Project Title

Tele Monitoring of Patients on Non Invasive Ventilation (NIV) Therapy - A Novel Approach

Project Lead and Members

Project Lead: Dr Nikhil Gautam

Project Members: Faheem Khan, Chiew Yong Seng, Dan Ong

Organisation(s) Involved

Ng Teng Fong General Hospital

Healthcare Family Group(s) Involved in this Project

Biomedical Engineering, Information Technology, Medical, Nursing and Respiratory Therapy (RT)

Applicable Specialty or Discipline

Intensive Care Medicine

Project Period

Start date: April 2021

Completed date: June 2022

Aim(s)

To provide continuous tele-monitoring, improve patient safety & be pandemic prepared

Background

See poster appended/ below

Methods

See poster appended/ below

Results

See poster appended/ below

Lessons Learnt

Hospital-wide initiatives are complex processes with many groups/teams of people needing to work in synergy for effective implementation of change. One thing that we would have done differently would be to identify from the start, the main representatives from each department involved in the project and initiate timelines and dates for completion. We are continually in the process of improving our system – the next challenge for us is working with industry partners in the development of a mobile app (ongoing).

Conclusion

Using IT, automation and a passion for change, our team comprising of a varied group of professionals have implemented a safe, effective and scalable method for enhanced delivery of care to patients in the GW. The main message we would like to share is this: in large scale, hospital wide projects like ours, there are many intricacies of working together with different departments. With effective communication and clear goals in mind, one can achieve good synergy in the group leading to positive results and a fruitful experience. At the bedside, the changes we have implemented have led to improved safety and enhanced clinical care delivery to our patients. There has been increased efficiency and productivity among the healthcare workers involved. And on a large scale, with increased utilisation in the event of the next pandemic surge, there is a capacity for saving precious ICU resources without compromising patient care.

Additional Information

With the completion of more than a year (April 2021-June 2022) of monitoring a small group of patients on the system, we are now in the process of formalising it with the development of a workflow involving the ED/ICU/GW teams. The clinical workflow/policy is in process.

Previously, NIV initiation in the GW was mostly done by respiratory physicians and ICU physicians – mostly for DNR patients. With the new system, we are seeing an increase in the number of non-DNR patients on NIV in the GW. With the completion of the workflow/policy document, we hope to see more patients being admitted from ED to the GWs with NIV.

For the whole of last year, we have only catered for a maximum of 5 patients on Tele NIV in the GWs at any one time. This will be escalated according to usage and demand in the future.

Project Category

Care & Process Redesign, Quality Improvement, Workflow Redesign

Technology, Digital Health, Tele-Monitoring

Keywords

Non-Invasive Ventilator (Niv) Therapy, Niv Support In General Ward (Gw), Remote Continuous Monitoring

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TELE MONITORING OF PATIENTS ON NON INVASIVE VENTILATOR (NIV) THERAPY – A NOVEL APPROACH

