SIGNIFICANT ADVERSE EVENT REVIEW REPORT

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SAER Team Lead	[redacted]		
SAER Team *Please detail members of review team indicating name and role.*	○ [redacted]		
Causation Code	☐ 1. Appropriate care/services: well planned and delivered/unavoidable outcome ☐ 2. Issues identified but they did not contribute to the event ☐ 3. Issues identified which may have caused or contributed to the event ☒ 4. Issues identified that directly related to the cause of the event		
Final SAER Report signed off by Commissioner Signature: ____ [redacted] _____4/8/21_____			

CHANGE RECORD

Date	Author	Change	Version No.	Agreed by Commissioner

THIS REPORT IS THE OPINION OF THE REVIEW TEAM WHO WILL DETERMINE FACTS.
IN MANY CASES THE TEAM WILL REACH A CONCLUSION BASED ON THE EVIDENCE AVAILABLE.

SIGNIFICANT ADVERSE EVENT REVIEW REPORT

EXECUTIVE SUMMARY

1. Situation

On 29th October 2020 at 21.44, an air conditioning unit ignited within a fully occupied two bed intensive care room within Ward 1 Critical Care Unit at University Hospital Hairmyres (UHH).

The air conditioning unit's propane refrigerant ignited, and a hydrocarbon accelerated fire occurred. There was a rapid rise in temperature with products of combustion flowing up the wall and windows of the room, rolling along the ceiling towards the door of the room. Thick black smoke filled the room and over spilled into adjacent areas of the critical care unit. Visibility was significantly impaired.

The staff responded swiftly, alerted switchboard to the fire, the break-glass alarm was activated, and evacuation of the patients initiated.

The Scottish Fire and Rescue Service (SFRS) arrived on site within 7 minutes, by which time staff had evacuated 12 critical care patients to the adjacent theatre complex. One patient was extricated by SFRS. Spreading smoke triggered the evacuation of the adjacent Acute Medical Receiving Unit. Activity on the UHH site was impaired, and health board wide business continuity plans were enacted. One patient sustained a small, [redacted]. A significant number of staff required support following this highly traumatic event.

2. Background

Ward 1 was converted to accommodate intensive care and medical high dependency patients in response to the Covid-19 pandemic. There was an urgent need to create more capacity for intensive care due to the predicted numbers of patients who would require the highest level of medical intervention.

When assessing Ward 1 for suitability there was concern regarding the environmental temperature for patients and staff. Staff had to work in full PPE, in a confined area, and with equipment which generates heat. A solution was recommended by way of air conditioning units and installed by the building operator.

In the rooms with two intensive care patients there were two air conditioning units. When the room was being utilised these units were on an automatic cooling mode.

The cause of the fire was an inherent manufacturing defect in one of these air conditioning units.

3. Assessment

There was a high level of fire awareness and preparedness within the Intensive Care Unit (ICU), developed through fire drills and high-fidelity multidisciplinary evacuation simulation. The Unit's Fire Nursing Lead was extremely proactive. The fire evacuation plan was appropriately detailed. The response of staff and the Scottish Fire and Rescue Service was swift and is commended.

The fire developed with such rapidity, and with thick black smoke impairing visibility, that real world conditions were substantially worse than had been simulated. The available time to evacuate patients was even shorter than had been anticipated. Evacuation processes and critical care bed spaces require review to consider if they could be pared back further to the absolute minimum to support rapid evacuation.

Independent joint multi party forensic analysis concluded that the air conditioning units were appropriately installed and operated.

The Fire Safety Advisors have concluded that the fire was not easily foreseeable. There is no evidence that increased ambient oxygen concentrations contributed to this fire, and the oxygen monitoring processes in place were evidence of good practice. The building operated as designed to stop the spread of fire and the alarm system operated as designed, however extraction fans may have contributed to some spread of smoke.

Cooling apparatus are used across all healthcare settings, and there is an increased use of highly flammable refrigerants in cooling devices. Catastrophic failure is extremely rare, but should be considered and planned for.

Potential breaches of Covid-19 infection control procedures occurred when multiple staff members responded urgently and appropriately to the fire. Although limited temporarily exposure may have occurred, no staff or patients contracted Covid-19 from this event.
The hospital clearly wanted to support its staff after this unusual and traumatic event. However, when asked, many staff felt support was inadequate. The needs of the staff were more complex than the system that was put in place could meet. The workload on support services at height of the pandemic may have exacerbated this.

4. Recommendations

1. Develop a detailed structured approach with a named clinical coordinator to ensure timely, effective and personalised support to all staff members following traumatic incidents within NHSL.
    a. Identify all staff requiring support and signpost the support available.
    b. Coordinate the support provided from multiple internal and external sources, and provide liaison between different agencies.
    c. Recognise that support may be required for a significant period of time after the event, therefore continue to operate for as long as required.

