Whanganui District Health Board

A Report by the

Health and Disability Commissioner

(Case 15HDC00850)

Health and Disability Commissioner
Te Toihau Hauora, Hauātanga

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Executive summary

1. Mr A (aged 74 years) was scheduled for total knee joint replacement in 2014. He had comorbidities including obesity and high blood pressure. He was reviewed by a resident medical officer in a pre-assessment clinic prior to surgery.

2. Mr A was prescribed slow-release morphine and gabapentin as preoperative medications. Following surgery, which was uneventful, he was prescribed slow- and immediate-release morphine, and other pain relief medications, to manage his postoperative pain.

3. Once Mr A was transferred to the surgical ward, there was evidence of his condition deteriorating. However, this was not acted upon, and Mr A's analgesia regimen was not reviewed in light of the deterioration.

4. Mr A was found unresponsive on the ward and was unable to be resuscitated.

Findings

5. The Commissioner found that the service provided by Whanganui DHB was suboptimal in the following ways:

- The system for the preoperative assessment of Mr A's risk, particularly of his risk during the postoperative period, was inadequate;
- Mr A's postoperative analgesia regimen was not reviewed in light of his particular circumstances; and
- Nursing staff failed to assess and monitor Mr A regularly. Accordingly, his deteriorating condition was not recognised, and no contact was made with a senior member of the team to review Mr A.

6. Accordingly, the Commissioner found that Whanganui DHB failed to provide services to Mr A with reasonable care and skill, and breached Right 4(1) of the Code of Health and Disability Services Consumers' Rights.[1]

Recommendations

7. The Commissioner recommended that Whanganui DHB comply with the following recommendations and report back to HDC:

a) Provide training to medical staff on the surgical ward regarding the use of opiates in the context of patients with obstructive sleep apnoea and/or renal impairment.

b) Consider reviewing its streaming processes for preoperative anaesthetic assessment in light of the comment by my expert anaesthetist advisor, Dr Jones, that some non-anaesthetists may not be able to recognise a difficult airway accurately.

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

c) Provide nursing staff on the surgical ward with refresher training on the use of the automated external defibrillator (AED).

Complaint and investigation

8. The Commissioner received a complaint from the Coroner about the services provided to Mr A (dec) at Whanganui District Health Board (DHB). The following issue was identified for investigation:

- *The appropriateness of the care provided by Whanganui District Health Board to Mr A in 2014.*

9. Parties mentioned in this report:

Mr A	Consumer (dec)
Dr B	Consultant anaesthetist
RN C	Registered nurse
Dr D	House officer
Dr E	Orthopaedic surgeon
RN F	Registered nurse
RN G	Registered nurse
RN H	Registered nurse
RN I	Registered nurse
Dr J	House officer
RN K	Registered nurse
Dr L	House officer
Dr N	Consultant physician

10. Whanganui DHB was directly involved in the investigation, and information from the Coroner was also reviewed.

11. Independent expert advice was obtained from orthopaedic surgeon Dr Alex Rutherford (**Appendix A**), registered nurse (RN) Dawn Carey (**Appendix B**), and anaesthetist Dr David Jones (**Appendix C**).

Information gathered during investigation

Introduction

12. At the time of these events, Mr A was 74 years old. He had had a total right knee replacement in 2004.

13. By 2013, Mr A was experiencing pain and limited function in his left knee. Mr A was placed on the waiting list for orthopaedic joint surgery at Whanganui DHB, and subsequently his total knee joint replacement surgery was scheduled for 2014.

14. This report relates to the preoperative and postoperative care provided to Mr A.

Preoperative anaesthetic assessment

15. Prior to Mr A's surgery, he completed a "pre-assessment adult questionnaire" (undated). On the form, Mr A stated that he was on medication for high blood pressure, did not have diabetes or kidney disease, and that his weight was 122kg. He did not list his regular medications, but noted that these were listed elsewhere. He ticked "yes" to allergies but did not list these. Mr A included the following further information:

- "[I] swallow my spit and choke if head below horizontal."
- Prescribed prednisone "for breathing [problems]" in 2010.
- Minor myocardial infarction (heart attack) around 1992.

16. Mr A confirmed on the form that he did not have any health problems other than the planned surgery. However, the form states under that heading, in different handwriting, "T2DM (Type 2 diabetes), hypertension".

17. At Whanganui DHB, preoperative assessments are conducted in the anaesthetic clinics. As Whanganui DHB does not have the capacity for all its patients to be seen by consultant anaesthetists, patients are triaged according to their clinical needs, and divided into three streams. Consultant anaesthetist Dr B explained that the streams are:

> "(i) Stream one — patients are medically fit and present for minor to intermediate procedures. The assessment is undertaken by a pre-operative nurse at the Preoperative Anaesthetic Clinic (Clinic). The on-call Anaesthetist is available for advice at all times
>
> (ii) Stream two — patients are seen by resident medical officers [RMOs] or a GP that regularly attends the Clinic presenting for major surgery. Patients have medical issues that are controlled. The on-call Anaesthetist is available for advice at all times
>
> (iii) Stream three — complicated medical patients presenting for intermediate to major surgery. All patients are assessed in the Clinic by a Consultant."

18. Following the clinic assessment, the anaesthetist confirms the findings on the day of the surgery, goes through the assessment again, and meets with the patient. The meeting provides the anaesthetist with an opportunity to identify or address any concerns that may or may not have been identified earlier.

19. RN C was working in the pre-admission clinic and said that she assessed Mr A before he was seen by a house officer, Dr D. RN C stated that Mr A's observations were recorded, an electrocardiogram (ECG)[2] was done, and the anaesthetic alert process (see

[2] An ECG is a medical test that detects problems with the electrical activity of the heart.

below) was initiated for the anaesthetist department review regarding Mr A's noted comorbidities. RN C said that the routine pre-admission process was completed and Mr A's notes were forwarded to patient scheduling for him to be booked for his surgery.

20. Dr D performed a preoperative anaesthetic assessment of Mr A in a stream two clinic. Dr D told HDC that these clinics run in parallel with an experienced anaesthetic nurse who does an initial assessment of every patient, and that the anaesthetists are available by telephone if further advice is required, or in person when they are between cases in theatre.

21. Dr D told HDC that she vaguely recalls Mr A, as he seemed to be "a very sprightly gentleman who it seemed would greatly benefit from this surgery". Dr D said that her assessment of Mr A's ECG was that it was normal, and that she discussed and consented him for a regional anaesthetic. Information recorded on the preoperative anaesthetic assessment form included:

- Allergies to aspirin and diclofenac.[3]
- Blood pressure (BP) 146/80mmHg[4] and oxygen saturation 95%.
- Weight 135kg, and body mass index (BMI) 49.[5]
- Creatinine[6] 79µmol/L, HbA1c[7] 50mmol/mol, estimated glomerular filtration rate (eGFR) 84 ml/min/1.73m².[8]
- Hypertension and myocardial infarction approximately 20 years earlier.
- Father had valve replacement and coronary artery bypass graft at 75 years.
- Regular medications included: candesartan,[9] simvastatin,[10] frusemide,[11] paracetamol, and tramadol.[12]
- Mallampati score of 2,[13] good neck movement, obese with short neck and loose skin.

22. The form states that the procedure explained to Mr A was a spinal/epidural anaesthetic.[14]

[3] A non-steroidal anti-inflammatory drug (NSAID).
[4] Normal adult blood pressure is considered to be around 120/80mmHg.
[5] BMI is a measure of body fat based on height and weight. A BMI above 40 refers to extreme or "morbid" obesity.
[6] If the kidneys become impaired for any reason, the creatinine level in the blood will rise owing to poor clearance of creatinine by the kidneys. Abnormally high levels of creatinine warn of possible malfunction or failure of the kidneys. The normal range is 50–120µmol/L.
[7] HbA1c is a measure of average blood glucose (sugar) levels. As a general guide, HbA1c levels of less than or equal to 40mmol/mol is normal; 41 to 49mmol/mol is prediabetes or "impaired fasting glucose"; and 50mmol/mol and above suggests diabetes.
[8] eGFR is an estimate of kidney function. In a person aged over 70 years the normal level is 75ml/min/1.73m².
[9] Used for ongoing maintenance of hypertension.
[10] Used to reduce the risk of coronary heart disease.
[11] A diuretic.
[12] An opioid pain medication used to treat moderate to moderately severe pain.
[13] The Mallampati classification is used to predict the ease of endotracheal intubation. It ranges from 1 to 4, with 4 being the most difficult to intubate.

23. Prior to Mr A's 2004 surgery, his anaesthetic risk was assessed to be ASA (American Society of Anaesthesiologists) score 3,[15] and his weight was documented as being 120kg. On the preoperative anaesthetic assessment form for the 2014 surgery, an ASA score of 2 is circled.

24. Dr D told HDC that she did not record an ASA score for Mr A because she was uncertain what to score him at the time. She stated:

> "I assume the senior anaesthetist on the day of the surgery has scored him a 2 and also added on Diclofenac under the section on allergies — information that I had not gathered at the time of my assessment."

25. Dr B stated with respect to the ASA score:

> "I can only conclude that [Mr A's] active lifestyle and absence of cardiac symptoms led the RMO in Clinic to assign [Mr A] an ASA2. This however, did not have any effect on my decision making when I reviewed the case … I was aware of his co-morbidities and adapted his anaesthetic accordingly."

26. Dr D said that she did not ask Mr A any questions about obstructive sleep apnoea,[16] and did not discuss her findings with Dr B prior to the surgery. Dr D said that she felt that Mr A was an appropriate candidate for regional (spinal) anaesthesia, but that had he been scheduled for a general anaesthetic she would have consulted with a consultant at the time "due to the concerns of a difficult airway and the potential need for further work up". Dr D was not involved further with Mr A's care following this assessment.

27. Dr B told HDC that Mr A had a number of significant health issues, most notably morbid obesity and ischaemic heart disease. Dr B said that Mr A had high blood pressure and borderline elevated blood sugar levels and, although Mr A did not mention sleep apnoea in his health questionnaire, it could reasonably have been assumed that he would have some impairment of breathing given his obesity. Dr B stated:

> "Given that the patient had no respiratory symptoms, and was limited in his activities only by the pain in his knee, it seems reasonable to me that no further action was undertaken regarding this. Although not written down, this would have been factored in when planning the anaesthetic technique, as most obese patients have respiratory obstruction to some degree."

28. Dr B told HDC that the anaesthetist reviews the clinical records and the preoperative assessment report. He stated: "Had I had any cause for concern regarding the pre-

[14] An injection of a substance into the spine to cause the lower part of the body to become unable to feel pain.

[15] The ASA score is a subjective assessment of a patient's overall health, and is based on five classes (1 to 5): 1. Patient is completely healthy and fit; 2. Patient has mild systemic disease; 3. Patient has severe systemic disease that is not incapacitating; 4. Patient has incapacitating disease that is a constant threat to life; and 5. A moribund patient who is not expected to live 24 hours with or without surgery.

[16] Obstructive sleep apnoea (OSA) is caused by complete or partial obstructions of the upper airway. It is characterised by repetitive episodes of shallow or paused breathing during sleep, despite the effort to breathe, and is usually associated with a reduction in blood oxygen saturation.

anaesthetic assessment when I was preparing for surgery, I would have personally reviewed [Mr A]."

29. Dr B stated that he believes that the risks of the anaesthetic were understood and conveyed to Mr A prior to surgery.

Anaesthetic alerts

30. Dr B told HDC that major comorbidities, pathologies, or potential difficulties are brought to the attention of the consultant anaesthetist assigned to the procedure prior to surgery as part of the planning and preparation of the anaesthetic care. This is done by way of an "anaesthetic alert" generated in the anaesthetic clinic and sent by email prior to surgery.

31. Dr B stated that the anaesthetic alerts are created by the pre-admission nurse based on the findings during the anaesthetic clinic visit, as recorded on the anaesthetic chart. The information is entered into a database, and an "anaesthetic alert" sticker is added to the patient notes. When the surgical lists are finalised, the theatre co-ordinator goes through the database, collects all the anaesthetic alerts for the following day, and emails them to the anaesthetists concerned. Dr B stated that a hard copy is also made and left in the anaesthetists' office.