Nikhil Gautam, F A Khan, Dan Ong, He Aixia, Che Lee Yean, Chiew Yong Seng

INTRODUCTION

Non Invasive Ventilation (NIV) is a way of providing breathing and oxygen support to patients with a wide range of respiratory conditions. Patients on NIV therapy in NTFGH are generally monitored and managed in the HDU/ICU area with few patients (especially patients with partial code or DNR status) being managed in the general wards (GW). With the need to save precious ICU/HDU beds and medical resources during the COVID-19 pandemic, we conceptualised and implemented a novel method of combining ventilator and physiological data in order to safely monitoring patients on NIV therapy in the GWs from a remote distance in the ICU. Continuous monitoring of specific alarms and physiological variables and an efficient and reliable escalation system would give physicians the confidence to manage an increasing number of patients with requirements for NIV support in the GW. On top of enhancing patient safety, this would have huge implications for resource management during pandemic/endemic times.
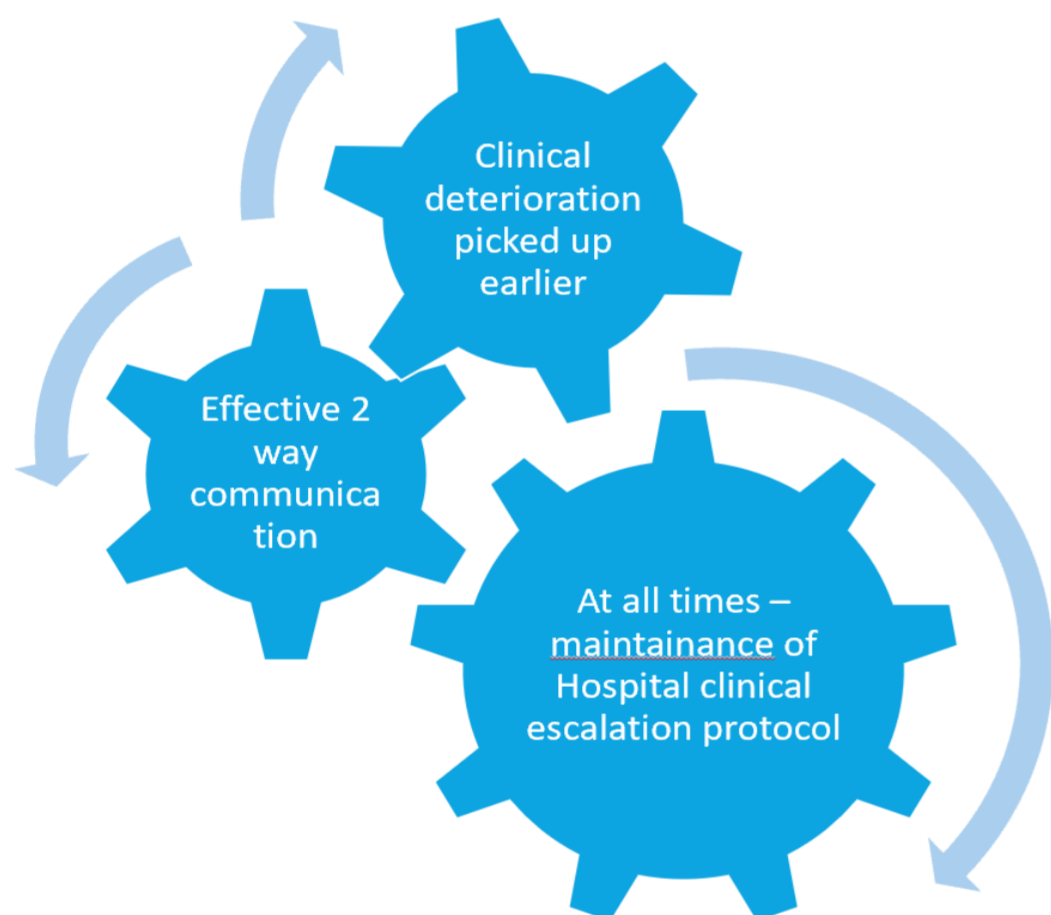
OBJECTIVES