2. Conduct a review of the procurement and installation of electrical apparatus containing highly flammable refrigerant throughout the NHSL estate.

3. Conduct a review of the installation of oxygen extraction fans, and their impact on the spread of smoke in the event of a fire, throughout the NHSL estate.

4. Develop a fire response and evacuation high fidelity, in-situ, simulation programme that can be used widely throughout the organisation.
    a. Use simulation to promote collaboration between the clinical and fire safety teams, sharing expert knowledge in an authentic environment to fully understand the operational and clinical challenges presented in each area.
    b. Determine and publicise the *minimum available time* to evacuate each area.
    c. Train until the *required* time meets the *minimum available time*, prioritising essential tasks.
    d. Simulate in both evacuation and receiving areas, incorporating command and control training.
    e. Ensure appropriate resource is allocated.

5. Develop a clear process to streamline evacuation when staff decide an area needs to be evacuated.
    a. This process should be initiated by a simple instruction, using language to portray urgency, such as “evacuate now”. Human factors should be carefully considered in its design.
    b. Transferable learning from safety critical industries such as aviation should be considered when developing this process.

6. Consider developing 2nd stage site-wide fire response teams, highly trained in facilitating evacuations, to supplement and support the immediate evacuation team.

7. Further refine the set-up of critical care bed spaces to minimise evacuation time.
    a. Refine through repeated simulation.
    b. Optimise for a smoke-filled environment, considering standardised life support device placement and high visibility device labelling.

8. Simplify and speed up the existing process, or develop a new automated one, to alert the receiving destination, rest of the hospital, relevant staff at home and wider organisation that an evacuation is in progress.

9. Develop a regional plan for the management of a major incident in one critical care unit within the West of Scotland Network, ideally involving a retrieval team approach.

MAIN REPORT

1. Scope of review and sources of information

This SAER review has been commissioned for the purpose of learning from the event. Fires necessitating evacuation of an intensive care unit are rare in the UK, although they have occurred at least 4 times in the last 12 years. Fires within hospital premises are more common. There is therefore learning to be extracted from this event to be shared within the critical care community and wider healthcare sector. This SAER will identify opportunities for improvement as well as identify areas of good practice to share.
The SAER will focus on:

- Ventilation, cooling and oxygen management within the Ward 1 expanded critical care area
- Fire preparation
- The fire response
- The aftercare following the fire

The following sources of information were used:

- Staff were interviewed and debriefed individually and in small groups
- A team debrief led by the NHSL Resilience Team
- The NHSL Fire Safety Advisors analysis of the event incorporating the SFRS analysis
- An independent joint multi party forensic investigators report into the air conditioning unit which caused the fire, submitted to the review team on 25 May 2021

2. Detail of incident

On 29th October 2020 at 21.44, an air conditioning unit ignited within a two bed intensive care room, occupied by two high acuity Covid-19 patients and one member of staff. Highly flammable propane refrigerant within the air conditioning unit ignited and a hydrocarbon accelerated fire occurred. There was a rapid rise in temperature with products of combustion flowing up the wall and windows of the room, rolling along the ceiling towards the door of the room. Thick black smoke filled the room and over spilled into adjacent areas of the critical care unit. Visibility was significantly impaired.

Staff immediately called the hospital's internal emergency number '2222' and break glass points were activated before even the smoke detectors had time to register the fire and activate the system. The fire alarm activated at 21:44:54. The hospital fire response was activated via pager system and multiple members of hospital staff arrived to assist with evacuation.

Scottish Fire & Rescue Service (SFRS) were on site within 7 minutes at 21:51, by which time staff had evacuated 12 of the 13 critical care patients from the ward to the theatre complex, including one from the room where the fire initiated. SFRS extricated the last remaining patient from the smoke filled room.

In the intervening period a member of staff attempted to fight the fire using a handheld fire extinguisher but was forced back by smoke and lack of visibility. As smoke spread evacuation of an adjacent fire compartment, the Acute Medical Receiving Unit, was automatically initiated into adjacent wards by progressive horizontal evacuation.
Multiple additional members of medical, nursing, management and support staff arrived from home, having been

called in via switchboard, WhatsApp, and the major incident callout cascade.
Nursing & medical staff contacted families rapidly to update them on their loved one's condition and provide reassurance.
The fire was extinguished by SFRS by the use of a hose reel, and the incident closed by 23:48.