32. RN C said that she created an "Anaesthetic Alert" for Mr A, which, based on a later review of the records, she believes would have said: "Hx [medical history] HTN [hypertension] on Rx [prescription medication], MI [myocardial infarction] 1992, Weight = 135kg, BMI = 49."

33. Whanganui DHB has not provided Mr A's anaesthetic alert to HDC. Dr B told HDC: "Once the operation has been completed, the 'anaesthetic alerts' are removed from the database, in order to prevent the alert being used inappropriately for a subsequent surgery."

Admission on Day 1[17]

34. An RN stated that she telephoned Mr A with his admission details on the evening before his surgery. She said that she told Mr A that his admission time was 7am and that he was to be nil by mouth from midnight. She stated that she asked the routine pre-admission questions and ascertained that Mr A had not had any recent health issues that would affect the surgery.

35. Mr A signed a "Request and agreement to treatment consent form", which states that he had agreed to a "left knee total knee joint replacement", and that the risks discussed were infection, deep vein thrombosis (DVT),[18] and bleeding. Mr A was under the care of orthopaedic surgeon Dr E. Dr E told Whanganui DHB that, as part of the informed consent process, he discussed the risks of the procedure with Mr A.

[17] Relevant dates are referred to as Days 1-3 to protect privacy.
[18] DVT occurs when a blood clot (thrombus) forms in one or more of the deep veins in the body, usually in the legs.

36. An RN working a morning shift in the day unit was assigned to care for Mr A. She stated that she performed the routine nursing admission, taking observations of Mr A's blood pressure, pulse, oxygen saturation,[19] respirations, and temperature. She said that she completed the preoperative check list in collaboration with Mr A and by examining his medical record to confirm the required information.

37. Dr B prescribed pre-medication doses of m-Eslon 30mg (slow-release morphine sulphate)[20] and gabapentin 300mg,[21] which were administered at 8.20am.

Surgery

38. Mr A's surgery was performed by Dr E, assisted by an orthopaedic registrar, a surgical scrub nurse, and a circulating nurse. The anaesthetist was Dr B. The procedure was performed under spinal anaesthesia with sedation of midazolam and propofol. Mr A was also given intravenous (IV) antibiotics, paracetamol, parecoxib,[22] dexamethasone,[23] and tranexamic acid.[24]

39. Dr B included the following comments in the anaesthetic record: "Hourly sats [oxygen saturation] monitoring in ward. Oral airway inserted due to obstruction of breathing during case." Dr B told HDC that he believes that the anaesthetic technique used was appropriate, and his aim was to minimise the risk of cardio-pulmonary complications to Mr A in light of his co-morbidities.

40. Dr E told HDC that the operation and the immediate postoperative period were uneventful. The postoperative plan, recorded by Dr E, was for Mr A's knee to be X-rayed, blood tests to be completed, and for Mr A to start mobilising. He was also to have aspirin and a foot pump to reduce the risk of DVT.

41. Dr B prescribed oral opiate therapy to manage Mr A's postoperative pain. This included m-Eslon 20–30mg twice daily, and Sevredol (immediate release morphine sulphate) 20mg as required for breakthrough pain. Mr A was also prescribed regular celecoxib,[25] gabapentin and paracetamol, plus tramadol as required. Dr B also prescribed terazosin[26] 2mg and zopiclone[27] 7.5mg to be administered at night. The zopiclone prescription states "do not give when drowsy". In response to the provisional opinion, Dr B stated that this clearly demonstrates concern for possible side effects of a sedative, as well as steps to try to minimise the impact of the drug postoperatively.

Post-anaesthesia care unit

42. An RN stated that she was assigned to care for Mr A in the post-anaesthesia care unit (PACU). She said that Mr A arrived awake at the PACU at 10.45am. Dr B said that he

[19] 94% on room air.
[20] Morphine sulphate is an opioid analgesic.
[21] Gabapentin is an analgesic that can be used to treat pain associated with surgery.
[22] Parecoxib is a nonsteroidal anti-inflammatory drug for the treatment of postoperative pain.
[23] Dexamethasone is a corticosteroid medication that may be used to treat inflammation.
[24] Tranexamic acid is a medication used to treat or prevent excessive blood loss.
[25] Celecoxib is a nonsteroidal anti-inflammatory drug used to treat pain or inflammation.
[26] Terazosin is an anti-hypertensive medication.
[27] Zopiclone is a nonbenzodiazepine hypnotic agent used in the treatment of insomnia.

"arranged for [Mr A] to be kept in PACU for an extended period of time for close monitoring/observation in recovery". While in the PACU, Mr A's observations were recorded approximately every 10 minutes. The RN told HDC that all Mr A's vital signs were within acceptable parameters, and he continued to receive oxygen at 6L/min via a Hudson mask.

43. The RN said that she checked Mr A's surgical site and found no signs of bleeding. A Cryo/Cuff (icepack) was in place on his left knee to maintain cooling, and his left foot was pink and warm to the touch. She said that Mr A was unable to move his left foot owing to the effect of the spinal anaesthetic. She noted that, during the time Mr A was in the PACU, he did not complain of pain.

44. At 11.52am (after 67 minutes in the PACU), the RN transferred Mr A to the surgical ward. Immediately prior to transfer, his observations were: oxygen saturations 97%, respiration rate 20 breaths per minute,[28] pulse 48bpm, and blood pressure 170/75mmHg.

Admission to surgical ward

45. On transfer to the surgical ward, Mr A had one litre of IV fluid (Hartmann's solution[29]) in progress, which completed at 12.10pm. Mr A had a further three litres of IV fluid prescribed, but they were not administered.

46. At 2.05pm, Mr A's oxygen saturations were 96%, and it is noted that his oxygen saturations were to be monitored because he had some sleep apnoea (at 4pm, Mr A's oxygen saturations were 90%, at 5.15pm they were 91%, and at 7pm they were 93%).

47. At 3.10pm, Mr A was reviewed by a physiotherapist who taught Mr A knee exercises and checked his range of movement. The physiotherapist documented that Mr A was able to stand for two minutes and was managing the bed exercises and standing well.

48. RN F was assigned to care for Mr A during the afternoon shift. She said that when she met him at handover he was alert and well orientated and able to hold a conversation. RN F said that Mr A was not distressed and his pain appeared well controlled. She stated that Mr A was drinking water and expressed that he was eager for his dinner. RN F said that Mr A was able to sit in a chair for his dinner, ate his meal, and continued to drink water regularly. She said that she advised Mr A to keep his oral fluid intake up because he did not have IV fluids running any more.

49. RN F said that the IV fluids were discontinued because Mr A had been drinking, and was able to comprehend that he needed to keep up his oral fluid intake. She stated:

> "Using the [Enhanced Recovery After Surgery] ERAS pathway,[30] if a patient is eating and drinking the IV fluids are usually discontinued. There were no specific

[28] The normal respiration rate for an adult at rest is 12 to 20 breaths per minute.
[29] A mixture of sodium chloride, sodium lactate, potassium chloride, and calcium chloride in water.
[30] The patient-centred Enhanced Recovery After Surgery (ERAS) pathway aims to ensure that people are in the best possible condition for surgery, have the best possible management during and after their operation, and participate in the best possible rehabilitation after surgery.

> orders handed over verbally that he was to have continued IV fluids, and there are no specific guidelines as to how much IV fluids are needed post operatively."

50. RN F said that, when Mr A returned to bed, he passed urine into a bottle. She said that when she emptied the bottle, it contained approximately 200ml of urine. She stated that Mr A did not pass urine again during her shift, but, as it had been handed over that he had passed urine on the morning shift, she was not concerned.

51. RN F said that Mr A's blood pressure remained stable at 139/78mmHg, and he continued to have oxygen at 3L/min via nasal prongs, "due to [her] being aware that his saturations were low due to suffering from sleep apnoea. They remained at 93%." RN F stated:

> "[Mr A] did not appear dehydrated or in distress at any time when he was in my care … The fluid balance chart was not completed but I was satisfied in my assessment of the patient that he was hydrated and had passed urine on my shift and the previous shift, his [blood pressure] was stable so I had no concerns in regards to stopping the IV fluids or with the patient's urinary function."

Overnight to Day 2

52. RN G worked on the night shift and was assigned to care for Mr A. She said that, at handover, she was told that Mr A was eating and drinking, passing urine via bottle, his observations were within normal limits, and he was having oxygen 3L/min via nasal prongs.

53. RN G stated that the other patients in the room with Mr A commented that Mr A was "extremely noisy while snoring and they were finding it difficult to sleep". She said that she did not carry out observations at midnight because Mr A was asleep and settled, but she carried out a full set of observations of Mr A at 5.30am. His pain score was 5/10, and his oxygen level was 89% on room air at that time. RN G recorded an early warning score (EWS) of 2.[31] She said that Mr A kept pulling off the oxygen nasal prongs because he was a very unsettled sleeper.

54. RN G said that she asked Mr A about his sleep apnoea history and whether he used a CPAP machine,[32] and he said that he did not use one. RN G said that Mr A's respiration rate was 20, but stated:

> "Considering his size of 135kg and the fact that he had just been moving himself around in his bed, I considered this not to be a reason to contact co-ordinator despite triggering an EWS of 2. A typical respiration rate for an adult at rest is 12–20, therefore I used my clinical nursing judgement."

[31] An EWS is a guide used by medical services to quickly determine the degree of illness of a patient. The Whanganui DHB EWS chart is detailed later in this report.

[32] Continuous positive airway pressure therapy (CPAP) uses a machine to help a person with obstructive sleep apnoea to breathe more easily during sleep. A CPAP machine increases air pressure in the throat so that the airway does not collapse when the person breathes in.

55. RN G said that Mr A had a urine bottle at his bedside and, at 5.30am, she asked him if he needed to pass urine because the bottle was still empty. She stated that he did not tell her that he had not voided overnight. Paracetamol was administered at 6am, and a Cryo/Cuff was put back on Mr A's knee for comfort.

Day 2

56. On Day 2, Mr A was reviewed by the registrar during the morning ward round. The progress notes record that Mr A was to have an X-ray and a blood test, and that the wound was to be reinforced.

57. RN H was assigned to care for Mr A from 7am to 3.30pm. RN H stated that Mr A appeared comfortable and did not express concerns when asked. RN H said that Mr A did not have IV fluid therapy infusing, but he recalls that Mr A was tolerating a standard diet and drinking sufficient amounts of oral fluids. RN H stated: "[Mr A] was alert and in a cheerful mood throughout my duty and appeared to be exceeding expectations for a patient day 1 post [total knee joint replacement]."

58. Mr A's blood test results (reported at 10.40am) showed that his creatinine was 142µmol/L (high) and his eGFR was 41mL/min/1.73m² (low).

59. At 12.25pm, Mr A was reviewed again by the physiotherapist who noted that Mr A was walking well, but became light headed, and that his wound was oozing after the walk. The physiotherapist recorded that dizziness and pain were limiting Mr A's mobility.

60. RN H told HDC that Mr A's vital signs were due to be recorded at 9.30am as per Whanganui DHB protocol, but "this was not achieved". RN H stated that he delegated a student nurse to record a set of vital signs at 1.55pm. In the clinical record the time is recorded as 0155, but should have read 1355. At that time, Mr A's oxygen saturation was recorded as 85% on room air (low), his temperature was 36.6°C, his heart rate was 55bpm, and his blood pressure was 95/64mmHg (low). No respiratory rate or EWS was recorded. RN H stated that he sighted these vital signs and documented that Mr A was asymptomatic, and that oral fluids should be encouraged in response to Mr A's low blood pressure.

61. RN H stated:

> "I take responsibility for not correcting the [student nurse's] documentation and for not following DHB protocol with regards to [Mr A's] altered EWS score of 2 that was recorded prior to the start of my duty."

62. In response to the provisional opinion, Whanganui DHB stated that its view is that the student was not adequately supervised.