Continuous Tele-monitoring

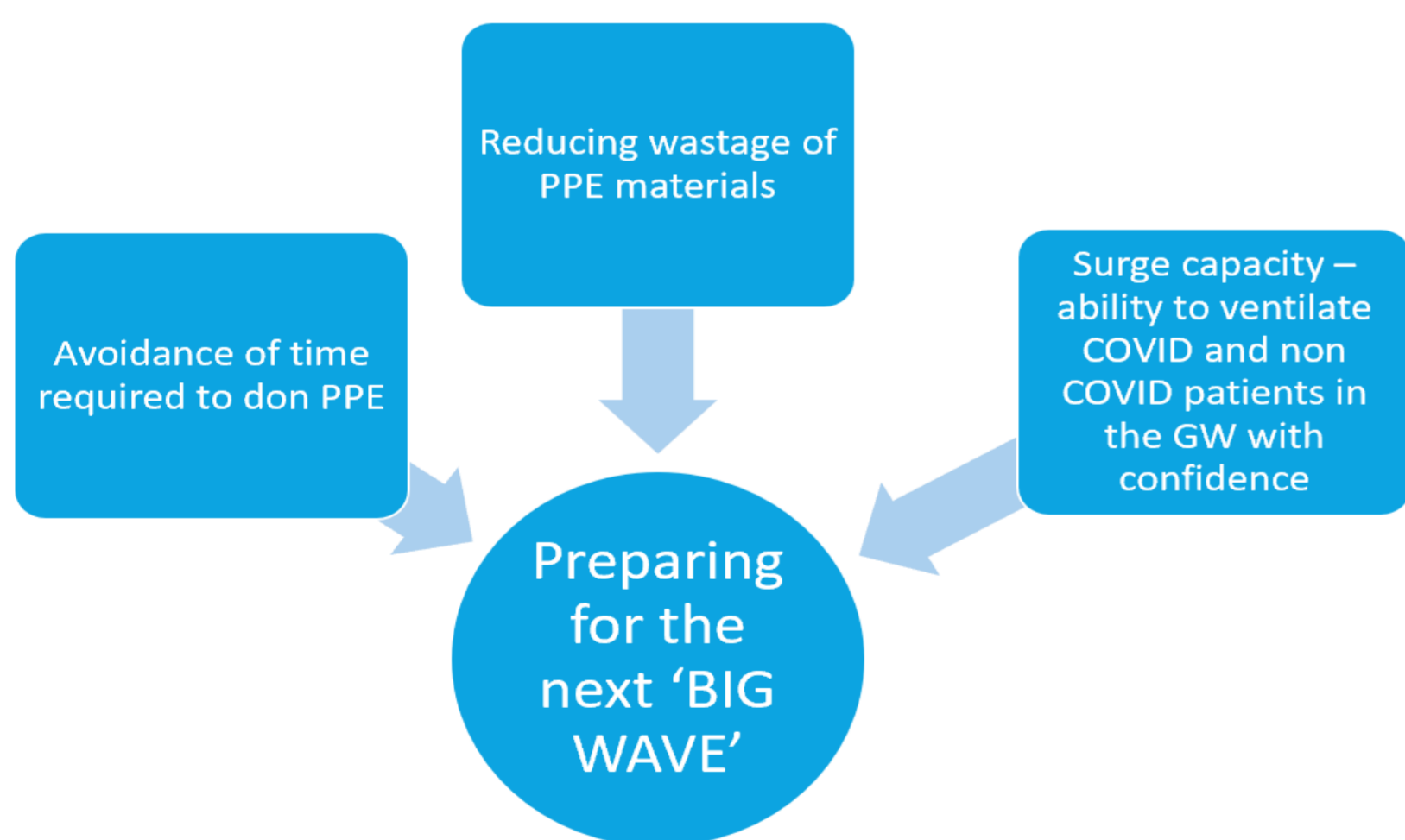Combining 2 types of data for a more holistic and enhanced assessment

| VENTILATOR DATA | PHYSIOLOGICAL VARIABLES | FINAL ASSESSMENT |
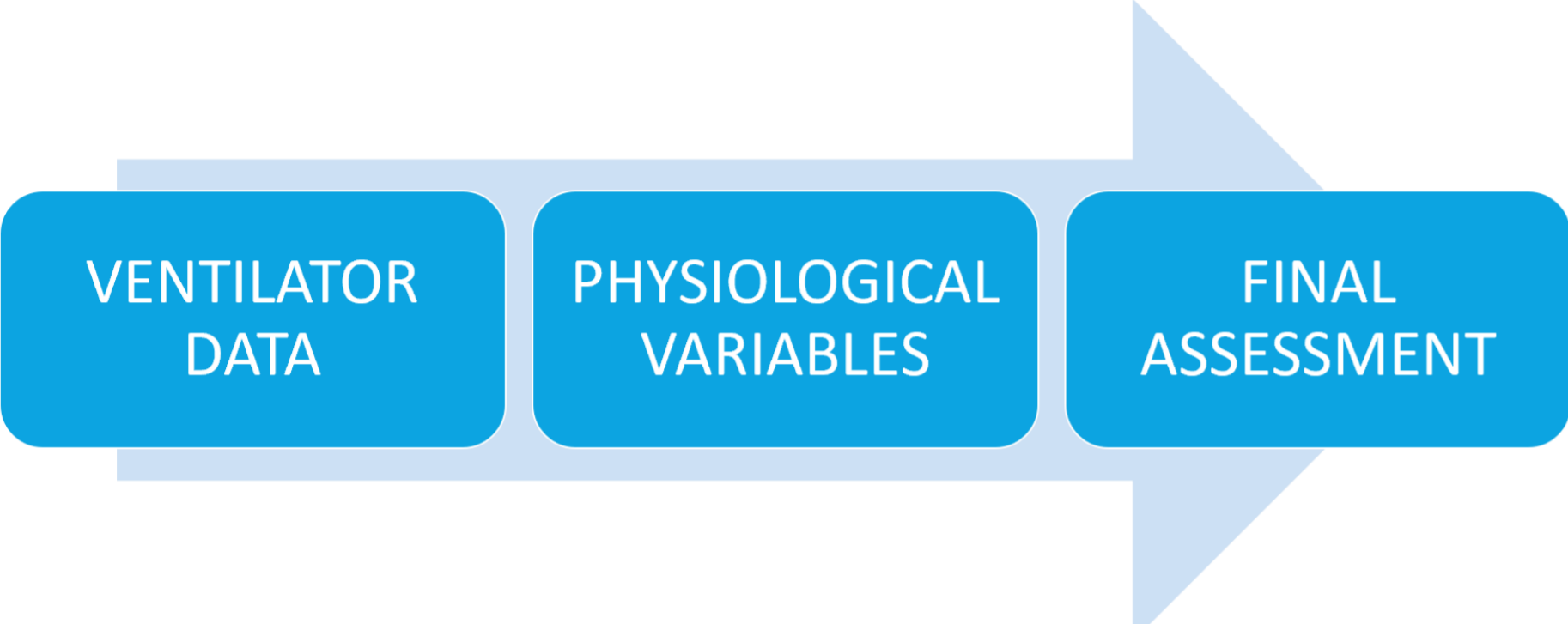
Improvement of patient safety