One patient suffered a small [redacted]. During the evacuation there were potential Covid-19 infection control breaches resulting in 21 members of staff requiring to subsequently self-isolate. No member of staff or patient contracted Covid-19 from this event. Nine members of staff were assessed for potential smoke inhalation but all were fit to go home.
A major incident was declared and the hospital diverted emergency admissions to other NHS Lanarkshire sites and NHS Greater Glasgow & Clyde for a period of approximately 24hours.

The hospital continued to deliver critical care in its existing unaffected second Intensive Care Unit and in operating theatres and theatre recovery areas. Existing in-patient care and emergency surgery was largely unaffected, but some elective surgery was rescheduled. Regional critical care units offered support, and a small number of patients were transferred for capacity reasons in the days following the fire.

The building operator, ISS Healthcare, and NHSL Property and Support Services Division (PSSD) worked tirelessly to refurbish the heavily damaged ward, getting it back in service within a matter of weeks.

77 members of staff required support following this highly traumatic event.

3. Key findings of review

Cooling, Ventilation and Oxygen Management Within the Ward 1 Critical Care Unit

Environment

Ward 1 is an expanded critical care area located opposite UHH's existing 10 bedded ICU/HDU. At the outset of the Covid-19 pandemic it was designated as a ward to receive Covid-19 patients and provide medical high dependency care. Intensive care units across Scotland were tasked with urgently preparing for up to 400% expansion in capacity. At the early stages of the pandemic UHH's expanded intensive care services operated out of two theatre recovery areas at either end of the theatre complex, significantly impacting theatre throughput and capacity.

As the first wave of the pandemic subsided and elective theatre activity restarted, there was a need to relocate expanded critical care services. Ward 1 was chosen given the location and layout.

Throughout the pandemic there was close collaboration between the building operators, PSSD, hospital management and the clinical teams to deliver the expanded services required, in this complex, dynamic and time critical situation.

Air Conditioning Units

The building operators recommended the installation of air conditioning into Ward 1. Hospital wards can be hot despite maximal ventilation, and critical care staff were finding working in full PPE uncomfortable, risking their ability to deliver high-quality patient care.

The air conditioning units were:

- recommended by the Authorising Ventilation Engineer, as appropriate for the air volume in the room
- purchased from a ISO 9001 certified ventilation supplier

- plugged into a standard installation socket, and extracted to the outside of the building
- subject to planned preventative maintenance by the building operator
- cleaned as part of standard infection control measures
- operated simply via an auto on/off switch, with which staff were familiar
- recorded in the ward emergency fire evacuation procedure document, submitted to the Fire Safety Advisors

Following the fire, independent multi party forensic analysis was commissioned by NHSL, ISS Healthcare, the equipment supplier, and the equipment manufacturer. This concluded that the cause of the fire was an inherent manufacturing defect in a portable air conditioning unit in Ward 1.

Abrasion of the insulation of the power supply cable for the compressor motor occurred where it impinged on refrigerant pipework. This allowed the live electrical power conductor to come into contact with, and arc against, the earthed refrigerant pipework.

Arcing caused a hole to form in the pipe releasing class 3 flammable R290 propane refrigerant. Ignition of the refrigerant occurred causing the fire. Ignition may have been by the spark resulting from arcing between the conductor and pipe.

Similar evidence of this manufacturing defect was observed in an exemplar unit subject to the same joint forensic analysis.

The electrical installation of the device within Ward 1 was found to be appropriate. The forensic investigators observed that whilst there was no manufacturer requirement for individual residual current device (RCD) protection of the apparatus, had this been fitted it may have operated prior to sufficient damage being caused to penetrate the refrigerant pipework. The forensic investigators however were uncertain that in reality this would have operated and offered protection.

Joint forensic analysis concluded that the manner of use of the appliance did not in any way contribute to the cause of the fire or its subsequent development.

Highly flammable refrigerants are increasingly being used in cooling devices worldwide. R290 has many ideal properties for cooling, but is highly flammable. Traditional refrigerants are being phased out due to the environmental damage they cause and new stringent environmental regulations. The unit that ignited contained 220g R290 and was labelled as containing such.

There are international standards, although this remains a developing area, describing the amount of flammable refrigerant that can be used in a device. This is primarily risk assessed based on the calculated atmospheric concentration that would develop in a standard room, and the subsequent risk of fire, should the gas be accidently released. This could occur for example during maintenance or accidental damage. 220g is within the internationally described safe limit.

This was a highly unusual incident in that it appears the gas released and ignited simultaneously from electrical arcing. The root cause of this is reported by the forensic analysis to be a manufacturing failure. The presence of R290 was however a contributory factor.