63. RN H stated that while under his care, Mr A was seen mobilising independently to the bathroom several times. RN H said that Mr A did not say that he was having any difficulty passing urine. RN H said that at approximately 3pm he discovered that Mr A had not passed urine during the shift, and handed over that information to the afternoon registered nurse to investigate further. RN H stated that during the shift there were no discussions regarding Mr A's renal impairment.

64. RN I was assigned to care for Mr A on the afternoon shift of Day 2. RN I stated that Mr A was fully alert and orientated, and his vital signs were stable. RN I said that he asked Mr A whether he had voided urine that day, and Mr A said that he had been up to the bathroom but had not voided. RN I conducted a bladder scan on Mr A, which revealed 596ml of urine. RN I then contacted the house officer on call, Dr J, who ordered IV fluids and an indwelling catheter.

65. Dr J recorded in the progress notes[33] that Mr A had high creatinine levels and low eGFR (per the blood tests taken that morning). Dr J noted that Mr A had not received the IV fluids charted postoperatively, and that Mr A reported not having passed any urine since the previous afternoon. Dr J prescribed IV fluids, and requested that kidney function tests be completed again the following day.

66. Dr J told HDC that she does not recall whether Mr A's condition was discussed with the registrar. She stated: "However, it was part of our daily practice as interns of the Orthopaedic team to do a paper round or discussion regarding any updates on inpatients."

67. At 4.45pm, Mr A's pain score was 2/10, his oxygen saturation was 90%, respiration rate was 24 (high), his temperature was 36.2°C, his heart rate was 55bpm, and his blood pressure 103/55mmHg (low). It is recorded that Mr A had an EWS of 2.

68. At 6.45pm, RN I recorded that Mr A was "[s]leeping but easily rousable. Vital signs stable/afebrile.[34] IV fluids recommenced as renal function [decreased]." RN I assisted Mr A to the bathroom, but Mr A was unable to pass urine, so RN I contacted the on-call doctor for assistance.

69. At 7.50pm, a senior house officer attended at RN I's request, and recorded: "Worsening renal function today. Not [passed urine]. 550ml in bladder now & uncomfortable. On IV fluid. Plan 1. Catheterise. 2. Continue IV fluid. 3. Renal function [in morning]."

70. RN I successfully catheterised Mr A and, at 8.30pm, recorded on the fluid balance sheet that 500ml of urine had drained. RN I did not record any oral input.

71. At 8.30pm, Mr A was administered m-Eslon, terazosin, and zopiclone.

Overnight Day 2–Day 3

72. RN G worked the next night shift overnight on Day 2–Day 3. She stated that it was handed over to her that Mr A had had a catheter inserted that afternoon owing to urine retention, and that IV fluids had been commenced because Mr A had deranged renal function results.

73. RN G checked Mr A's vital signs at 12.30am while he was asleep. His respiratory rate was 20, his temperature was 36.5°C, his pulse was 59bpm, and his blood pressure 109/59mmHg. The IV fluids were continuing and due to be changed at 6am.

[33] The time of this is not documented. However, it is included between entries made at 2.30pm and 6.45pm.
[34] Without fever.

74. RN G stated that at 2am, Mr A woke with slight pain (rated 2/10). At that time, she checked his oxygen saturation, which was 89%, and his respiratory rate, which was 24. RN G reapplied the Cryo/Cuff, following which Mr A settled.

75. At 4am, RN G recorded on the fluid balance sheet a total of 150ml of urine in the catheter output.

76. RN G said that, just before 6am, she went into Mr A's room and realised that he was very quiet. She said that she touched his arm to inform him that she would be putting up IV fluids, but he did not respond. She then carried out a sternal rub and received no response. RN G said that she then pushed the emergency bell, put Mr A's bedhead down flat, and applied oxygen 10L by a mask until the arrest trolley arrived.

77. RN K recorded in the progress notes that when she was notified by RN G that Mr A was unresponsive, she contacted another RN and they initiated standard cardiac arrest protocols. RN G stated that they tried to get Mr A's nightgown off to apply defibrillator pads. However, as he was a very large man on a regular bed it made the resuscitation difficult.

78. RN G said that the arrest team arrived approximately four minutes after the arrest was called (it is documented that they arrived at 6.06am); however, the house officers advised that they arrived within 30 seconds of the call. One house officer noted that Dr L arrived approximately 15 seconds after him. The house officer recorded that the initial assessment showed that Mr A was unresponsive, had no pulse, had cold peripheries, had no heart sounds and no breath sounds, and had fixed dilated pupils.

79. Mr A was shocked once by defibrillator, cardiopulmonary resuscitation (CPR) continued, and adrenalin was given. The house officer recorded that they were unable to establish a laryngeal mask airway,[35] and that Mr A had blood-stained sputum in his mouth, but that an intraosseous[36] line was established successfully.

80. RN K recorded that she was asked to ring for more staff, which she did, but was told that no other staff were available at that stage. RN K recorded that she then called the switchboard and asked to be transferred to the emergency department (ED), but was unable to contact the ED consultant. She then called the medical ward to request help, but there was no answer. She said that she called the switchboard back and requested a page of the on-call consultant. Thereafter, she contacted Mr A's next of kin and explained that he was acutely unwell, and said that she would contact them again once more information was available.

81. On-call consultant physician Dr N told HDC that his first contact with Mr A was when he was called in because of Mr A's cardiac arrest. Dr N stated that, when he arrived, the resuscitation had been going on for about 35 minutes, and had been unsuccessful. Dr N said that after evaluating Mr A, he decided to call off the resuscitation. Dr N stated: "I

[35] A medical device that keeps a patient's airway open during anaesthesia or unconsciousness.
[36] Intraosseous infusion (IO) is the process of injecting directly into the marrow of a bone to provide a non-collapsible entry point into the systemic venous system. This technique is used to provide fluids and medication when IV access is not available or not feasible.

do not believe that the outcome would be any different, if resuscitation would have gone on beyond 40 minutes." Dr L documented that Mr A died at 6.40am.

82. A doctor contacted Mr A's family to advise them that Mr A had died after attempts to resuscitate him.

Further information — Whanganui DHB

ERAS guidelines

83. Whanganui DHB said that the ERAS guidelines used for Mr A were put in place on 26 October 2012. The guidelines contain a list of actions to be performed. The list was not completed for the day of surgery. The list was completed on Day 1 postoperatively, but it was not completed thereafter.

EWS chart

84. The EWS chart (used at the time of these events) provides that if a patient has a score of 2, the actions to be taken are: "Assess patient with shift co-ordinator, Assess an optimised plan of care, Review urine output."

85. If the patient has a score of 3–5, the actions to be taken are: "Liaise with shift co-ordinator, page [house surgeon] to attend within 20 mins, 1500–0700 inform duty nurse manager, report using ISBAR."[37] The form states that if the house surgeon is unable to attend within 20 minutes, the staff should inform the clinical nurse manager and/or the duty nurse manager.

Analgesia

86. Whanganui DHB stated that Mr A was prescribed an analgesic regimen that is standard in the public hospital based on international guidelines for ERAS programmes for hip and knee replacements. Whanganui DHB said that it uses gabapentin routinely as an adjunct to opiates, which provides additional non-opioid analgesia to decrease the risk of opiate-induced side effects.

87. Whanganui DHB stated that m-Eslon was prescribed in routinely used dosages to provide Mr A with constant pain relief. It noted that all opiates have the potential to cause respiratory depression, but said that this has to be weighed up against the risk of inadequate analgesia, which can lead to high blood pressure and heart rate and has the potential to produce myocardial ischaemia.

88. Whanganui DHB told HDC: "[T]he dose of m-Eslon should have been adjusted, once it was known the patient was developing acute kidney injury (AKI) post operatively."

Other issues

89. Whanganui DHB also stated that there were a number of points of concern regarding the care provided to Mr A:

[37] ISBAR (Identify, Situation, Background, Assessment and Recommendation) is a mnemonic created to improve safety in the transfer of critical information. The "I" in ISBAR is to ensure that accurate identification of those participating in handover and of the patient is established.

- The prescribed fluids were not given on the ward. The ERAS guidelines state that intravenous fluids may be discontinued when the patient is eating and drinking, but the rationale for not administering intravenous fluids should have been documented in Mr A's health record.

- When Mr A's oxygen saturation levels desaturated, that should have prompted immediate action.

- The development of AKI was a significant development that should have prompted a review of Mr A's medication, as well as his fluid status. Whanganui DHB stated: "[E]scalation of treatment to a more senior member of the team for advice would have been beneficial. Once again, the [EWS] should have alerted the medical and nursing staff to take prompt action."

Critical systems analysis review and changes made

90. Whanganui DHB told HDC that Mr A's death was subject to a review. Some months later, the Coroner, at the suggestion of the pathologist who conducted the post mortem, asked the Whanganui DHB to consider a further anaesthetic review, and so a Critical Systems Analysis (CSA) was commissioned. The CSA was conducted in order to identify factors that might have contributed to Mr A's unexpected death. The key findings from the CSA were:

- After the first 12 hours postoperatively, Mr A's observations were infrequent and there was no increased recording of observation or action taken in response to his EWS score or his lower blood pressure and oxygen levels.
- Documentation in the patient notes did not reflect the changes in Mr A's condition or meet the expected documentation standard.
- It was difficult to determine how much fluid Mr A had received and what his output was. It is recorded in his notes that he had passed urine but it was difficult to find exact amounts and timings.

91. The CSA review found that the observations documented at "0155" on Day 2 would have triggered an EWS of three.

92. Whanganui DHB stated that the staff involved in Mr A's care would be informed of the CSA outcome and findings, and senior members of staff would be held accountable for ensuring that the recommendations were implemented in order to learn from the findings in improved patient care.

93. Whanganui DHB provided HDC with a table of changes made as a result of the CSA recommendations:

- Ward standards for postoperative observations and action for observation changes were reviewed, and an audit of EWS observation charts was undertaken. As a result, Whanganui DHB updated its guidelines on the frequency for monitoring and recording vital signs for postoperative patients.

- Nursing staff completed training on the use of EWS, and actions to take when an EWS score is noted. Nursing staff also completed training on Acute Life-Threatening Events Recognition and Treatment (ALERT).
- Training on fluid balance guidelines has been completed.
- Audits are occurring to measure compliance with recording patient progress/condition against the existing health records procedure (ongoing).
- Audits of the documentation and procedures for fluid balance monitoring are occurring (ongoing).

94. On 12 October 2015, Whanganui DHB launched a new EWS and vital sign chart. The chart was launched across the central region to provide consistency and greater understanding for those communicating a patient's condition. Prior to implementation, training was provided to clinical staff.

Responses to the provisional opinion

95. Responses to the provisional opinion were received from Whanganui DHB and Dr B. Where appropriate, changes have been made to the "information gathered" section above.

96. Whanganui DHB stated that there are several areas where the medical staff should have been more vigilant in monitoring changes in Mr A's condition. Whanganui DHB stated that it acknowledges my findings and supports the recommendations made.

97. Whanganui DHB said that it considers there to be an opportunity to educate staff about the GCS, in relation to my expert advisor Dr Jones' comments that this is not a reliable measure for detecting respiratory depression. It also stated that it will work on an improvement plan in relation to monitoring of fluid balance, vital signs, and blood result changes.

98. Dr B stated that he considers that the analgesic regimen was appropriate for Mr A's case, and was within acceptable limits. He stated: "[T]here is always a difficult balance between providing adequate pain relief to prevent complications associated with severe pain and side-effects of medications."

99. Dr B noted that slow-release opioids are used in various hospitals, via ERAS protocols, as part of a national programme to improve outcomes for surgical patients and to encourage early mobility. Dr B stated that there is no clear evidence that long-acting opioids cause more harm than short-acting opioids, and provided reference material. Dr B acknowledged that opioids have the potential for significant side effects, and that opioid-sparing modalities should be used where possible. He considers that the dose of opioids and NSAIDs should have been reduced or stopped once AKI was detected, but did not consider that the initial dose was excessive.

100. Dr B stated: "[T]here is a delicate balance between providing adequate analgesia and risking side-effects from the pain medication, and finding the right balance is an everyday challenge for anaesthetists, especially with the increased prevalence of obesity in the community."

