

**Orthopaedic Surgeon, Dr B
Wairarapa District Health Board**

**A Report by the
Health and Disability Commissioner**

(Case 17HDC02431)

Contents

Executive summary	1
Complaint and investigation	1
Information gathered during investigation	2
Opinion: Wairarapa DHB — breach	5
Opinion: Dr B — breach.....	7
Recommendations.....	8
Follow-up actions	8
Appendix A: Independent advice to the Commissioner	10

Executive summary

1. On 4 September 2017, Mr A was admitted to Wairarapa District Health Board (DHB) for knee surgery. The orthopaedic surgeon was Dr B.
2. During the surgery, Dr B applied Betadine with alcohol on the edge of Mr A's wound to minimise the risk of infection. Dr B then applied diathermy without waiting for the alcohol solution to dry first. As a result, Mr A's leg caught fire and he sustained burns.

Findings

3. The Commissioner found that Wairarapa DHB failed to provide appropriate care to Mr A, and breached Right 4(1)¹ of the Code, owing to the fire that occurred during the knee surgery, and for failing to have in place an appropriate fire hazard policy for operating theatres.
4. The Commissioner also found that Dr B did not provide services to Mr A with reasonable care and skill and breached Right 4(1) of the Code, as the use of diathermy immediately after an application of alcohol solution caused Mr A's leg to catch fire.

Recommendations

5. The Commissioner recommended that Wairarapa DHB provide a written apology to Mr A, confirm the implementation of its new policy forbidding the use of alcohol-based solution until diathermy has been disabled, and conduct a review of the effectiveness of the policy. It was also recommended that Wairarapa DHB prepare a fire hazard policy, audit its compliance with the existing guideline, and arrange training for its staff on fire hazards.
6. The Commissioner recommended that Dr B provide a written apology to Mr A and undertake further training about fire hazards in operating theatres.

Complaint and investigation

7. The Health and Disability Commissioner (HDC) received a complaint from Mr A about the services provided to him by Dr B at Wairarapa DHB. The following issues were identified for investigation:
 - *Whether Wairarapa District Health Board provided Mr A with an appropriate standard of care in 2017.*
 - *Whether Dr B provided Mr A with an appropriate standard of care in 2017.*
8. This report is the opinion of the Health and Disability Commissioner, Anthony Hill.

¹ Every consumer has the right to have services provided with reasonable care and skill.

9. The parties directly involved in the investigation were:

Mr A	Complainant
Dr B	Orthopaedic surgeon
Wairarapa DHB	Provider

10. Independent expert advice was obtained from Dr Alex Rutherford, orthopaedic surgeon, and is included as Appendix A.
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Information gathered during investigation

Introduction

11. Mr A underwent surgery on his right knee (the knee surgery) at Wairarapa DHB on 4 September 2017. Dr B² was the operating surgeon.
12. Mr A experienced adverse events during the surgery. This report concerns the care he received during the operation, in particular the fire that occurred.

Knee surgery

13. During the operation, Dr B used Betadine³ with alcohol to swab the edges of the wound to minimise the risk of peri-prosthetic infection.⁴ Diathermy⁵ was then used, causing the alcohol solution on Mr A's leg to catch fire. Dr B quickly extinguished the flame using water from the irrigation solution.
14. An incident report recorded:

“[Dr B] used a betadine soaked sponge to clean the surgical wound before placing the implants on. The diathermy tip was in touch with the crepe bandage, which had been used to wrap the leg (distal to the knee joint). The crepe bandage was wet with the above solution as well. The diathermy pencil got activated and thereby caused fumigating smoke coming from the crepe bandage.”

15. Mr A was discharged on 11 September 2017, seven days after his knee surgery. At the time, it was not known whether or not the burns were full thickness burns.⁶ Dr B stated: “Following the burns that [Mr A] sustained ... the incident was fully discussed with the

² Dr B is a registered practitioner in New Zealand and has full vocational registration as an orthopaedic surgeon. He is a Fellow of the New Zealand Orthopaedic Association, and also a member of the Knee Society of the New Zealand Orthopaedic Association.

³ An antiseptic used for skin disinfection before and after surgery.

⁴ Infection following joint replacement surgery.

⁵ Diathermy is electrically induced heat or the use of high-frequency electromagnetic currents as a form of physical therapy and in surgical procedures.