Nevertheless, fire associated with these devices have been described internationally, either during maintenance or operation, and their use needs to be reviewed.
Cooling apparatus is in use across the health care sector. With the phasing out of traditional refrigerant, and the increasing use of highly flammable ones, careful consideration should be given to the procurement and installation of these devices. Manufacturing failure of this magnitude is extremely unusual, but there must be a

plan in place for these rare but serious events.

The Incident was reported to NHS National Services Scotland Incident Reporting and Investigation Centre and an interim national Safety Action Notice was issued regarding the hazards associated with the use of portable electrical appliances including air conditioning units and the measures that should be taken to ensure they are used safely.

Oxygen Management

During the Covid-19 pandemic the safe management of oxygen was a challenge for the entire NHS. There were concerns about the capacity to deliver enough oxygen via existing infrastructure and pipelines, the safe storage of backup oxygen supplies and the risk associated with increased environmental oxygen concentrations. Clinical and management teams within NHSL worked in close collaboration on these issues from the very earliest stages of the pandemic.

Enriched oxygen environments are a fire risk. Technically by definition any oxygen concentration exceeding room air is an enriched oxygen environment, however formal definitions vary between organisations, usually based on the threshold at which there starts to be an observable increase in fire risk. Ambient oxygen concentrations above 23% are often defined as an Oxygen Enriched Atmospheres (OEA). Comprehensive oxygen hazard analysis determines fire risk based on both atmospheric oxygen concentrations and other specific factors increasing the probability and consequences of ignition.

At the outset of the pandemic additional extraction fans were fitted to patient rooms throughout the hospital, given an anticipated uplift in oxygen usage across clinical areas within the site. The fans operate if more than 10 l/ min of oxygen was in use in a room. These extraction fans deliver approximately 10 air changes per hour to the rooms.

NHS Lanarkshire developed a standard operating procedure (SOP) to monitor oxygen usage and measure ambient oxygen levels in wards and rooms across the site. The NHSL SOP implemented 22% as a safety cut off, with immediate mitigation measures in place should this threshold be detected. Despite comprehensive monitoring throughout the site during the Covid-19 pandemic, no 23% OEAs were detected. A very small number of transient 22% alerts were noted and immediately mitigated.

At the time of the fire both patients in the room were receiving oxygen, [redacted]. These are standard therapies for intensive care patients. Both extraction fans in the room were operating normally. Neither of these oxygen delivery devices were in proximity to the air-conditioning unit. At 1800 the ambient oxygen levels in the room were measured at 20.9%, which is normal room air, and there was no significant change in the oxygen usage in the room prior to the fire. Whilst oxygen is of course a key ingredient of any fire, there is no evidence that increased ambient oxygen concentrations contributed to this fire.

Ventilation

Ward 1 traditionally has ventilation supply and extract built into the ceiling of the ward, and provides approximately 3.3 air changes per hour. Heating and cooling are usually provided via this system. Ventilation systems may be interlinked with the fire alarm system and some will shut down automatically in the event of a fire.

Additional extract fans were fitted at the outset of the pandemic to each clinical room. In addition to providing oxygen extraction, they upgraded the air flow to 10 air changes per hour and provided a degree of negative pressure airflow. These parameters have the additional benefit of augmenting infection control for Covid-19 patient undergoing aerosol generating procedures (AGPs).

As stand-alone devices, these fans are not interlinked with the fire alarm system. The building operators had consulted with the authorising ventilation engineer and fire safety advisors with regard to their installation.

The fire in Ward 1 generated a significant amount of thick black smoke which over spilled rapidly to common areas and adjacent rooms within the ward. Smoke is described entering adjacent rooms from gaps between ceiling tiles in the roof. Although each room is designed to contain within the compartment created by the floor above, the walls and the door, in this case the smoke was not completely contained. The degradation of ceiling tiles within the room, giving access to the ceiling void, coupled with extraction fans throughout the ward may have drawn smoke beyond the area of ignition.

Fire Preparation

Physical Environment

The materials and construction of the room performed as designed to prevent the spread of fire however the smoke spread much faster than the staff expected.

Staff Preparedness & Simulation

There was a high level of fire awareness and preparation amongst the staff. This was particularly true of the two Intensive Care Charge Nurses who were on shift in Ward 1 at the time of the fire. Regular mandatory fire drills were run within the critical care unit, day and night, championed by a highly proactive Unit Fire Lead Nurse. Fire evacuation scenarios were part of the Intensive Care Unit's regular educational programme, and participation was highlighted via their social media channel.

High-fidelity simulated evacuation of Ward 1 had recently been run by the critical care team involving nurses, doctors, managers, switchboard, estates, porters and support staff followed by a structured debrief.

High-fidelity simulation of a major incident response involving population of the theatre complex with critically unwell patients had been carried out previously by the critical care team, in conjunction with theatre staff, followed by a structured debrief.