101. Dr B said that Mr A's risk profile was taken into account, and his anaesthetic was tailored to his specific needs. Dr B noted that Mr A was observed for an extended period in recovery, and was to receive hourly monitoring of oxygen saturation and respirations, which is more than the norm. He said that this directive was to monitor and detect complications at an early stage so that Mr A could be transferred if required.

102. Dr B acknowledged the importance of the role of anaesthetic planning. He stated that he considers that obesity should be considered in the streaming process for anaesthetic clinics to ensure that these patients are seen with the appropriate level of expertise.

Opinion: Whanganui District Health Board — breach

Introduction

103. In my view, some aspects of the care Whanganui DHB provided to Mr A before and after his total knee joint replacement were suboptimal. Individual clinicians who provided care to Mr A hold a degree of responsibility for the suboptimal care at various times. However, DHBs are responsible for the operation of the clinical services they provide, and can be held responsible for any service failures. Whanganui DHB had an organisational duty to ensure that care was provided to Mr A with adequate care and skill. Taking into account the number of staff involved in Mr A's suboptimal treatment, and the systems issues in this case, I consider that Whanganui DHB holds primary responsibility for the poor standard of care provided.

Anaesthetic assessment

104. Prior to surgery, Mr A completed a pre-assessment adult questionnaire, which states that his weight was 122kg, he was on medication for high blood pressure, he had previously been prescribed medication for breathing problems, and he confirmed that he did not have any other health problems apart from the planned surgery. An addition to the form states that Mr A had Type 2 diabetes and hypertension.

105. At Whanganui DHB, patients are triaged according to their clinical needs, and those who have medical issues that are controlled (stream 2) are seen by RMOs or a GP, with the on-call anaesthetist available for advice.

106. Mr A was assigned to stream 2 and seen by a house officer, Dr D, for a preoperative anaesthetic assessment. Following this assessment, the preoperative anaesthetic assessment form was completed. Dr D recorded that Mr A's weight was 135kg, his BMI was 49 (morbidly obese), and his HbA1c level was 50mmol/mol.

107. It is recorded on the form that Mr A was assigned an ASA score of 2 (indicating mild systemic disease). At the time of Mr A's previous knee replacement surgery in 2004, his anaesthetic risk had been assessed at the higher level of ASA 3, when his weight was 120kg.

108. Dr D told HDC that she did not record the ASA score for Mr A as she was uncertain what to score him at the time. Dr B stated with respect to the ASA score: "I can only conclude that [Mr A's] active lifestyle and absence of cardiac symptoms led the RMO in Clinic to assign [Mr A] an ASA 2."

109. Given the differing accounts, I am unable to make a finding regarding who decided on the ASA 2 score. However, I note Dr B's comment that the score "did not have any effect on [his] decision making when [he] reviewed the case". Dr B stated that he was aware of Mr A's comorbidities and adapted his anaesthetic accordingly.

110. No reference to sleep apnoea was recorded in any of the pre-assessment documentation. However, Dr B stated: "Although not written down, this would have been factored in when planning the anaesthetic technique, as most obese patients have respiratory obstruction to some degree."

111. I obtained expert advice from anaesthetist Dr David Jones, who stated that there were no indications that Mr A's condition had improved in the 10 years since his knee surgery in 2004 (when he had an ASA of 3), given that his weight and BMI had increased. Dr Jones stated: "[A] specialist anaesthetist could reasonably be expected to review an available previous record and conclude that [Mr A] would unlikely be better 10 years later."

112. Dr Jones advised that the score of ASA 2 on the 2014 anaesthetic record "underestimated the classification (risks) for Mr A". In Dr Jones' view, Mr A's ASA score should have been at least ASA 3, by virtue of morbid obesity and observations suggesting a likely difficult airway. Dr Jones stated that these factors, taken together, "lead [him] to conclude that this patient should have been recognised before the day of surgery to be at high potential risk for obstructive sleep apnoea and hypoxic episodes postoperatively".

113. Dr Jones stated that, in his view, given Mr A's risk factors, he should have been seen by an anaesthetist before the day of surgery, and possibly admitted the night before surgery, where sleep apnoea episodes could have been observed independent of the additional effects of surgery and analgesic opioid effects.

114. Dr Jones advised that the inaccuracy in Mr A's assessment was a system problem, rather than solely the fault of the person who was assigned to perform the assessment. He said that the system in this case bypassed the "safety-valve" of having experienced anaesthetists assess the patients they will anaesthetise, and their prescribing of appropriate perioperative care measures. I also note Dr Jones' advice that his preference would be to have a system that required personal direct communication with the qualified specialist for advice.

115. I accept Dr Jones' advice. In my view, given Mr A's risk factors, the Whanganui DHB system should have allowed for him to be assessed preoperatively by a consultant anaesthetist. The preoperative assessment of Mr A's risk, particularly of his risk during the postoperative period, was inadequate. In making this comment, I acknowledge that Dr B said that he was aware of Mr A's risk factors preoperatively. However, the fact

that the risk factors were not recorded formally (through the higher ASA rating) had the potential to impact on Mr A's care throughout his patient journey.

Failure to review postoperative analgesia regimen

116. Dr B prescribed oral opiate therapy to manage Mr A's postoperative pain. The analgesia regimen included m-Eslon, Sevredol, regular celecoxib, gabapentin and paracetamol, plus tramadol as required, and zopiclone. My expert advisor, orthopaedic surgeon Dr Alex Rutherford, advised me that Mr A's postoperative pain relief regimen was a standard pain relief programme used in many hospitals in New Zealand after total joint replacement.

117. Dr Jones advised that he has not found international reports recommending the use of slow-release morphine (m-Eslon) in the way in which it was used in Mr A's case — by commencing slow-release morphine before the surgery as a pre-medication, and with a postoperative daily dose as high as was prescribed for Mr A. Dr Jones stated that the use of gabapentin preoperatively is consistent with literature recommendations.

118. Mr A was administered 30mg m-Eslon preoperatively, and 20mg m-Eslon and 20mg Sevredol postoperatively on the day of surgery. He received a further 20mg m-Eslon the following morning, totalling 90mg morphine sulphate in 24 hours. Dr Jones advised that this was "bold" in his opinion, and stated that, as a general rule, older and obese patients need considerable scaling down of opiate doses.

119. At 1.55pm on Day 2 2015, Mr A's observations would have triggered an EWS of 3. In light of this, Dr Jones stated that the morphine should have ceased, or at least been withheld. Mr A was reviewed by an on-call house officer, Dr J, later that afternoon, and Dr J made notes acknowledging that Mr A's kidney function was deteriorating. Mr A's analgesia regimen was not reviewed, and further m-Eslon was given to Mr A at 8.30pm, in combination with zopiclone. Whanganui DHB acknowledged that the dose of m-Eslon should have been adjusted once it was recognised that Mr A was developing AKI.

120. Dr Rutherford advised that Mr A's postoperative deterioration and AKI should have triggered a review of his postoperative analgesia, and it would have been appropriate to have discussed this with a more senior member of the team. Dr Rutherford stated: "Notwithstanding that the actions taken by the Resident Officers were appropriate and I do not feel there has been a significant departure of standard of Mr A'[s] care in their management of the deterioration."

121. Dr Jones also advised that those with the continuing medical responsibility for Mr A should have recognised the need to strike out further doses of m-Eslon and sedatives.

122. I accept Dr Rutherford's and Dr Jones' advice, and I am critical that Mr A's postoperative analgesia regimen was not reviewed in light of his deterioration.

Inadequate monitoring

123. The observation chart shows that, postoperatively, Mr A's vital signs were recorded every one to two hours until 7pm on Day 1. Mr A's vital signs were not recorded again

until 5.30am on Day 2. RN G stated that she did not carry out observations at midnight because Mr A was asleep. My in-house nursing advisor, RN Carey, advised that the nursing staff should have monitored Mr A's vital signs at least four hourly after 7pm.

124. At 5.30am, Mr A's EWS was 2; his oxygen saturation was 89%, and his respiration rate was 20. RN Carey advised that an EWS of 2 should have resulted in an assessment with a shift co-ordinator and a review of Mr A's urine output. RN Carey is critical that this did not occur, and that no action was taken in response to Mr A's oxygen saturations being below his baseline admission recording of 94% on room air.

125. RN Carey advised that, in her view, Mr A's low blood pressure, poor oxygenation, and increased respiratory rate readings required actions such as commencement of oxygen therapy, increased monitoring, and communication with the relevant surgical team. She stated: "I would expect such actions from an RN regardless of whether they worked in an environment that used a monitoring guideline tool such as EWS or not."

126. RN Carey also advised that Mr A's fluid status was monitored inadequately, and his fluid balance chart was not maintained accurately over the period Day 1 to Day 2.

127. RN Carey advised that the nursing care with relation to monitoring and assessment departed mildly to moderately from accepted standards, which impacted on the nurses' failure to appreciate that Mr A's overall clinical status was deteriorating.

128. On Day 2, Mr A was also reviewed by the registrar during the morning ward round. The progress notes record that Mr A was to have an X-ray and blood tests, and his wound was to be reinforced. RN Carey stated that she was concerned that during the ward round review, the team was not aware that Mr A had not received his prescribed IV fluids, and was unaware of Mr A's vital signs recorded at 5.30am. She stated:

> "While I acknowledge that registered nurses are accountable for their assessments and need to communicate them, I also consider that assessment and drug charts should be a consistent part of the documentation reviewed by the nurse co-ordinator and consultant/registrar during a ward round."

129. In the afternoon, RN H delegated a student nurse to record a set of vital signs at 1.55pm. Mr A's oxygen saturation was 85% on room air, his temperature was 36.6°C, his heart rate was 55bpm, and his blood pressure was 95/64mmHg. No EWS or respiratory rate was recorded. RN Carey advised that these findings should have triggered an EWS of 3, which would require notifying the shift co-ordinator, and requesting an RMO review within 20 minutes. In response to the provisional opinion, Whanganui DHB stated that its view is that the student was not adequately supervised.

130. RN I cared for Mr A on the afternoon shift, and he contacted Dr J to assist, as Mr A had not passed urine for some time. Dr J prescribed IV fluids, which were commenced at 4.30pm in response to Mr A's renal dysfunction. However, no oral intake is recorded, and only one output of urine of 500ml is recorded at 8.30pm after the insertion of a urinary catheter. Mr A was not medically reviewed again.

131. The records of the monitoring of Mr A's vital signs at 4.45pm included oxygen saturation of 90%, a respiration rate of 24, blood pressure of 100/55mmHg, and an EWS of 2.

132. RN Carey advised that Mr A had poor oxygenation, which required oxygen therapy and a medical review. She noted that his recorded blood pressure readings are generally at least 40mmHg below his baseline and showing a consistent downward trend. RN Carey stated:

> "While this is not triggering an EWS alert in itself, I consider it concerning in the context of his serum biochemistry results and poor urine output. In my opinion, appropriate actions would include setting vital sign parameters, increased monitoring of vital signs, strict maintenance of a [fluid balance chart] and review of medications."

133. The nursing staff failed to assess and monitor Mr A regularly. Accordingly, his overall deteriorating condition was not recognised, and no contact was made with a senior member of the team to review Mr A. I am critical that this did not occur.

Conclusions

134. DHBs are responsible for the operation of the clinical services they provide, and can be held responsible for any failures in the provision of those services. Whanganui DHB had a responsibility to have in place adequate systems and appropriate oversight of staff in order to ensure that Mr A received appropriate care. I consider the multiple failures of the Whanganui DHB clinical staff in providing care to Mr A to be service failures that are directly attributable to Whanganui DHB as the service operator. The service provided by Whanganui DHB was suboptimal in the following ways:

- The system for the preoperative assessment of Mr A's risk, particularly of his risk during the postoperative period, was inadequate;
- Mr A's postoperative analgesia regimen was not reviewed in light of his particular circumstances; and
- Nursing staff failed to assess and monitor Mr A regularly. Accordingly, his deteriorating condition was not recognised, and no contact was made with a senior member of the team to review Mr A.