⁶ Full thickness burns destroy both layers of skin and may penetrate more deeply into underlying structures.

patient and his family in an open and transparent manner.” No issues were raised by Mr A regarding the disclosure and communication of this incident.

16. By 19 September 2017, it had become obvious that the burns were full thickness, and Mr A was referred to a burns unit. He was admitted on 28 September 2017, and underwent debridement⁷ and skin grafting.⁸ Mr A remained in hospital for a week.

Responses to HDC regarding the knee surgery

17. Dr B stated:

“I did not appreciate the fire hazard with this routine, and neither did anyone else, until we did have a fire following a spark from the diathermy, and [Mr A’s] leg was burnt ... [T]o [Mr A], I can only repeat that I am very sorry that he experienced such a serious complication ... I had been using Betadine alc[o]hol prep solution during the course of joint replacement surgery, for around a year, with no adverse events.”

18. Wairarapa DHB told HDC:

“It is clear the actions of [Dr B] using alcohol and then diathermy immediately after was an error. Infection in joint replacement is a catastrophic event for the patient concerned ... [Dr B’s] actions were to swab the edges of the wound with an alcohol containing anti-septic to minimise this risk. It is my understanding that in general this action was undertaken after completion of any diathermy work. For whatever reason on this occasion, wiping the margins of the wound with alcohol was followed in close succession by the use of diathermy. This was clearly an error that [Dr B] admits to.”

19. Wairarapa DHB sought advice from other orthopaedic surgeons regarding this issue, as follows:

- One orthopaedic surgeon said that “it is clearly recognised that excessive use of alcoholic skin prep runs the risk of fire if diathermy is used”.
- A second orthopaedic surgeon stated:

“The issue here is the use of alcohol based solutions as opposed to aqueous based solution. The former is flammable and has a known risk of surgical fire in the literature. If alcohol based solutions are used intra-operatively then recommendation is that the solution needs to be let to dry completely before use of any ignition source (including diathermy) ... surgical fires are potentially avoidable adverse incidents when using alcohol based skin preparation solutions and all staff in the operating theatre need to be aware of the potential for fire and serious injury when these are used.”

Subsequent event

20. Following the knee surgery, Wairarapa DHB initiated an adverse event investigation led by the Chief Medical Officer (CMO).

⁷ Removal of damaged skin tissue.

⁸ Transplantation of skin.

21. On 24 October 2017, a meeting was held between Mr A, Mr A's wife, the CMO, and the Patient Experience Coordinator. The Event Investigation Report recorded:

"[At] that meeting the circumstances surrounding the fire in the theatre was discussed fully, the patient and his wife were given the opportunity to ask any questions. At this meeting the patient brought up details about a previous adverse event when he had his first knee joint replaced. He recalled that at that time there appeared to be a total cover up ..."

22. On 26 October 2017, the CMO sent a letter to Mr A to confirm the content of what had been discussed at the meeting. The CMO apologised to Mr A on behalf of Wairarapa DHB for the injuries he had suffered, and informed him that a clinical review of the incident was being conducted.
23. Mr A told HDC that on 3 November 2017 he also discussed his concerns with the Board Chair of Wairarapa DHB.
24. On 3 November 2017, the CMO sent a letter to the Charge Nurse Manager, which stated:

"The clinical event review group has decided as an action that in future no alcohol-containing fluids will be permitted to be within the operating environment once an operation has commenced."

25. The Event Investigation Report was finalised on 6 November 2017.

26. On 24 November 2017, the CMO met with Mr and Mrs A. The meeting notes state:

"[The CMO] advised [Mr and Mrs A] about the HQSC⁹ annual report ... He advised that the list of these events was published in an anonymous form but that [they] should be aware of this in case they came across some details in the public arena."

Wairarapa DHB policies

Fire Hazard Policy

27. Wairarapa DHB told HDC that "at the time of the event there was no specific local Fire Hazard protocol for operating theatres". Wairarapa DHB provided the Aseptic Technique Surgical Skin Preparation Clinical Guideline (the Guideline) that was in place at that time. The Guideline stated:

"Pooling of solution in areas such as the umbilicus or excessive wetting is avoided and areas must be dried if necessary — particularly alcohol-based solutions. Solution must not have contact with diathermy plates or tourniquets."