Given the additional usage and storage of oxygen, and the knowledge that hospital fires are associated with oxygen cylinder usage, there was a heightened awareness of the fire risk within the Unit. The key item highlighted on the Ward 1 safety board at the time of the fire was an article, with pictures, detailing a past fire in Royal United Hospital's Bath Intensive Care Unit caused by an oxygen cylinder.

Fire Evacuation Procedure

A written emergency fire evacuation plan was developed for Ward 1 in conjunction with NHSL Fire Safety Advisors. Oxygen storage, electrical equipment, air conditioning units and extraction fans were all appropriately described in the fire risk assessment.

The Fire Response

The Fire Alarm System

The fire alarm system operated as expected, although staff were surprised that it didn't sound instantaneously at the time of ignition. A delay of a few seconds does occur whilst smoke detectors actuate. Exceptionally swift actions by staff triggered the system before the smoke detectors had time to react. This was a key element of the response, facilitating a fast response from Scottish Fire and Rescue Service. There was one member of staff, in a rest area outside the Unit who did not immediately hear the fire alarm.

Staff Response

When the air conditioning unit ignited a nurse was in the room in full PPE, with two patients. They immediately shouted for help. One patient was [redacted]. One patient was [redacted].

There were two Charge Nurses immediately outside the room who instantly called '2222', alerted the rest of the ward and coordinated the evacuation of patients and staff. The Charge Nurses did not have time to don a 'Fire Evacuation Coordinator' high visibility tabard, prioritising immediate evacuation instead. In this particular case, as a team used to dealing with both simulated and real life emergencies, it was absolutely clear to the staff who was in charge of the evacuation of the ward. Whilst tabards are a key element in the NHSL fire response and widely recognised as good practice, it should be recognised that physical and human factors may impair their use.

The SFRS Incident Commander on the night and the South Lanarkshire Station Commander commended the staff's leadership and conduct of the response, both verbally on the night of the fire and in a follow-up letter. He noted that staff took appropriate and swift action and continually provided the information and support needed to bring the incident to a safe conclusion. He commended them for their dedication, courage and professionalism, all demonstrated whilst also dealing with the unprecedented pressures of the Covid-19 pandemic.

Tackling the Fire

The room that contained the fire rapidly filled with smoke making it difficult to evacuate the second patient. Staff could not breathe normally in the room. For infection control purposes, a member of staff who was in the room had a different type of mask on (filtering face piece 3, FFP3) and felt more able to breathe. Whilst this may have been the case transiently, it should be noted that these masks offer absolutely no protection from the smoke and toxic gases given off by a fire nor from the oxygen deficient atmosphere a fire creates.

The staff member exited the room, noticed a fire extinguisher placed outside the door of the room, picked it up and immediately re-entered. Although visibility was poor they could clearly see the flames through the smoke. They directed and discharged the extinguisher at the flames until it appeared they had been extinguished. At this point visibility significantly worsened. It was their intention to then remove the patient from the room but the smoke and visibility made this impossible to do so and the patient was extricated by SFRS.

In this type of scenario staff are required to make a dynamic risk assessment to calculate the likelihood of success of an intervention that potentially puts their own health at risk. The organisation would not expect staff to put themselves at risk as part of their employment. This was an extremely challenging situation, and simulation training would potentially help staff judge acceptable levels of intervention.

Evacuating Critical Care Bed Spaces

Critical care bed-spaces are complex environments with often unconscious, immobile, patients attached to multiple pieces of life support equipment. This makes evacuation extremely difficult. Rapidly discontinuing therapy and disconnecting equipment comes with a high risk of harm to the patient. This is in fact true of many patient areas within the hospital, all of which have their own specific challenges with the potential to result in significant harm during evacuation.

The fire alarm system was emitting a continuous siren indicating that staff must prepare to evacuate. Faced with a sudden fire of unknown origin, and rapidly spreading smoke, it was clear in this case that evacuation must be initiated immediately. It wouldn't always be as clear cut as this.

As the fire was located in the middle of the ward, patients and staff were evacuated from both ends, either into the main hospital corridor or into the car-park. From here they proceeded to the immediately adjacent theatre complex, as per the fire evacuation plan.

Staff did not have time to assemble and discuss the evacuation plan, they did not have time to close windows and doors, and they did not have time, or free hands, to retrieve and use the torches provided for lighting failures.

Staff disconnected all unnecessary equipment and, where necessary, hand ventilated patients using Ambu bags connected to either standard or integrated valve oxygen cylinders stored at the bed space for evacuation purposes. They found it cumbersome to open the cover on integrated valve cylinders, and that the Ambu bag disconnected easily. Size D oxygen cylinders containing 340 litres of oxygen emptied rapidly however when a larger cylinder was used, the lack of manoeuvrability added to the difficulty of evacuation.