135. Accordingly, I find that Whanganui DHB failed to provide services to Mr A with reasonable care and skill, and breached Right 4(1) of the Code of Health and Disability Services Consumers' Rights.[38]

Analgesia prescription — other comment

136. Dr B prescribed oral opiate therapy to manage Mr A's postoperative pain. The analgesia regimen included m-Eslon, Sevredol, regular celecoxib, gabapentin and paracetamol, plus tramadol as required, and zopiclone. Whanganui DHB stated that Mr A was

[38] Right 4(1) of the Code states: "Every consumer has the right to have services provided with reasonable care and skill."

prescribed an analgesic regimen that is standard in the public hospital based on international guidelines for ERAS programmes for hip and knee replacements, and that m-Eslon was prescribed in routinely used dosages to provide Mr A with constant pain relief.

137. Dr Rutherford advised that Mr A's postoperative pain relief regimen was a standard pain relief programme used in many hospitals in New Zealand after total joint replacement.

138. Dr Jones advised that he has not found international reports recommending the use of slow-release morphine (m-Eslon) in the way it was used in Mr A's case — by commencing slow-release morphine before the surgery as a pre-medication, and with a postoperative daily dose as high as was prescribed for Mr A. Dr Jones acknowledged that the use of gabapentin preoperatively is consistent with literature recommendations.

139. Mr A was administered 30mg m-Eslon preoperatively, and 20mg m-Eslon and 20mg Sevredol postoperatively on the day of surgery. He received a further 20mg m-Eslon the following morning, totalling 90mg morphine sulphate in 24 hours.

140. Dr Jones advised:

> "Ninety mg of Morphine in 24 hours (in addition to other analgesic measures like Tramadol) to an aged (74yrs) morbidly obese patient, most likely with obstructive sleep apnoea, is very 'bold' in my opinion. As a general rule, older and obese patients need considerable scaling down of opioid doses. The way the protocol is described in the post hoc reports has the appearance of being a 'one size fits all' approach."

141. In response to the provisional opinion, Dr B stated that he considers that the analgesic regimen was appropriate for Mr A's case, and was within acceptable limits. He stated: "[T]here is always a difficult balance between providing adequate pain relief to prevent complications associated with severe pain and side-effects of medications." Dr B stated that there is no clear evidence that long-acting opioids cause more harm than short-acting opioids, and provided reference material. Dr B acknowledged that opioids have the potential for significant side effects, and that opioid-sparing modalities should be used where possible. He stated that he did take into account Mr A's risk profile, and that the anaesthetic was tailored to his specific needs. Dr B noted the postoperative care instructions that he gave, which were given in order to detect complications at an early stage if necessary.

142. I have considered Dr Jones' advice and Dr B's explanations. On balance, I am satisfied that Dr B did take into account Mr A's comorbidities when planning Mr A's analgesic regimen.

Resuscitation — other comment

143. On Day 3, just before 6am, RN G discovered that Mr A was not breathing. She pushed the emergency bell, lowered the bed head, and applied oxygen 10L by mask. Two RNs

attended, and they initiated standard cardiac arrest protocols. RN G stated that they had difficulty applying the defibrillator pads.

144. RN G said that the arrest team arrived approximately four minutes after the arrest was called; however, the house officers said that they arrived within 30 seconds of the call.

145. After the house officers arrived, Mr A was shocked once by defibrillator, CPR continued, and he was given adrenalin. RN K made attempts to contact the ED consultant. RN K rang the medical ward to request help, and then requested a page for the on-call consultant. When Dr N arrived, he said that after evaluating Mr A he decided to call off the resuscitation. Dr L documented that Mr A died at 6.40am.

146. RN Carey noted that the defibrillator was not applied until the arrival of the house officers. She advised that prompt application of an automated external defibrillator (AED) is recommended as a priority, and stated:

> "I would recommend that [Whanganui DHB] highlight the need to prioritise the application of the AED with nursing staff and ensure that they feel competent to use one while awaiting the arrival of other members of the resuscitation team. Even if the nursing timings are accurate, I would not consider the delay to demonstrate a significant departure."

147. Dr Rutherford stated that it is not clear from the notes how many staff were available to attend the resuscitation, but said that, in general, five staff would be the desired number. He stated: "I am aware that there is not senior staff routinely available at the public hospital for cardiac arrest calls." He noted that the overall documentation of the resuscitation was not of a high standard, but said that those criticisms should be tempered by the fact that all resuscitations are emergency procedures.

148. RN Carey advised that, in her experience, documentation of resuscitation can be lacking unless there are enough staff members present for the role of a designated scribe to be allocated. She stated: "It is important to acknowledge that at 6am there were not a lot of staff members available for the nursing staff to utilise."

149. Dr Rutherford noted that there was room to improve the standard of resuscitation with attention to airway management, a need for the earliest possible application of the AED, and the documentation of the resuscitation.

150. I acknowledge that nursing staff had difficulty with the resuscitation because of Mr A's size. However, I accept the advice of RN Carey and Dr Rutherford that the AED should have been applied expeditiously. I also consider that the documentation of the resuscitation could have been improved.

Recommendations

151. I recommend that, within three months of the date of this opinion, Whanganui DHB comply with the following recommendations and report back to HDC:

a) Provide training to medical staff on the surgical ward regarding the use of opiates in the context of patients with obstructive sleep apnoea and/or renal impairment.

b) Consider reviewing its streaming processes for preoperative anaesthetic assessment in light of the comment by my expert anaesthetist advisor, Dr Jones, that some non-anaesthetists may not be able to recognise a difficult airway accurately.

c) Provide nursing staff on the surgical ward with refresher training on the use of the AED.

152. In the provisional report I recommended that Whanganui DHB provide an update to HDC regarding the implementation of all other changes made following the CSA. This recommendation has now been met.

Follow-up actions

153. A copy of this report will be sent to the Coroner.

154. A copy of this report with details identifying the parties removed, except Whanganui DHB and the experts who advised on this case, will be sent to the Nursing Council of New Zealand, the Medical Council of New Zealand, and HealthCERT, and will be placed on the Health and Disability Commissioner website, www.hdc.org.nz, for educational purposes.

Appendix A: Independent orthopaedic advice to the Commissioner

The following expert advice was obtained from orthopaedic surgeon Dr Alex Rutherford:

> "Thank for asking me to provide expert advice to the Health and Disability Commissioner. You have asked my opinion on the care that [Mr A] received at [the public hospital] between [Day 1 and Day 3]. You have provided me with copies of the provider response and clinical records.
>
> **Background to the complaint**
> [Mr A] (74year old) underwent elective total knee replacement under a spinal anaesthetic in [the public hospital] on [Day 1]. On [Day 2] it was noticed that he had a rise in Creatinine, that he had not received the intravenous (IV) fluids charted post-operatively and he had not passed any urine since the previous afternoon. IV fluids were commenced and he was subsequently catheterised. He was found unresponsive the next morning and resuscitation was unsuccessful.
>
> You have asked if I would review the documents and provide my opinion on the following issues:
>
> 1) whether [Mr A's] pain management regime was appropriate;
> 2) whether [Mr A's] IV therapy prescription was appropriate;
> 3) whether [Mr A's] post-operative deterioration was appropriately investigated and managed;
> 4) whether [Mr A's] resuscitation was conducted appropriately and in a timely manner and
> 5) any other comments on the care provided.
>
> I note that you have also asked for expert anaesthetic and nursing advice and I am advised that I do not need to comment on those aspects of care.
>
> **Opinion**
> [Mr A] had a painful osteoarthritic left knee which initially was managed conservatively. He had previously had a successful right knee replacement performed some eight or nine years previously. [Mr A] was subsequently put on the waiting list at [the public hospital] and he came forward for left total knee replacement on [Day 1]. A straight forward knee replacement was performed under spinal anaesthetic.
>
> [Mr A's] co-morbidities included obesity with a weight of 135kg and a BMI of 49, previous myocardial infarct and hypertension.
>
> [Mr A's] post-operative pain relief regime consisted of local anaesthetic in wound, Paracetamol and Celecoxib, M-Eslon (Morphine Sulphate) and Gabapentin post-operatively.
>
> This is a standard pain relief programme used in many hospitals in New Zealand after total joint replacement.
>
> [Mr A's] IV fluid regime of one litre of Hartmann's twelve hourly would also be standard. Again if the patient were eating and drinking in the post-operative period the

fact that the fluids had not been given would not in my opinion constitute a significant departure of an acceptable standard of care.

[Mr A's] post-operative deterioration became clear with evidence of acute renal injury and deteriorating saturations on [Day 2]. [Mr A] was reviewed by the House Officer in the afternoon where it was noted that the Creatinine had risen to 143 and that there had been no significant urine since the previous afternoon. Appropriate fluid regime was charted along with rechecking of the renal functions. Subsequently that evening the patient was re-checked and catheterised.

Patient was checked during the night by the night shift and seen to be sleeping, urine output was noted on the fluid balance chart. Observations include a saturation of 89% at 2 o'clock in the morning.

[Mr A's] post-operative deterioration and acute kidney injury should have triggered a review of his post-operative analgesia and it would have been appropriate to have discussed this with a more senior member of the team. Notwithstanding that the actions taken by the Resident Officers were appropriate and I do not feel there has been a significant departure of standard of [Mr A's] care in their management of the deterioration.

[Mr A] was found unresponsive with fixed dilated pupils at 6 o'clock and an arrest call was made at that time. Oxygen was applied and CPR began. At 6.06 two RMOs arrived, the AED was attached and the shock given. Adrenaline was subsequently administered at 6.15am and 6.20am followed by Calcium Gluconate. Calls for help were made to E.D. and the medical ward, but further medical staff did not arrive until 6.40am. This was Dr N who arrived and advised that resuscitation was not likely to be successful and the patient was declared deceased.

There are some discrepancies regarding the documentation of resuscitation. The RMOs advised that they arrived within thirty seconds from the call, but the nurses notes say it was six minutes before the RMOs arrived. It was noted that the automated external defibrillator was not applied until the RMO arrived. It is not clear where the automated external defibrillator was kept. If this was on the ward it should have been applied as soon as possible by nursing staff. It is noted that the RMOs tried to establish a laryngeal mask airway and that they could not establish intubation. It is not clear whether they were able to resolve the airway problem and if a nasopharyngeal airway had been attempted. It is noted that they were not able to contact more senior staff for assistance for forty minutes.

It is not clear from the notes how many staff were available to attend the resuscitation but in general 5 would be the desirable number. I am aware that there is not senior staff routinely available at [the public hospital] for cardiac arrest calls.

The overall documentation for resuscitation was not of high standard.

These criticisms should be tempered by the fact that all resuscitations are emergency procedure and that 6am in the morning is a very bad time to suffer a cardiac arrest.

These events never run as smoothly as those practised on mannequins during teaching sessions. Although there are some mitigating factors there would seem to be room to improve the standard of resuscitation with attention to airway management, a need for earliest possible application of the automated external defibrillator and documentation.

It is not possible to know whether any of these issues would have made any difference to the outcome of [Mr A's] resuscitation. This is a situation where with the benefit of hindsight one can see aspects of care that could be improved, but overall the care provided was not a significant departure from an acceptable standard."

Appendix B: Independent nursing advice to the Commissioner

The following expert advice was obtained from RN Dawn Carey:

"1. Thank you for the request that I provide clinical advice in relation to the complaint from [the Coroner] about the care provided to [Mr A] at [the public hospital]. In preparing the advice on this case to the best of my knowledge I have no personal or professional conflict of interest. I have read and agree to follow the Commissioner's Guidelines for Independent Advisors. My advice is limited to the nursing care provided to [Mr A].

2. I have reviewed the following documentation: response from Whanganui District Health Board (WDHB) including [Mr A's] clinical notes and critical systems analysis review (CSAR).

3. Complaint background
[Mr A] (74 years old) was admitted to [the public hospital] for elective total knee joint replacement (TKJR). He weighed 135 kilograms and his body mass index is recorded as 49 (morbidly obese). Medical history includes hypertension, previous myocardial infarction and osteoarthritis. He underwent left TKJR under spinal anaesthetic, at [the public hospital] on [Day 1]. On [Day 2], it was noted that he had a rise in his serum creatinine, that he had not received the intravenous (IV) fluids charted post-operatively and that he had not passed any urine since the previous afternoon. IV fluids were prescribed and commenced and he was subsequently catheterised. The next morning at approximately 6am, [Mr A] was found to be unresponsive and not breathing. Resuscitation attempts were commenced but unsuccessful. [Mr A's] death was referred to the Coroner.