28. When asked about the Guideline, Dr B stated:

"I was not aware of this guideline prior to this case. In fact, there was limited awareness of the guideline within the Department. It had never been brought to my

⁹ Health Quality & Safety Commission.

attention nor raised with me in the operating room. As such, along with some of my colleagues, I had been using this technique of cleaning the wound edges with surgical prep during the operation for many months.”

Changes made since knee surgery

29. Dr B told HDC that as a result of the knee surgery incident, he has “amended [his] practice regarding the use of alcohol prep solution”.
30. Wairarapa DHB said that as a result of the 2017 knee surgery incident, it “employed a local policy that forbids the supply of any solution containing any alcohol to the operating team until after the diathermy has been disabled and this has been implemented and adhered to”.

Responses to provisional opinion

Mr A

31. Mr A was provided with an opportunity to comment on the provisional opinion. He said:

“It is clear that some procedures weren’t followed due to various reasons but I trust that as a result all correct procedures are implemented now and are followed in future to prevent injuries such as mine happening again. As a result I fully accept the findings of the investigation and your recommendations.”

Dr B

32. Dr B was provided with an opportunity to comment on the provisional opinion. He provided a letter of apology to Mr A. Where relevant, changes have been made to the report to reflect his comments.

Wairarapa DHB

33. Wairarapa DHB was provided with an opportunity to comment on the provisional opinion. The DHB stated that it is “happy with the provisional decision and has no other comments”.

Opinion: Wairarapa DHB — breach

34. This opinion concerns the standard of care provided by Wairarapa DHB and Dr B to Mr A in relation to his knee operation.
35. Wairarapa DHB has an organisational duty to provide services of an appropriate standard. This includes providing adequate support to staff in respect of the application of relevant policies, and ensuring that all staff work together and communicate effectively.
36. The care provided to Mr A by Wairarapa DHB was suboptimal in a number of respects.

37. On 4 September 2017, Mr A was admitted to Wairarapa DHB for a knee joint replacement. The surgeon was Dr B. During the surgery, Dr B applied a swab soaked with Betadine in alcohol around the wound edges. Dr B then used diathermy, which lit the alcohol, causing a fire on Mr A's leg. This resulted in burns to the area around Mr A's knee, which subsequently required debridement and skin grafts.
38. I received expert orthopaedic advice from Dr Alexander Rutherford, who advised:
- “The use of an alcohol-based antiseptic on the wound and immediately afterwards using diathermy is clearly a significant risk factor for fire and I consider this a serious departure from the accepted standard.”
39. I accept this advice. Wairarapa DHB was responsible for ensuring that Mr A received care of an appropriate standard. The fire that occurred during the knee surgery is a significant departure from the standard of care expected of a surgical service. There were a number of contributing factors. Dr B used diathermy following the application of an alcohol-based solution, which caused fire around Mr A's knee. Wairarapa DHB said that at the time of the incident there was no specific local fire hazard protocol for operating theatres, but there was advice in the Aseptic Technique Surgical Skin Preparation Clinical Guideline. The Guideline provides a brief paragraph regarding the risk of pooling of solution, and states that the solution must not have contact with diathermy plates or tourniquets. The Guideline does not discuss specific fire hazards.
40. Dr B told HDC that he was not aware of the Guideline, and nor were his colleagues.
41. Dr Rutherford advised that “most operating fires are preventable with communication, appropriate education and management of risk”. He also stated:
- “[T]he WDHB Guideline of 2007 should be updated and expanded ... there does need to be greater awareness of the fire danger that is present when flammable substances, ignition sources and oxygen are present. The guideline should include the hazard of both fires and chemical burns.”
42. Dr Rutherford also referred to Charles E Cowles' article on fire safety, which states that “overall awareness of fire risk is the shared responsibility of all team members”. Dr Rutherford stated: “It is essential that operating rooms have a fire risk strategy and that this is reviewed regularly.” I agree with Dr Rutherford's advice. Wairarapa DHB has a responsibility to ensure that it has appropriate policies to prevent and lower the risks of adverse events, including the risk of fire in operating theatres. It also has a responsibility to ensure that its staff are aware of its policies and are trained accordingly.
43. I consider that at the time of the incident, Wairarapa DHB staff had a limited awareness of the risk of fire, and there was a lack of appropriate guidance in Wairarapa DHB's policy in relation to fire hazards.

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44. District health boards are responsible for the operation of the clinical services they provide, and are responsible for any service failures. In my view, the fire that occurred is a service failure that is directly attributable to Wairarapa DHB as the service operator.

