the public', saying she 'should not have taken her attention away from her patient, even for a short period'