4. Advice request
I have been asked to provide clinical nursing advice on the following matters:

   a. whether [Mr A's] IV fluid therapy was administered appropriately;

   b. whether [Mr A's] post-operative deterioration was appropriately investigated and managed;

   c. whether [Mr A's] resuscitation was conducted appropriately and in a timely manner; and

   d. any other comment on the care provided.

5. Review of clinical records

   i. [Mr A] returned to ward following his surgery on [Day 1] at approximately 12.15pm. Consistent with the operating theatre and post anaesthetic care unit (PACU) nursing notes, the ward fluid balance chart (FBC) indicates that [Mr A's] total blood loss was 150 millilitres (mls) and that he had one litre IV Hartmann's solution in progress which finished on the ward. A further three litres of IV fluids were prescribed — one litre to be infused per 12 hours — but not administered. Ward nursing documentation reports [Mr A] as tolerating oral

fluid and diet. Knee Replacement Guidelines (KRG) report … full diet and fluids after surgery … Afternoon and night shift nursing documentation report [Mr A] as passing urine via a bottle with a subjective good amount reported. Urine output or oral intake is not recorded on [Mr A's] FBC.

ii. The observation chart (OC) shows that post operatively [Mr A's] vital signs were recorded every one to two hours until 7pm. In my opinion this is appropriate and expected. Next recorded vital signs is at 5.30am; *pain score 5/10, $Sa0_2$ 89% room air, respiration rate 20, temperature 36.3°C, heart rate 60 Blood pressure 122/70mmHg.* This triggered an Early Warning Score (EWS) of 2.
Comments: In my opinion, nursing staff should have maintained vital sign monitoring at least four hourly after 7pm. The WDHB response reports that a EWS 2 should result in an assessment with the shift co-ordinator and a review of urine output. I am critical that there is no evidence of these actions. I am also critical that [Mr A's] oxygen saturations were below his baseline admission recording — 94% on room air — and that no action was taken in response to this.

iii. During the morning of [Day 2], [Mr A] was reviewed by the orthopaedic team led by the registrar. RMO notes are minimal; *Plan — xray, bloods, reinforce wound.* OC documentation reports vital signs being checked at *1/05 01.55 pain score 5/10, $Sa0_2$85% room air, respiration rate 20, temperature 36.6°C, heart rate 55, Blood pressure 95/64mmHg.* This should have triggered a EWS of 3 — notify shift co-ordinator and RMO review within 20 minutes. As acknowledged by the CSAR team the recorded time does not fit into the timeline but based on the PN documentation these vital signs were taken at some time during the morning shift. Biochemistry results reported at 11.08am indicate new renal dysfunction, which resulted in a RMO review. This review is untimed but is recorded post nursing documentation at 2.30pm. The RMO notes *has not received charted bags of fluids post op … IV fluids 200mls/hr then 8^o…*This RMO was also present at the morning ward round. FBC reports IV fluids being commenced at 4.30pm. No oral intake is recorded and one output of urine — 500mls — is recorded for 8.30pm post insertion of a urinary catheter. PN documentation prior to this, reports [Mr A] passing urine in the toilet and via bottles. Vital sign monitoring at 4.45pm *pain score 2/10, $Sa0_2$90% room air, respiration rate 24, temperature 36.2°C, heart rate 55, Blood pressure 103/55mmHg*. EWS 2 is recorded.
Comment: I consider [Mr A] to have poor oxygenation that requires oxygen therapy and a medical review. Also his recorded BP readings are generally at least 40mmHg below his baseline and showing a consistent downward trend. While this is not triggering a EWS alert in itself, I consider it concerning in the context of his serum biochemistry results and poor urine output. In my opinion, appropriate actions would include setting vital sign parameters, increased monitoring of vital signs, strict maintenance of a FBC and review of medications.

iv. Overnight [Mr A's] vital signs were checked twice; *00.30 asleep, respiration rate 20, temperature 36.7°C, heart rate 58, Blood pressure 108/60mmHg EWS 2. 02.00 pain score 2/10, $Sa0_2$89% room air, respiration rate 24.* FBC reports IV fluids continuing. No oral intake is recorded and one output of urine — 150 mls — is recorded at 4am.

v. [Day 3]: RN documentation reports approaching [Mr A] at 6am and noticing that he was unresponsive and not breathing. The emergency alarm was activated. While one nurse made the 'code' call to switchboard to alert the resuscitation team, cardiopulmonary resuscitation was commenced by the other two members of nursing staff. Initial resuscitation team members — two RMOs — are reported as arriving by 6.06am by nursing documentation and earlier by their individual and contemporaneous statements. PN documentation and resuscitation record form detail resuscitation care as per the algorithm. Bag mask ventilation is reported as being maintained while attempts to secure [Mr A's] airway with a laryngeal mask were unsuccessful. A SMO arrived at 6.40am and resuscitation measures were still in progress. As resuscitation had been in progress for 35 minutes with no return of circulation, it was agreed that it was appropriate to stop. Subsequent actions included communication with family members and referral to the Coroner.

6. Clinical advice

a) Whether [Mr A's] IV fluid therapy was administered appropriately

[Mr A] did not receive three litres of prescribed IV fluids on [Day 1]. However, I would not consider this to be a significant departure in this case. The response from WDHB indicates that the Enhanced Recovery After Surgery (ERAS) pathway was being used for its joint replacement patients [at that time]. I agree that the pathway recommends that IV fluids are discontinued as soon as the patient is tolerating fluid and diet. I note that the submitted KRG do not refer to the ERAS pathway specifically and I am unaware whether the Anaesthetist expected [Mr A's] prescribed IV fluids to be administered in addition to oral intake or with the ERAS pathway recommendations in mind. I acknowledge that an IV infusion rate of 83mls/hour can be easily replaced by oral intake. [Mr A's] subsequent prescription of IV fluids was appropriately administered by nursing staff.

b) Whether [Mr A's] post-operative deterioration was appropriately investigated and managed

In my opinion no, although I do not consider that this can be viewed as solely a nursing failure. Over forty eight hours, [Mr A] became hypoxic, relatively hypotensive and oliguric. This trend occurred and continued over a period of time when [Mr A] was reviewed by his surgical team. I have found no evidence of a management plan, other than administer IV fluids, being communicated to the nursing staff. This mitigates my criticism of the provided nursing care.

In my opinion, after 7pm on [Day 1], nursing staff did not ensure that [Mr A] consistently received an appropriate level of vital sign monitoring. I am critical

of the frequency of assessment and the lack of action both when a EWS was triggered or when his vital sign significantly deviated from his admission baseline. In my opinion, low blood pressure, poor oxygenation and increased respiration rate readings requires action such as commencement of oxygen therapy, increased monitoring and communication with the relevant surgical team. I would expect such actions from a RN regardless of whether they worked in an environment that used a monitoring guideline tool such as EWS or not.

I also consider that [Mr A's] fluid status was inadequately monitored. I am critical of the standard of fluid balance monitoring following the realisation of the new kidney dysfunction and commencement of IV fluids.

In my opinion, the provided nursing care in relation to monitoring and assessment departed mild–moderately from accepted standards. I consider that this impacted on the nursing appreciation that [Mr A's] overall clinical status was deteriorating.

c) Whether [Mr A's] resuscitation was conducted appropriately and in a timely manner

Yes, I consider that it was. In my experience, documentation of resuscitation can be lacking unless there are enough staff members for the role of a designated scribe to be allocated. It is important to acknowledge that at 6am there were not a lot of staff members available for the nursing staff to utilise.

I am unsure whether the referenced automated external defibrillator (AED) was easily available to nursing staff prior to the arrival of the resuscitation team. Prompt application of an AED is recommended as a priority. If the nursing staff documentation of timings — 6 minutes — prior to RMO arrival and application of AED, I would recommend that WDHB highlight the need to prioritise the application of the AED with nursing staff and ensure that they feel competent to use one while awaiting the arrival of other members of the resuscitation team. Even if the nursing timings are accurate, I would not consider the delay to demonstrate a significant departure.

d) Any other comment on the care provided

i. **Fluid balance monitoring** — In my opinion, a nursing decision not to administer prescribed IV fluids even when recommended as part of a pathway, requires a clinical rationale based on a nursing assessment. I consider that such assessment requires accurate fluid intake and output monitoring. In my opinion, this is a reasonably straight forward action when nursing an immobile patient who is voiding into a bottle. I am critical that [Mr A's] FBC was not accurately maintained immediately post operatively, [Day 1-Day 2]. I acknowledge that the CSAR team have made recommendations concerning fluid balance monitoring and that the WDHB response includes evidence of the recommendations being actioned. In my opinion, the recommendations and subsequent action by WDHB are appropriate.

ii. **Vital sign monitoring** — I note the nursing care plan reporting monitoring of vital signs at a frequency of eight hour intervals. I strongly disagree that such intervals are appropriate during the first forty-eight hours following joint replacement. I also disagree that [Mr A's] clinical status during his [public hospital] admission was ever stable enough for eight hourly monitoring. I acknowledge that the CSAR team have made recommendations concerning post operative vital sign monitoring and use of EWS. I also note that the WDHB response includes evidence of the recommendations being actioned. In my opinion, the recommendations and subsequent action by WDHB are appropriate.

iii. **Clinical oversight and leadership** — I am concerned that the ward round review team on [Day 2] was not aware that [Mr A] had not received his prescribed IV fluids and was not aware of his vital signs recorded at 5.30am. While I acknowledge that registered nurses are accountable for their assessments and need to communicate them, I also consider that assessment and drug charts should be a consistent part of the documentation reviewed by the Nurse Co-ordinator and Consultant/Registrar during a ward round."

The following further advice was provided by RN Carey:

"1. Thank you for the request that I consider my previous advice on this case in light of the further responses received. In addition, I have been asked to identify whether I have concerns about any of the individual nurses who provided care to [Mr A]. In preparing the advice on this case to the best of my knowledge I have no personal or professional conflict of interest. I have read and agree to follow the Commissioner's Guidelines for Independent Advisors.

2. I have reviewed the following documentation: Whanganui DHB response and enclosures including staff statements dated 11 December 2015; Whanganui DHB response and enclosures dated 31 August 2016, [Dr J] response dated 14 November 2016, [Dr D] response dated 1 September 2016, my clinical advice report dated 29 October 2015.

3. Clinical advice
Following a review of the further information provided I have determined no cause to amend the opined criticisms or identified level of nursing departures as per my clinical advice report dated 29 October 2015. As noted previously, I consider that [Mr A's] post operative deterioration was not appropriately investigated and managed but that this was not solely a nursing failure. I do acknowledge that the nurses are responsible for the incidences where [Mr A] did not consistently receive an appropriate level of monitoring — vital signs and fluid balance — and for the inadequate evaluation of the recorded monitoring findings. However, I am mindful that this information — observation chart and fluid balance chart — was available for review by the other practitioners involved in [Mr A's] care. This knowledge and the general lack of a surgical management plan has mitigated my criticisms of the provided nursing care.

a. [RN H] — [Day 2] morning duty

In my opinion, [Mr A] was not monitored in accordance with accepted standards. In addition, I consider that [RN H] failed to respond appropriately to [Mr A's] documented vital signs at 1.55pm[1] and I am critical of this. In my opinion, [RN H's] practice was a mild–moderate departure from accepted nursing standards[2].

b. [RN I] — [Day 2] afternoon duty

In my opinion, [Mr A] was not monitored in accordance with accepted standards. I am critical that his vital signs were only checked once on this shift despite his recorded respiration rate being 24 and his recorded blood pressure being approximately 40mmHg below his baseline with known renal dysfunction being acknowledged in [RN I's] contemporaneous notes. I also consider that the lack of oral input recording negates the efficacy of the fluid balance monitoring. In my opinion, [RN I's] practice was a mild–moderate departure from accepted nursing standards.

c. [RN G] — [Day 1] night shift, [Day 2] night shift

In my opinion, [Mr A] was not monitored in accordance with accepted standards over both of these shifts. I am critical that a comprehensive set of vital signs only occurred once per shift and with significant passage of time elapsing — over 10 hours on [Day 1] night shift and 7 hours on [Day 2] — from the previous check. In addition, I am critical that despite [Mr A's] respiration rate being 24 at 2am on [Day 2], a full set of vital signs were not checked at this time. I also consider the standard of fluid balance monitoring completed on [Day 2] to be inadequate and without the expected level of evaluation and critical thinking. During this shift, [RN G] recorded a total of 150mls of urinary catheter output for a period of almost eight hours. In my opinion, [RN G's] practice was a mild–moderate departure from accepted nursing standards."