Conclusion

45. I find that Wairarapa DHB failed to provide appropriate care to Mr A, owing to the fire that occurred during the knee surgery, and for failing to have in place an appropriate fire hazard policy for operating theatres. Accordingly, I find that Wairarapa DHB breached Right 4(1) of the Code of Health and Disability Services Consumers' Rights (the Code).¹⁰
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Opinion: Dr B — breach

46. I am critical of some of the aspects of the care provided by Dr B, particularly the use of alcohol solution prior the use of diathermy during the knee surgery.

Fire during knee surgery — breach

47. As discussed above, Dr B was the surgeon for Mr A's knee surgery. Following the application of Betadine in alcohol around Mr A's wound, Dr B used diathermy, without waiting for the solution to dry. This caused burns on Mr A's leg.
48. Dr B accepts that he did not appreciate the fire hazard with this routine, and he apologised to Mr A regarding the incident. Wairarapa DHB said that it is clear that Dr B's use of alcohol and then diathermy immediately afterwards was an error. Wairarapa DHB sought external opinions regarding the incident, and was advised that the excessive use of alcohol in skin preparation for surgery runs the risk of fire if diathermy is used. The external opinions all agreed that diathermy should not be used following the application of alcohol-based solution.
49. Additionally, Dr B failed to follow Wairarapa DHB's Aseptic Technique Surgical Skin Preparation Clinical Guideline regarding the use of alcohol-based solution and diathermy. The Guideline stated that alcohol-based solutions must not have contact with diathermy plates. However, the Guideline does not discuss specific fire hazards. Dr B explained that he was not aware of the Guideline, and said that generally there was limited awareness of the Guideline within the Orthopaedic Department. He failed to follow the Guideline by allowing the diathermy plates to make contact with the alcohol-based solution. Dr B said that the method of skin preparation used had been his normal practice for a year prior to Mr A's operation, and there had been no issues previously.
50. As mentioned above, Dr Rutherford advised that the use of diathermy immediately following the use of an alcohol-based antiseptic was a significant risk factor for fire, and was a serious departure from the accepted standard of care.

¹⁰ Right 4(1) states: "Every consumer has the right to have services provided with reasonable care and skill."

51. I agree with Dr Rutherford that Dr B did not provide services to Mr A with reasonable care and skill. I am also concerned that Dr B was not aware of Wairarapa DHB's Guideline regarding the use of alcohol-based solution and diathermy. Accordingly, I find that Dr B breached Right 4(1) of the Code.
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Recommendations

52. In response to the recommendation in my provisional opinion, Dr B provided an apology to Mr A. I recommend that Dr B undertake further education and training on fire hazards in operating theatres, to be provided by Wairarapa DHB as stated in paragraph 53(e) below. Confirmation that the training has been completed should be provided to HDC within six months of the date of this report.
53. I recommend that Wairarapa DHB:
- a) Provide a written apology to Mr A for its breach of the Code. The apology is to be sent to HDC, for forwarding to Mr A, within three weeks of the date of this report.
 - b) Confirm the implementation of its policy that forbids the supply of any alcohol-based solution to the operating team until after diathermy has been disabled — as stated in its letter to HDC dated 30 January 2018 — and conduct a review of the effectiveness of the policy and report back to HDC within three months of the date of this report.
 - c) Prepare a fire hazard policy that reflects the expert advisor's comments (in the Appendix to this opinion), and provide a copy of the policy to HDC within three months of the date of this report.
 - d) Audit its compliance with the Aseptic Technique Surgical Skin Preparation Clinical Guideline, and report the results of the audit to HDC within three months of the date of this report.
 - e) Arrange training for its staff on the fire hazard policy referred to in (c) above, and on the Aseptic Technique Surgical Skin Preparation Clinical Guideline, and provide evidence of that training to HDC within six months of the date of this report.
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Follow-up actions

54. A copy of this report with details identifying the parties removed, except the expert who advised on this case and Wairarapa DHB, will be sent to Medical Council of New Zealand, and it will be advised of Dr B's name.
55. A copy of this report with details identifying the parties removed, except the expert who advised on this case and Wairarapa DHB, will be sent to the New Zealand Orthopaedic Association.

56. A copy of this report with details identifying the parties removed, except the expert who advised on this case and Wairarapa DHB, will be sent to the Health Quality & Safety Commission and placed on the Health and Disability Commissioner website, www.hdc.org.nz, for educational purposes.