Visibility deteriorated rapidly and staff were unable to read the labels on drug infusion pumps. Disengaging pumps from stacks and placement on the bed in a controlled fashion proved too time consuming. Infusion syringes, with the attempted exception of inotropes and vasopressors (cardiovascular support drugs), were pulled from the pumps manually and placed on the beds.

Additional equipment stored at the bed spaces made manoeuvrability difficult and patient monitoring cables wrapped in tight bundles were time consuming to free up.

No patient case notes were taken, and in one case a patient name band was lost during the evacuation. Although this made contacting families in the immediate aftermath of the evacuation more challenging, it was still accomplished rapidly using electronic hospital systems and with help from Police Scotland.

During the evacuation there was no time to call additional staff in to help, or to manually operate the major incident callout cascade. Staff arrived from multiple areas of the hospital alerted via the fire pager alert system and word of mouth. It was fortunate that a number of staff were together in a handover meeting when the pager system activated.

Despite simulation and debrief attempting to reduce the required time to evacuate to the minimum, there was substantially less time and visibility in the real world scenario.

Units need to perform repeated evacuation simulation, until the required time is less than the minimum available time, and in limited visibility scenarios. Key to this is streamlining and simplifying ICU bed spaces. This will be required in addition to the standard Learn Pro fire training module.

Moving to Theatre

Patients were evacuated into the theatre complex. Major incident simulation and debrief had previously practiced this scenario, albeit for a simulated external mass casualty event with more time to prepare the theatre complex to receive casualties.

Staff in the theatre complex were unaware that an evacuation was occurring and the first patients arrived without warning. However as soon as they arrived, patients were rapidly assigned to appropriate locations and therapy re-established.

Ordinarily, an intermittent siren sounds in all fire compartments adjacent to where the fire alarm has been activated. This alerts staff to investigate further and prepare for a stage 1 horizontal evacuation of patients into their compartment.

In this case, although Ward 1 and the theatre complex are geographically close, they are on opposite sides of the main hospital corridor and therefore not in adjacent fire compartments. Despite the continuous evacuation alarm sounding in Ward 1, the alarm did not sound at all in the theatre complex. Similarly, staff in the main ICU/HDU were initially unaware an evacuation was occurring.

Covid-19 Infection Control

Many of the patients evacuated were receiving treatment for infection with Covid-19. Some were undergoing aerosol generating procedures in which there is a risk of aerosolised spread of the virus.

The patients were in isolation rooms, and staff looking after them were wearing personal protective equipment which included eye protection, fluid repellent gowns and FFP3 standard facemasks.

Isolation procedures were necessarily breached during the evacuation. They were re-established once the patients were evacuated into operating theatres where the ventilation systems meet the required number of air changes per hour to limit aerosolised spread in infectious organisms.

The process of donning 'full' PPE is relatively time consuming. Staff arriving to help evacuate the patients did not have time to do this. Some, but not all, staff were able to put on FFP3 masks.

Full contact tracing of all staff was performed immediately after the fire. Staff who were deemed to have had potential Covid-19 exposure were required to self-isolate. Having to cope with the aftermath of being involved in a fire, the potential risk to themselves of Covid-19 exposure and the requirement to self-isolate was understandably extremely distressing for staff.

There were no identified episodes of patient to staff or patient to patient Covid-19 transmission as a result of the fire.

The Fire Team Response & Help from Other Areas of the Hospital

The hospital fire team consists of up to 5 page holders (duty manager, duty nurse, a porter, security, estates and health & safety officer) When the fire alarm activated their pagers alerted them to the location of the fire and they attended immediately. This however brings limited manpower.

One of the page holders was in a handover meeting with a number of other medical staff and they all went immediately to the ward. This level of immediate response wouldn't always be the case. Automating and expanding the alerts to a larger pool of staff to assist with evacuation would improve this. In addition to these first responders, additional help was summoned by word of mouth.

The NHSL Fire Safety Advisors have recommended a site-wide '2nd Stage Fire Response' is implemented in which a larger team of staff trained highly in evacuation would respond to incidents, as soon as evacuation was triggered.

A local command and control post was set up by staff within minutes of the evacuation at the major incident whiteboard at the entrance to the theatre complex. Staff described clear leadership and instruction at this post and this was commended by the SFRS Incident Commander on the night.