[1] These vital signs were taken and recorded by a student nurse who incorrectly recorded the time as *01.55*. I note that the response from [RN H] advises *… I do recall sighting these vital signs and documenting that the patient was asymptomatic and encouraging oral fluids in response to the patient's low BP…*

[2] Nursing Council of New Zealand (NCNZ), *Code of conduct for nurses* (Wellington, NCNZ, 2012).

Appendix C: Independent anaesthetist advice to the Commissioner

The following expert advice was obtained from anaesthetist Dr David Jones:

> "I have read and agree to follow the Health and Disability Commissioner's guidelines for independent advisers dated 31 July 2014.
>
> I qualified [as] Fellow of the Faculty of Anaesthetists, Royal Australasian College of Surgeons (FFARACS) in 1980, and as Foundation Fellow of the Faculty of Pain Medicine (FFPMANZCA) in 1999. I have practised at Dunedin Hospital as a specialist in anaesthesia and pain medicine since 1983.
>
> I have no conflicts of interest in relation to this case and enquiry; I am not acquainted with any of the staff delivering care to [Mr A]. I have not seen the [expert report to the Coroner], a post mortem report, nor the Coroner's report.
>
> I have reviewed for this case:
>
> 1. Copy of Clinical Records file of [the public hospital], covering pre-operative details and this admission only.
> 2. Provider response 31 July 2014.
>
> Background:
>
> [Mr A], 74yrs, underwent elective (Lt) Total Knee Joint Replacement under spinal anaesthesia on [Day 1] and was returned to postoperative ward around middle of day.
>
> The following afternoon (following the am nursing shift entry at 14:30hrs, [Day 2], therefore just over about 24hrs post return to ward) he was noted to be hypotensive, had negligible urine output since the afternoon of operation and had laboratory test evidence of acute kidney injury (AKI). He later deteriorated and was found unresponsive in his hospital bed at 06:00 hrs the following day ([Day 3]) and did not respond to resuscitation efforts.
>
> Your specific questions:
>
> 1. Whether [Mr A's] preoperative anaesthetic assessment was appropriate, including in regard to risk assessment and
>
> 2. any other comment on the care provided.
>
> I understand you are obtaining advice regarding orthopaedic and nursing aspects of care.
>
> 1. Whether [Mr A's] preoperative anaesthetic assessment was appropriate, including in regard to risk assessment?
>
> a. A preoperative assessment was carried out approx 6 weeks prior to surgery. This appears to have been carried out by a non-anaesthetist medical officer (probably

RMO) and Registered Nurse. It is sufficiently legible, but carries no name(s), and is unsigned.

b. Apart from common co-morbidities (hypertension, ischaemic heart disease with CABG 20yrs ago, probable diabetes with Hb1AC 50, 'COPD'), this patient presented with morbid obesity, BMI 49, PLUS observations suggesting a likely difficult airway. These items were recorded on the assessment form. Collectively these raise in my mind very significant risk flags.

c. (The difficult airway did pose a problem during resuscitation intubation attempts, albeit they were carried out by other than an anaesthetist. That does not convey a criticism on them on account of the emergency situation.)

d. The only 'formal' preoperative risk assessment process was as described in (a) above, and indicated ('quantified') by a circled 'ASA 2' score using the American Society of Anaesthesiologists classification (Appendix 1). This is used internationally, so is applicable to New Zealand.

e. In my opinion the recorded score has underestimated the classification (risks) for [Mr A]. I would rate his ASA score at least 3 by virtue of morbid obesity (BMI 49) with likely accompanying sleep apnoea[1], quite apart from that being superimposed on the other co-morbidity items in (b) above.

f. No mention of a chest X-ray was found in the records, nor assessment of cardiac size by clinical examination. The only cardiac assessment recorded is 'S1 + S2' for heart sounds, 'sinus rhythm' for ECG (which I could not find filed in the records) plus the description of a murmur. While elimination of unnecessary routine tests is important, in a case of this risk magnitude a closer attention to cardiac status was warranted. An echocardiogram would be the most useful single test to determine left ventricular function.

g. The letter of Chief Executive dated 31 July 2014 states 'Although [Mr A] had significant co-morbidities, he was asymptomatic and led an active life …' appears to be at odds with other data recorded in the file:

i. Orthopaedic Assessment Tool completed 16/12/2013 records BMI 47.3 which therefore increased by time of operation: the assessor recorded 'Extreme (L) knee pain, limiting function …'

ii. Oxford Knee Score, item 1: 'serious limitation of activity'

h. For somebody with these risks and about to have a major operation, in my opinion they should have been seen by an anaesthetist before the day of surgery, and possibly admitted the night before surgery where sleep apnoea episodes could have been observed independent of the additional effects of surgery and analgesic opioid effects.

[1] There was no preoperative mention of sleep apnoea, but it appears in both the postoperative notes and the post-hoc report of the anaesthetist. With a BMI of 49 there has to be a high degree of suspicion of it.

i. There is no point in documenting any risk assessment unless it can be used to modify the care to mitigate those risks amenable to altered care. It is not just an exonerating statistic for when things go wrong. In my opinion this patient would have been best managed postoperatively in a high dependency unit (HDU) with closer monitoring and observations than persons without such a high risk. That would have required more than simply filling in the assessment forms, even if done correctly. It required making arrangements in advance. I do not know if there is such an HDU in the hospital concerned.

j. The care in this case was like 'usual care', unmodified for this patient's significant risks from co-morbidities.

k. I have appended another form of risk assessment tool (POSSUM, or Physiological and Operative Severity Score for enumeration of Mortality and morbidity) which takes into account 12 physiologic factors about the patient plus 6 surgical severity effects. While this, like the ASA score, is not an absolute tool it illustrates a predicted high risk of serious morbidity from the factors applicable to this patient (34.5%).

l. I should point out use of this tool is not standard practice. It is presented here just to illustrate what I suspect could also have been obvious from a glance at the patient and his list of comorbidities.

m. ANZCA Professional Document PS07 describes standards of preoperative assessment for anaesthesia; extracts are included in Appendix 2, with items particularly relevant to this case highlighted in red.

n. It was unclear to me from the record, or the post hoc report, whether the preoperative assessment record form was brought to the attention of the anaesthetist in advance of the day of surgery. If it had, the 'ASA 2' grading would have been misleading, although the list of co-morbidities should not have been, especially BMI 49.

o. However, you probably are aware of the growing trend for hospitals to devise systems whereby preoperative assessment of patients for anaesthesia and surgery is performed by a non-anaesthetist (eg RMO and/or Registered Nurse), as in this case. With other than healthy patients this is a poor substitute for an anaesthetist carrying out this function. If there are inaccuracies in assessment, as I suggest there were in this case, that is a system problem rather than just the fault of a person assigned to do it but acting outside of their area of expertise.

p. These systems are driven by economic reasons, usually to maximise anaesthetist availability for the actual in-theatre work, as well as to avoid patients having to either wait around for assessment at the end of an anaesthetist's theatre working day, or similar reasons. Given the assessment in this case was six weeks in advance, rostering to determine the procedural anaesthetist might also not have been prepared that far in advance.

q. While assessment systems as in this case are also more convenient for patients, it does bypass the safety-valve of an experienced anaesthetist assessing the patients they will anaesthetise, and their prescribing of appropriate peri-operative care measures.

r. Some locations roster an experienced anaesthetist to this task, whereby they will assess patients for their colleagues. Safety is dependent on communication so as to convey important risk information to the correct procedural person, with enough advance warning, and sometimes make other necessary arrangements such as book an HDU bed etc. This is covered in ANZCA PS07 2.2 and 2.4.

s. Departure from ANZCA Standards: assessment used a non-anaesthetist, recorded an incorrect ASA, the anaesthetist described no communication to him in advance regarding this patient's risks, resulting in lack of planning/preparation to adapt care to this patient. This is a significant departure from ANZCA recommended standards, but does reflect a growing trend to take the anaesthetist out of the assessment safety loop.

t. However, even if all those standards were met, they do not guarantee the patient will ultimately survive, or not experience a serious adverse outcome.

2. Any other comment on the care provided?

a. ANZCA PS07 describes preoperative assessment's important role in patient safety by giving the opportunity to 'plan the anaesthesia (including pre- and post-) management'.

b. In this case the anaesthetist prescribed premedication with 30mg Slow Release Morphine plus Gabapentin, which was administered at 08:20hrs, as the case began.

c. The anaesthetist also prescribed additional oral morphine pain relief for postoperative administration.

d. These were subsequently described by the anaesthetist, and repeated by the Chief Executive in a letter to you (31 July 2015), as being a 'standard regime' for this type of operation and 'based on international guidelines for ERAS programs for hip and knee replacements'.

e. In accordance with those prescriptions a further 2 doses of morphine (20mg Slow Release and 20mg Immediate Release) were administered on [Day 1] (the day of operation), plus 20mg Slow Release the following morning at 08:00hrs, totalling 90mg/24hrs.

f. Ninety mg of Morphine in 24 hours (in addition to other analgesic measures like Tramadol) to an aged (74yrs) morbidly obese patient, most likely with obstructive sleep apnoea, is very 'bold' in my opinion. As a general rule, older and obese patients need considerable scaling down of opioid doses. The way the protocol is described in the post hoc reports has the appearance of being a 'one size fits all' approach.

g. Therefore the important role of planning care, as defined in ANZCA PS07 (ie adjusting treatment/doses etc to suit the condition and co-morbidities of the particular

patient), has not eventuated from the particular system in place on this occasion. It appears to me the anaesthetist met this patient as first on his list on 30 March 2014. That is a significant departure from the standard expected of an anaesthetist, but noting it is contributed to by hospital systems which assign the assessment role to other than the procedural anaesthetist (see 1 n. above).

h. Morphine has extra significance in this case, where it escaped notice that urine output was very low, and no IV fluids were administered until more than 24hrs postoperative. Blood tests the following morning indicated acute kidney injury (AKI). My best guess at the reason would be dehydration (pre-renal) superimposed on early renal impairment most likely arising from his hypertension.

i. Informed prescribers would likely reduce my emphasis on 'bold' as a description for the 90mg/24hours dose prescribed, because the liver breaks down ORAL morphine ('first pass effect'). They might compare this dose to only 30mg intravenous morphine equivalent. Not so in renal failure.

j. Morphine is metabolised by the liver to ACTIVE waste products, which are normally removed (excreted) by the kidneys. In the case of renal impairment they cannot be excreted, and therefore cumulate with much increased effect, typically evident on days 2 or 3.

k. The ACTIVE morphine wastes depress the CNS and respiratory system just as the parent morphine does, therefore are additive when further doses of morphine are administered. [Mr A] did become hypoxic during the first night after the operation (SaO2 85%) at a time when the record indicates he was on Room Air ('RA') without oxygen being administered.

l. There is therefore a series of compounding problems — morbid obesity, associated sleep apnoea (confirmed most likely by the nurse's report 'very noisy sleeper') and a greater than usual CNS depressing effect from what was already a 'bold' dose of Morphine for this situation.

m. Once the AKI was identified by mid-afternoon [Day 2], no further morphine should have been administered. However 20mg further morphine was administered at 20:30hrs, based on 'standard regime'. This was conceded in the Chief Executive's letter.

n. Similar could be said about administering Celecoxib (20:30hrs, [Day 2]) once AKI was identified. Although the AKI is already present, conventional wisdom is not to prescribe or administer medications known to be adverse to the kidney.