Appendix A: Independent advice to the Commissioner

The following expert advice was obtained from Dr Alexander Rutherford:

“Thank you for your letter of the 13th of July 2018 regarding complaint [Dr B].

You have asked my opinion on the care provided by [Dr B] to [Mr A] during his knee replacement surgeries on [date] and 4th September 2017 at Wairarapa [DHB].

I have read the guidelines for independent advisors and agree to follow their guidelines. I am not aware of any conflict of interest in this case.

I am currently practising as a general Orthopaedic Surgeon, performing joint arthroplasty at Nelson Hospital. I am currently the Head of the Department. I have previously been on the Executive of the New Zealand Orthopaedic Association and Chairman of the Continuing Professional Development Committee of that association. I have in the past provided guidelines to the association on hip and knee joint replacement.

I have been provided with the following documents:

- A letter of complaint, received [...];
- [Dr B’s] response dated 26th April 2018;
- Clinical records from the Wairarapa District Health Board relating to [Mr A’s] knee replacement surgeries on [date] and 4th September 2017;
- Reports from the staff involved in [Mr A’s] knee replacement surgeries;
- The event investigation reports related to [Mr A’s] knee replacement surgeries and supporting documents;
- [Dr B’s] response to this office’s proposed referral of the matter to the Medical Council of New Zealand dated 8th June 2018;
- The Wairarapa District Health Board’s response to this office’s request for further information, dated 25th June 2018.

You have asked that I review the enclosed documentation and advise whether I consider the care provided to [Mr A] by [Dr B] was reasonable in the circumstances and why. In particular [...] you have also noted that your office appreciates that it was unreasonable for [Dr B] to use Povidone-iodine in alcohol on an open wound immediately prior to using diathermy, and you have asked that I advise how significant a departure you consider this to be.

For each question you have asked what is the standard of care/accepted practice if there has been a departure from the standard care or accepted practice; how

significant a departure do I consider this to be, how would it be viewed by your peers, and you have asked for any recommendations for improvement that may help prevent a similar occurrence in future.

Background to the complaint

[...] On the 4th September 2017 [Mr A] underwent knee replacement surgery on his right knee. During the procedure [Dr B] swabbed the wound edges with Povidone-iodine and alcohol and then used diathermy. [Mr A's] leg caught fire which [Dr B] quickly extinguished, using water from the irrigation solution. [Mr A] required a transfer to [a burns unit] where he underwent excision and skin-grafting of his burns.

Comment

[...] Fire in the operating room is a rare event but when it does occur the medical outcomes are often catastrophic for the injured patient and with severe consequences for the surgical team and facility.

Most operating fires are preventable with communication, appropriate education and management of risk.

A fire requires an oxidiser such as oxygen or nitrous oxide, fuel, of which alcohol-based prep solution, surgical towels and drapes are the most common, and an ignition source such as electrosurgery units (Bovie), are the most common. Risk factors for fires in the operating room are: an open oxygen source, such as delivery of oxygen via the nasal cannula or facemask, presence of an ignition source such as electrosurgery, especially in procedures at or about the level of the xiphoid process. Joint replacement surgery normally uses alcohol-based skin prep solutions to reduce the risk of post-operative infection but it is essential to let the solutions dry and prevent pooling. Most draping systems now have good systems to prevent pooling and to limit access to sponges and gauzes which may act as fuel supply. The use of an alcohol-based antiseptic on the wound and immediately afterwards using diathermy is clearly a significant risk factor for fire and I consider this a serious departure from the accepted standard of care.

In Charles E Cowles' article on fire safety in the operating room, published December 2, 2017, it points out that although each element of the fire triad is typically managed by an individual member of the surgical team, i.e. the anaesthesiologist controlling the oxygen, surgeon controlling the diathermy, and nursing staff controlling swabs and alcohol-based solutions, overall awareness of fire risk is the shared responsibility of all team members.

The fire risk is quite well-assessed using the Silverstein Fire Risk Assessment Tool. This assessment requires the surgical team to identify the three key elements that are necessary for a fire to start — the fire triangle — 1. Heat; 2. Fuel and 3. Oxygen. In the operating room there are three key risks. These are a surgical site or incision above the xiphoid process (nipple line), an open oxygen source, i.e. the patient receiving

supplemental oxygen via facemask or nasal cannula; and an available ignition source such as electrosurgical unit, laser, or fiberoptic light source. In the Silverstein Fire Risk Assessment each of these is given a score of 1. This assessment should be added to the OR documentation with a view to improving the communication amongst the surgical team members and identifying the elements of the fire risk triangle.