An extra layer of safety through constant monitoring and immediate feedback

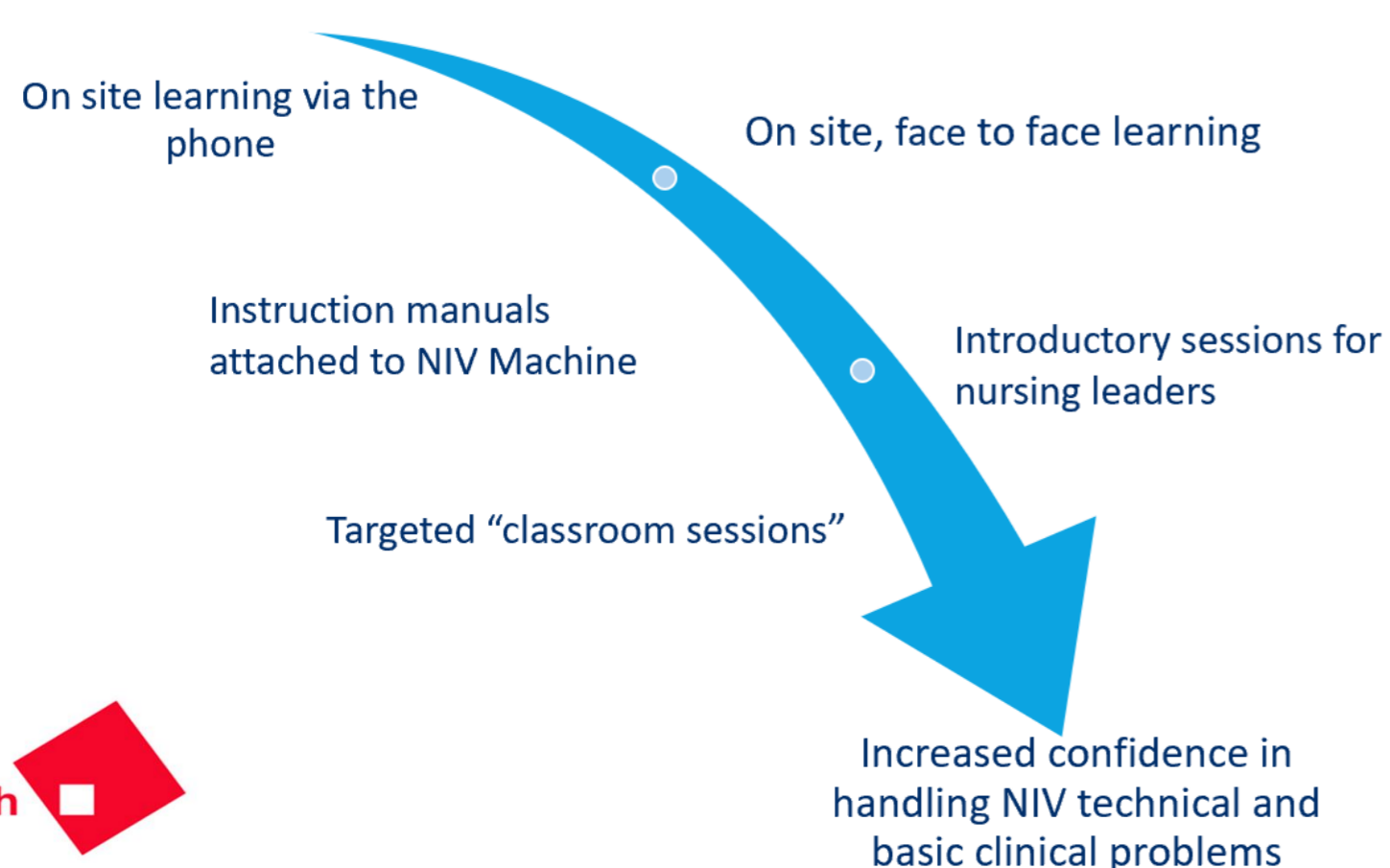- Clinical deterioration picked up earlier
- Effective 2 way communication
- At all times – maintainance of Hospital clinical escalation protocol