Evacuating Other Areas of the Hospital

As smoke spread a stage 1 progressive horizontal evacuation of the Acute Medical Receiving Unit adjacent to Ward 1 was automatically initiated. Staff and patients were evacuated into the adjacent Surgical Receiving Unit. Although this was extremely well managed it took a number of hours before the Acute Medical Receiving Unit

was declared safe to go back into use.

Staff from throughout the hospital, not just intensive care, were involved with and impacted by the fire incident. As well as medical and nursing staff, allied health professionals, cleaning & domestic staff, clinical support workers, admin staff, porters, estates staff, switchboard, managers, spiritual care and many others performed exceptionally to keep patients safe. They are all commended for their outstanding professionalism.

Calling in Staff & the Major Incident Cascade

Multiple members of staff were called in from home to assist with the incident. The duty ICU consultant was immediately alerted and the hospital switchboard started calling in all available Consultant Intensivists & Anaesthetists.

Alerts were sent out on the Anaesthetic Department WhatsApp group asking staff to respond. This generated a rapid response and staff arrived quickly.

The theatre manager started calling in ICU and theatre nursing staff from a paper based rostering system and a callout cascade.

The Duty Hospital Manager declared a Major Incident and the major incident callout list was contacted by the hospital switchboard. This included clinical staff from all disciplines, managers and support staff. A Major Incident Command Centre was set up in the hospital boardroom.

This was an unusual major incident in that it was an internal incident, and there was no preparation phase. The normal process of pre-alert via 'Major Incident Standby' was not possible here.

Whilst staff were alerted and responded from home extremely quickly, it relied on a manual based system of callout, augmented by Whatsapp messaging. Opportunities to further automate this process should be explored.

The Hospital Response

In tandem with the declaration of a Major Incident, the hospital diverted emergency admissions to other NHSL sites. Tried and tested arrangements were drawn on to ensure business continuity across the health board.

In the immediate aftermath the configuration of critical care was rearranged, with all Covid-19 +ve patients being cohorted in the existing unaffected main ICU/HDU, with an additional ICU set up in the theatre recovery area. The hospital re-opened to emergency admissions within 24 hours.

Some elective theatre work was postponed and limited number of emergency cardiology admissions were diverted to the Golden Jubilee National Hospital for a period after the fire, to reduce pressure on critical care beds.

The hospital released a media holding statement, cognisant of the rapid and significant spread of information via social media and other channels. A more detailed statement was released a few hours later. A number of other health boards contacted NHS Lanarkshire to offer assistance.

A number of local intensive care units offered assistance, and some patients were transferred in the days following the fire for capacity reasons. All intensive care units in the local area were dealing with considerable Covid-19 workload at the time, and the process of identifying suitable beds for transfer was a little challenging.

Whilst on this occasion it wasn't necessary to transfer any patients off site in the immediate aftermath of the fire, a regional approach to the evacuation of a West of Scotland intensive care unit should be developed. Ideally this

would involve local units dividing the retrieval workload and collecting patients, providing the staff and equipment to do so.

Staff Aftercare Following the Fire

The spiritual care department provided support to staff during the night of the fire and some groups of staff were supported by their line mangers. Colleagues supported each other via a private social media group created in response to the fire. Spiritual care remained in contact with some staff on an ongoing basis. Positive feedback from SFRS, the NHSL Board and the Scottish Government was shared with staff in writing and staff were thanked for their professionalism. Many staff were also supported formally and informally within their teams.

A number of staff were referred to the occupational health team (SALUS) for further support. The workload of the occupational health team at the time during the pandemic was such that NHSL outsourced to an external company to provide counselling for those staff whom SALUS felt required a referral. Line managers were requested to refer individual staff to SALUS to enable onward referral, and some opportunities to do this were missed. A number of staff have reported significant delays in accessing specialist support and ongoing support has been varied with some staff are still waiting for occupational health input.

A post incident hot debrief was facilitated for the staff working in ICU on the night of the fire. Supported debriefs were also planned for wider groups. A desire for fire investigations to be completed in advance of these debriefs contributed to delay.

A cold debriefing session was arranged by the NHSL Resilience Team and there was an assumption by staff and managers that this would offer them the opportunity to share their experiences in a supported environment. The purpose of this session was however more focused on organisational learning and didn't meet the needs of staff. This contributed to missed opportunities for supportive debrief.

The hospital clearly wanted to support its staff after this unusual and traumatic event, and support was offered to staff from multiple sources after the fire. However, when asked, many staff felt support was inadequate. The needs of the staff were more complex that the system that was put in place could meet. Although the workload of the hospital and support services at height of the pandemic may have exacerbated this, it is regrettable that these needs were not met.