It is essential that operating rooms have a fire risk strategy and that this is reviewed regularly.

Consideration could be given to adding fire risk to the sign-in procedures prior to the start of any operation that was being performed in the upper part of the body above the nipple line.

Kind regards



Alex Rutherford
Orthopaedic Consultant
Head of Department

Cui Y, et al. BMJ Open 2016; 6:e011325. doi:10.1136/bmjopen-2016-011325

Fire Safety in the Operating Room — Charles E Cowles. www.uptodate.com/fire-safety-in-the-operating-room. Dec 2, 2017”

Further expert advice was obtained from Dr Rutherford:

“Thank you for your letter of the 22 March requesting further advice regarding the care provided by [Dr B] to [Mr A] during his knee replacement surgeries on 4 September 2017 at Wairarapa [DHB].

I do not have a personal or professional conflict in this case. I have reviewed the HDC guidelines for Independent Advisors.

I have been provided with the following documents:

- A letter of complaint, received [...];
- [Dr B’s] response dated 25th April 2018;
- Clinical records from the Wairarapa District Health Board relating to [Mr A’s] knee replacement surgeries on [date] and 4th September 2017;
- Reports from the staff involved in [Mr A’s] knee replacement surgeries;
- The event investigation reports related to [Mr A’s] knee replacement surgeries and supporting documents;

- [Dr B's] response to this office's proposed referral of the matter to the Medical Council of New Zealand dated 8th June 2018;
- The Wairarapa District Health Board's response to this office's request for further information, dated 25th June 2018.

I have also been provided with the following documents (not previously provided):

- Wairarapa District Health Board's response dated 30 January 2019
- [Dr B's] response dated 4 February 2019
- Wairarapa District Health Board's letter dated 8 February 2019 and supporting documents.

I have been asked to review the enclosed documentation and advise whether it causes me to amend the conclusions drawn in my initial advice, or whether I wish to make any additional comments.

I have also been asked to comment on the appropriateness of the policies/guidelines at Wairarapa District Health Board regarding fire hazard and/or the use of alcohol-based solution in Operating Theatres in September 2017.

I have reviewed the letter from [Dr B] dated 4 February 2019 and note the genuine remorse that [Dr B] feels regarding [Mr A's] complication and that fortunately the end result is a well-functioning Knee replacement for the patient.

[Dr B] has provided the following answer in response to your questions:

1. [Dr B] replies that as surgical fires are now so rare that general awareness amongst operating staff, including himself is low. He was using the alcohol/iodine solution on the wound edges of [Mr A's] incision to lower the risk of a possible periprosthetic infection. At the time he did not consider the risk of fire following the use of the diathermy, which caused ignition of the alcohol solution. He deeply regrets the incident and most of all the harm it caused [Mr A]. It was a relief that he realised the leg was growing warm and was able to douse the flames before further damage was done.
2. After this incident he learnt that the Wairarapa DHB had a clinical guideline regarding skin Preparation in January 2012.
3. He notes there was limited awareness of the guideline within the department. It had never been brought to his attention, nor raised with him in the operating room. As such, along with some of his colleagues, he had been using this technique of cleaning the wound edges with surgical prep during the operation for many months.

My Comments:

Surgical fires are a rare but preventable complication and I agree that general awareness amongst operating room staff is low. However, researchers have estimated that between 550 to 650 surgical fires have occurred annually in the United States making this complication as frequent as wrong site surgery.

Furthermore, as the Centre for Disease Control and Prevention has advised that Alcohol based Skin Preparations are now the preferred method of skin disinfection there is a much greater possibility of a flammable solution being present. Previously used Aqueous solutions provided no fire risk. (1)

There are clear guidelines regarding the use of Alcohol based solution for skin preparations and reducing fire risk. These include avoiding pooling of the solution, avoiding contact with diathermy plates or tourniquets and providing the surgeon with a limited amount of solution (100mls). It is essential to allow sufficient drying time to allow evaporation of the volatile agents.

There is no evidence that these guidelines were not followed at the beginning of [Mr A's] operation.