Pandemic Preparedness

A matter of time – bringing the ICU to the wards

- Reducing wastage of PPE materials
- Avoidance of time required to don PPE
- Surge capacity – ability to ventilate COVID and non COVID patients in the GW with confidence

→ Preparing for the next 'BIG WAVE'

Education and empowerment

GW staff including nurses, junior doctors

- On site learning via the phone
- On site, face to face learning
- Instruction manuals attached to NIV Machine
- Introductory sessions for nursing leaders
- Targeted "classroom sessions"

→ Increased confidence in handling NIV technical and basic clinical problems
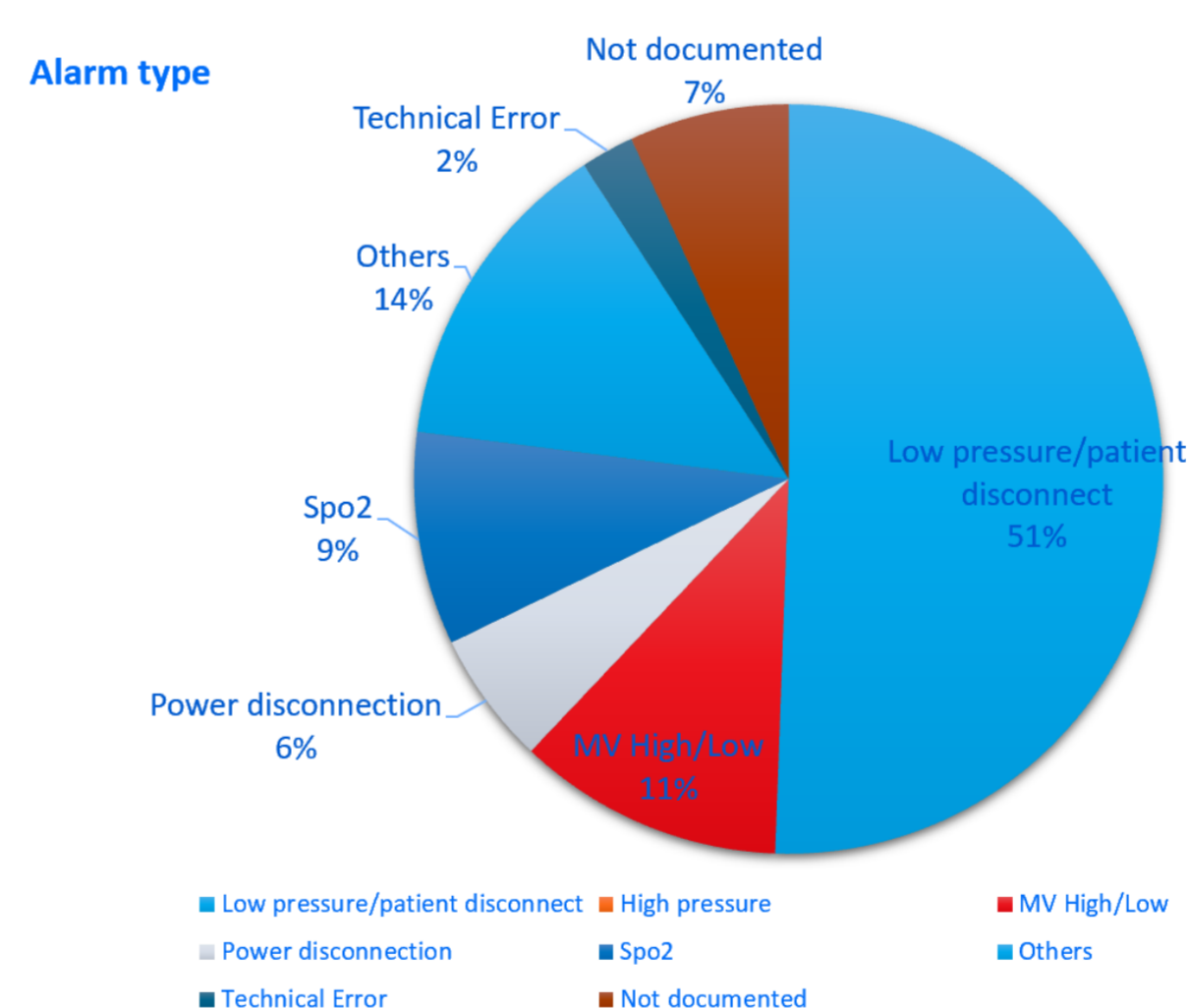
Jurong Health