The Faculty of Intensive Care Medicine 2019 General Provision of Intensive Care Services (GPICS) guideline recommends utilising the Trauma Resilience Management (TRiM) system screening tool. This allows follow up staff for signs of a trauma stress reaction or Post Traumatic Stress Disorder (PTSD) for staff involved in a traumatic incident.

4. Involvement and Support of the Patient and / or Families

At the time of the fire all the relatives of the patients who were evacuated were contacted and informed that the fire had taken place and that their relative was evacuated and was safe. This was implemented as soon as possible as there was recognition that it would be essential to hear from the hospital before relatives heard any concerning news reports about the fire.

5. Involvement and Support of Staff participating in the Adverse Event / Incident

Not all of the staff who were involved in the fire response have been interviewed as it was felt a selection of key individuals would provide enough information for the review. Staff have been open, candid and very helpful in

providing information for the review.
Staff also participated in a structured de-brief facilitated by the NHSL Resilience Team.
Staff were sent copies of the draft report for comment, prior to the final copy of the report being issued.

6. Outcome / Conclusion

There was close collaboration between clinical and non-clinical stakeholders in the development of expanded critical care Covid-19 pandemic services.

The fire was caused by an inherent manufacturing defect in a portable air conditioning unit. These units appear to have been appropriately installed and operated.

There is no evidence that increased ambient oxygen concentrations contributed to this fire. The oxygen monitoring SOP and mitigation measures are examples of good practice. Extraction fans may have contributed to the spread of smoke throughout the ward. If this was the case, a system to shut them down in the event of a fire is required.

There was a high level of fire awareness within the Unit helped by the high fidelity evacuation simulation and fire drills that had been performed. These were highly beneficial in preparing for the fire evacuation. However, the fire developed with such rapidity, and with thick black smoke impairing visibility, that real world conditions were substantially worse than had been simulated. The ward fire evacuation plan appropriately detailed and the building operated as designed to stop the spread of fire.

The response of staff and the Scottish Fire and Rescue Service was swift and is highly commended. The fire alarm system operated as designed.

It is clear that seconds count, before smoke and heat degrade the environment to make evacuation impossible Therefore there is recognition that critical care bed spaces need to be paired back even more to make evacuation easier. There is increased awareness that smoke makes it impossible to identify key elements of life support equipment i.e. inotrope and vasopressor infusions.

Patients were evacuated to the theatre complex before theatre were aware this was occurring. A fast method is required to alert receiving areas that an evacuation is occurring.

Potential breaches of Covid-19 infection control occurred due to multiple staff members responding appropriately.

The Fire Safety Advisors have concluded that the fire was not easily foreseeable.

7. Recommendations

1. Develop a detailed structured approach with a named clinical coordinator to ensure timely, effective and personalised support to all staff members following traumatic incidents within NHSL.
    a. Identify all staff requiring support and signpost the support available.
    b. Coordinate the support provided from multiple internal and external sources, and provide liaison between different agencies.
    c. Recognise that support may be required for a significant period of time after the event, therefore continue to operate for as long as required.

2. Conduct a review of the procurement and installation of electrical apparatus containing highly flammable refrigerant throughout the NHSL estate.

3. Conduct a review of the installation of oxygen extraction fans, and their impact on the spread of smoke in the event of a fire, throughout the NHSL estate.

4. Develop a fire response and evacuation high fidelity, in-situ, simulation programme that can be used widely throughout the organisation.
    a. Use simulation to promote collaboration between the clinical and fire safety teams, sharing expert knowledge in an authentic environment to fully understand the operational and clinical challenges presented in each area.
    b. Determine and publicise the *minimum available time* to evacuate each area.
    c. Train until the *required* time meets the *minimum available time*, prioritising essential tasks.
    d. Simulate in both evacuation and receiving areas, incorporating command and control training.
    e. Ensure appropriate resource is allocated.

5. Develop a clear process to streamline evacuation when staff decide an area needs to be evacuated.
    c. This process should be initiated by a simple instruction, using language to portray urgency, such as “evacuate now”. Human factors should be carefully considered in its design.
    d. Transferable learning from safety critical industries such as aviation should be considered when developing this process.

6. Consider developing 2nd stage site-wide fire response teams, highly trained in facilitating evacuations, to supplement and support the immediate evacuation team.

7. Further refine the set-up of critical care bed spaces to minimise evacuation time.
    a. Refine through repeated simulation.
    b. Optimise for a smoke-filled environment, considering standardised life support device placement and high visibility device labelling.

8. Simplify and speed up the existing process, or develop a new automated one, to alert the receiving destination, rest of the hospital, relevant staff at home and wider organisation that an evacuation is in progress.

9. Develop a regional plan for the management of a major incident in one critical care unit within the West of Scotland Network, ideally involving a retrieval team approach.