The use of Alcohol-based scrub solutions is routine at the Wairarapa DHB. Aqueous non-flammable solutions have been tried at other centres but are not nearly as effective as alcohol-based solutions (70% alcohol). The Alcohol provides 70–80% of the antimicrobial activity of the cleaning solution and it is essential to use Alcohol in the cleaning solutions to prevent post-operative infections is also recommended by the Health Quality and Safety Commission as part of the Periprosthetic infection prevention program.

It is appropriate that an Alcohol based Skin Preparation was used at the beginning of the case to disinfect the skin.

The anaesthetist does not play any role in the decision about which type of scrub solution will be used and would not have any input into this, in this instance no such discussion was held with the anaesthetist or the scrub nurse. One of the authors of the clinical guideline regarding the use of surgical prep was [the scrub nurse] for this very case. [Dr B] mentions this to highlight the fact that the general awareness amongst the whole theatre team about the fire hazard regarding alcoholic surgical prep was very low. At the time he attributed the burns [Mr A] sustained to the inappropriate use of the Diathermy. He did not realize that there are general guidelines in other centres preventing the use of alcoholic surgical prep during surgery due to the fire hazard that exists from any source.

The use of irrigating solutions on wounds is controversial. A large number of agents have been used including sterile water, normal saline, hydrogen peroxide, sodium hypochlorite, chlorhexidine, Betadine both aqueous and alcohol based.

Many of these agents are cytotoxic and alcohol-based agents are flammable.

A Cochrane review in 2017 concluded that the evidence for which agent should be used was of low quality. It noted that the addition of Betadine may reduce surgical site infections and the use of pulsed lavage may also be helpful.

I am not aware of any guidelines in New Zealand regarding the use of irrigating solutions for surgical wounds (as distinct from Skin Preparation prior to surgery).

The CDC guideline for Prevention of Surgical site infections advises the use of Aqueous based Iodophor agents for irrigation of wounds. (1)

The use of an Alcohol based agent however adds flammability to the risk of cytotoxicity and is not an appropriate agent.

WDHB/OT/Guidelines 2007

Clinical Guideline Aseptic Technique — Surgical Skin Preparation

I have reviewed the Wairarapa DHB clinical guideline Aseptic Technique — Surgical Skin Preparation January 2007 and compared it with guidelines from [three other hospitals].

I have also reviewed the advice from Medsafe regarding the use of Alcohol based Skin prep solutions (2) and the Centre for Disease Control and Prevention Guideline for Prevention of surgical site infection 2017.

Protocols for Skin preparation prior to Surgery should include

- Instructions for the patient preparing for surgery
- Cleaning instructions (showering, instructions regarding deodorants cosmetics)
- Hair removal (shaving, clipping)
- Solutions to be used and recommendations for these
- Management of contaminated area and damaged skin
- Prevention of pooling of the Skin preparation solution
- Protective measures to prevent prolonged contact of the patient to the solution
- Protection of electrodes and tourniquets from contact with skin preparations
- Drying time to ensure evaporation of volatile agents and to improve antiseptic efficacy (2–5 mins)
- That staff be familiar with the warnings of skin preps prior to use and note the Hazard warnings of Alcohol Skin Preparations (Flammability).
- Limit the quantity of skin prep provided to the surgeon to 100mls or less.
- Disposal of Alcohol based solutions should not be via a drain or waterway.

The WDHB Guidelines of 2007 should be updated and expanded to include Instructions for patients prior to surgery, Cleansing instructions, current recommendations for Surgical site skin preparations, recommendations of volumes of solution to be used along with recommendations for disposal.

The 2007 WDHB guidelines do contain warnings against pooling of solutions, particularly Alcohol based solutions and that solutions must not have contact with diathermy plates or tourniquets however there does need to be greater awareness of the fire danger that is present when flammable substances, ignition sources and oxygen are present.

The guidelines should include the hazard of both fires and chemical burns.

Operating room fires are a rare but devastating event which can be lethal when it involves the airway.

The three components of an operating room fire are present in virtually all surgical procedures, an oxidizer (Oxygen, Nitrous oxide), an ignition source (i.e., Laser, Diathermy, light source) and a fuel.

There are now recommendations that a fire risk assessment be part of the Surgical Time out or Team briefing at the beginning of a surgical list. Potential risks for a surgical fire can be identified and risk reduction strategies implemented.

Dr Alex Rutherford
Orthopaedic Consultant