METHODS

A multidisciplinary team consisting of members from the Biomedical Engineering, Information Technology, Medical, Nursing and Respiratory Therapy(RT) department worked together with Industry partners to implement a redesign of the monitoring and clinical/technical escalation protocols. A specially designed cable was used to combine 2 types of data: patient ventilator data (respiratory rate, airway pressures, respiratory volumes, power disconnections and oxygen supply) with physiological data (pulse rate and Spo2 levels). The data was then transmitted live to a remote monitoring station in the ICU. The two different processed are compared below :

PREVIOUS PROCESS

- Ward Nurse notices technical issue with NIV machine (alarms/ disconnection etc.) or clinical issue of patient on NIV
- Ward Nurse calls RT (located in ICU) for help with troubleshooting
- RT makes an attempt to trouble-shoot and resolve the problem on the phone
- RT goes up to the ward to assess the situation and takes action to resolve the issue
- RT may recommend that the case be escalated to the team or ICU doctors in the case of clinical deterioration

NEW PROCESS

- RT (based in ICU) is alerted to one of 6 pre-determined alarms* on the ventilator
- RT then reviews the vital signs as well as ventilator data which will help in the overall assessment
- With the two types of data in hand, the RT then calls the GW nurse to alert him/her to the situation and attempts to remedy the condition over the phone
- If the condition cannot be remedied over the phone, the RT will make his way to the GW to assess the situation on the ground

RESULTS

Analysis of Tele NIV Data

Alarm type

- Low pressure/patient disconnect 51%
- Not documented 7%
- Technical Error 2%
- Others 14%
- Spo2 9%
- Power disconnection 6%
- MV High/Low 2%
- High pressure

Legend: Low pressure/patient disconnect | High pressure | MV High/Low | Power disconnection | Spo2 | Others | Technical Error | Not documented

- 7 definite episodes where an acutely deteriorating condition was captured and intervention made a clinical difference – 1 case every week

- Many other episodes where early detection of a clinical or technical issue (eg mask fit/circuit disconnection) has prevented further deterioration of the patient

A total of 21 patients were studied with 95 alarm encounters as part of an initial pilot project assessing for safety and feasibility of the process. There were no clinical safety or IT connectivity/security issues documented. . RT workload was reduced with most issues being resolved over the phone. RT response and resolution times were documented as a median of 2 minutes and a mean of 5.3 minutes

CONCLUSION

Using IT and a passion for change, our team comprising of a varied group of professionals have implemented a safe, effective and scalable method for enhanced delivery of care to patients in the GW. At the bedside, the changes we have implemented have led to improved safety and enhanced clinical care delivery to our patients. There has been increased efficiency and productivity among the healthcare workers involved. And on a large scale, with increased utilisation in the event of the next pandemic surge, there is a capacity for saving precious ICU resources without compromising patient care. Our ongoing education and empowerment efforts for GW nurses will go a long way in ensuring capability, confidence and adoption of the new process. Looking to the future, we are developing a mobile app for enhanced monitoring on the go which will further enhance our monitoring process and increase staff efficiency.