o. ERAS protocols are popular and practised in many parts of the world, with undoubted associated benefits, including cost savings. However I suggest there will always be high risk patients for which they are inappropriate. The whole nature of an anaesthetist's specialist training is to understand the varying individual elements each patient brings and to adapt care accordingly. A one-size fits all approach cannot meet that need.

p. I find it unusual to see absence of a urinary catheter in a case such as this, because spinal anaesthesia has a lingering effect on ability to empty the bladder for quite a number of hours postoperative, added to by morphine effects.

q. Urine output is also a valuable monitor of adequacy of some important physiologic functions. I consider much earlier attention to this patient's several deteriorating conditions could have occurred by earlier recognition of the renal failure. That includes a halt to further doses of morphine on the first postoperative day, as it is relatively contraindicated or doses should be markedly attenuated in renal failure.

r. Even without AKI, post-op pain at the knee surgery site together with morbid obesity would likely impair ability to mobilise to bathroom for some patients. If it is the experience of this team/location that they can do without urinary catheterisation (most of the time — as this case illustrates the opposite), then a tighter focus on observing/measuring urine output volume should be instituted for patients voiding themselves; and also to detect overfilled bladders if spinal anaesthesia sensory block effects continue since over distended bladders cause other problems.

s. At 18:45 hrs on [Day 2] (~ 30hrs post op) [Mr A] was assisted to the bathroom on a walking frame, but was unable to void the 500mls shown to be in his bladder by ultrasound scan, which later was drained by urinary catheter insertion.

t. The preoperative record, and a medication list printed on 18 March 2014, indicate [Mr A] was prescribed Terazocine, leading me to conclude he likely had some prostatism (meaning obstruction to urinary flow by prostate) as that is the typical use for that medication. Which could explain his inability to void the 500ml urine in the bladder until a urine catheter was inserted. It is conceivable that urine had remained in his bladder from some time early in the operation or soon after.

u. The same preoperative record indicates 'Frusemide' in his medication list, although the pharmacy medication list does not show any dispensed after 20 December 2013. It should have run out by the time of his operation if he had used it regularly. These are potential confounding factors in regard to his subsequently observed low urine output state on the first postoperative day.

v. The lack of urinary catheter during surgery also denied the anaesthetist an opportunity to monitor urine output peri-operatively and during the PACU time. Urine output is a valuable physiologic variable, and with residual spinal anaesthesia bladder distension can be damaging. I do wonder if a full bladder was the explanation for the BP 190/75 (much higher than I would expect for a spinal anaesthesia case postoperatively) with HR 46 (remarkably slow) by the end of the PACU period just before return to ward.

…

x. Notwithstanding any of the above, AKI on its own should not have caused death in such a short time frame. The record '2/5 Nurse Nocte' (actual time it was written not recorded) states 'General: Pt slept overnight'. It seems he remained in a room with

other patients, having kept them awake the preceding night with loud snoring. There is no record of whether that repeated during this night. The next 2 items of the written record are out of order, although understandably so due to the arrest activity. The same nurse (as far as signature appears) records finding [Mr A] 'not breathing' … which seems incongruous with their prior note quoted above stating 'slept overnight'.

[…]

Appendix 1

American Society of Anaesthesiologists classification (ASA score) … is a subjective assessment of a patient's overall health, with five classes (1 to 5):

1. Patient is a completely healthy fit patient
2. Patient has mild systemic disease
3. Patient has severe systemic disease that is not incapacitating
4. Patient has incapacitating disease that is a constant threat to life
5. A moribund patient who is not expected to live 24 hours with or without surgery

E. Emergency surgery

Notes:

There is much inter-rater variability.

ASA 2: No functional limitations; has a well-controlled disease of one body system; controlled hypertension or diabetes without systemic effects, cigarette smoking without chronic obstructive pulmonary disease (COPD); mild obesity.

ASA 3: Some **functional limitation;** has a **controlled disease of more than one body system or one major system;** no immediate danger of death; controlled congestive heart failure (CHF), stable angina, **old heart attack, poorly** controlled hypertension, **morbid obesity,** chronic renal failure; bronchospastic disease with intermittent symptoms.

In the case of [Mr A], items in [bold] above were applicable.

Appendix 2

Extracted from: ANZCA Professional Document (PS07):

http://www.anzca.edu.au/resources/professional-documents/pdfs/ps07-2008-recommendations-for-the-pre-anaesthesia-consultation.pdf

Consultation by a medical practitioner is essential for the medical assessment of a patient prior to anaesthesia (see TE6 *Guidelines on the Duties of an Anaesthetist*).

This pre-anaesthesia consultation should:

- ensure the patient's state of health has been optimised
- plan the anaesthesia (including pre- and post-) management
- allow appropriate prior discussion with the patient and/or guardian
- obtain informed consent for the anaesthesia and related procedures

Adequate pre-anaesthesia consultation has been identified as an important factor in patient safety.

2.2 Even if a pre-anaesthesia consultation has been performed by some other person, the medical practitioner responsible for administering the anaesthesia must be satisfied that all elements of that consultation have been adequately addressed, and if necessary repeat any elements about which there may be doubt.

2.4 The consultation must take place at an appropriate time prior to anaesthesia and the planned procedure in order to allow for adequate consideration of all factors. This is particularly important where:

- there is significant patient co-morbidity
- major surgery is planned
- there are specific anaesthesia concerns

2.5 The difficulties inherent in adequately assessing patients admitted on the day of surgery or medical procedure must be recognised. Ideally such patients should be assessed prior to admission. Otherwise admission times, list planning and session times must accommodate the extra time required for pre-anaesthesia consultations.

Appendix 3

Case: **DHM4606**	POSSUM_Orthopaedic[2,3]	
PHYSIOLOGIC	Value	Score
Age	74	4
Cardiac signs/meds	Candesartan/PH CABG	2
CXR / COPD	COPD; Cardiomegaly: unknown	4
SBP	146/80	2
PR	56	1
Coma	GCS 15	1
Urea	9.6 [Cr 79, 88]	2
Na+	138	1
K+	4.7	1
Hb	148, 151	1
WCC	7	1
ECG	'SR'	1

[2] Bone and Joint Surgery (Br). 2002. Vol 84; 735–739.
[3] Copland GP, Jones D, Walters M. 'POSSUM: a scoring system for surgical audit'. Br. J. Surg. 1991, V78, March, 355–360.

TOTAL:		**21**
SURGICAL SEVERITY:		
Magnitude	TKJR, Major	4
Op. procedures in 30 days	1	1
Blood Loss	[est <=500][44]	2
Contamination	None	1
Malignancy	None	1
Urgency	Elective	1
TOTAL:		**10**

P-POSSUM Predictions: 1.87% Mortality"

The following further advice was received from Dr Jones:

"The hospital concerned does not use a reliable sedation score ('SS') on its Observation Chart annotated 'Rev.03 March 2010'. There is an opportunity here to update a system, educate the most relevant staff about changing knowledge of opioid respiratory risks, and possibly intervene earlier in a similar situation.

Although this chart uses an Early Warning Score (EWS) column, despite this being recorded '2' for [Mr A], it was not acted upon. A false sense of security may have ensued due to the Respiratory Rate not being depressed (20, 24).

The only score which assesses consciousness on this chart is Glasgow Coma Scale (GCS), which is intended for other purposes and unreliable for detecting ventilatory depression.

There has been recent literature[5] about opioids effects on respiration, with description of some traps in detecting impending serious outcomes. A newer term for this is Opioid Induced Ventilatory Impairment (OIVI), or depression of respiratory drive. As yet there is no single observation scale which reliably unequivocally identifies such an outcome. Two traps, which can only be mitigated by more education especially of front line nurses and junior medical officers, are:

a. A high respiratory rate does not prove there is no OIVI. Reduced respiratory rate is a later warning than increasing sedation, or inversely increasing difficulty to rouse and remain awake. …

David Jones

[4] Despite operative tourniquet, postoperative blood loss appeared problematic, as dressings needed reinforcement multiple times due to blood oozing through them.
[5] Macintyre PE, Loadsman JA, Scott DA. Opioids, ventilation and acute pain management.Anaesth. Intensive care, 2011 Jul;39(4):545–58.

Noble KA, Pasero C. Opioid-induced ventilatory impairment (OIVI). J Perianaesth Nurs. 2014 Apr;29(2):143–51. doi: 10.1016/j.jopan.2014.01.003.

Lam KK, Kunder S, Wong J, Doufas AG, Chung F. Obstructive sleep apnoea, pain, and opioids: is the riddle solved? Curr Opin Anaesthesiol. 2015 Nov 5.([Epub ahead of print)"

The following further advice was received from Dr Jones:

"I continue to have no personal/professional conflict of interest in this case.

You have provided the following documents obtained since my earlier report:

1. Response from [Dr J], 14 November 2016
2. Response from [Dr D], 1 September 2016
3. Responses from Whanganui DHB, 11 December 2015, 31 August 2016
4. … plus attachments, including statements from 14 staff members
5. … plus letter [Dr B] to [HDC], 27 November 2015
6. Clinical records Whanganui DHB for Rt Knee arthroplasty, 2004

1. Your question: '…with regard to standard of care provided by [Dr B]'

   (a) In the new documents provided [Dr D] indicated that he did not rate an ASA score for [Mr A]. Therefore I infer that 'ASA 2' ringed on the anaesthetic record was done by the Anaesthetist on the day of surgery (see anaesthetic record, and [Dr B] report 27 November 2015, page 2, para 6). This is a conflict of attribution as to who rated the 'ASA 2'. A specialist anaesthetist could reasonably be expected to recognise the serious risks associated with the high BMI morbid obesity plus the other comorbidities, and know the ASA would be higher than that.

   (b) In the new documents you provided I note that when [Mr A] had his first knee operation in 2004, he was at that time assessed by the then Anaesthetist to be 'ASA 3'.

   (c) There are no indications that this patient's condition had improved in the ensuing ~10 years; his weight and BMI increased. A specialist anaesthetist could reasonably be expected to review an available previous record, and conclude that he would unlikely be better 10 years later.

   (d) Therefore the 'ASA 2' marked on the 2014 anaesthetic record as a lower risk category for this operation could not be correct considering the above factors.

   (e) On the postoperative section of the 2014 anaesthetic record the Anaesthetist wrote instructions: 'Hourly sats monitoring in Ward. Oral airway inserted due to obstruction of breathing during case.' (emphasis mine).

(f) During the actual theatre anaesthetic care time there would have been minimal effect from the slow release morphine (30 mg premed) as there is a lag time for absorption and onset of effect. So the interaction between the morphine, morbid obesity and tendency to airway obstruction was yet to be fully revealed after the time in theatre or even after PACU time.

(g) After PACU monitoring without any recorded problem, the notes of the nurse receiving him on the Ward state ([Day 1], 14:35): 'to monitor O2 sats as pt has some sleep apnoea'. Therefore at the time of hand over there was recognition of this patient's sleep apnoea risk.

(h) The Anaesthetist's response to [HDC] 27 November 2015 to explain pre-operative assessment seems to invert the order of information being available to him to plan the anaesthesia:

i. … 'given his obesity, as well as the history of 'snoring' in the Ward, I agree that it can reasonably be assumed he may have had some impairment of breathing' (page 2, paragraph 2). 'Snoring in the ward' was *post hoc* information, not something that he could have taken into account in planning.

ii. He states further (paragraph 4) that 'it was likely that he had some degree of respiratory obstruction and therefore [I] took this into account when determining the anaesthetic to be used'. Again *post hoc* information. That should have helped make a risk *prediction* based on the morbid obesity, and became known by the end of the case in theatre as per the recorded instructions in (e) above.

iii. There is no recognition mentioned by [Dr B] of the previous ASA 3 rating 10 years earlier (younger), at a time when BMI was lower.

iv. The choice of spinal anaesthetic was however the most appropriate one.

(i) Taken together, these things all lead me to conclude that this patient should have been recognised before the day of surgery to be at high potential risk for obstructive sleep apnoea and hypoxic episodes postoperatively. This would be especially true coupled with *any* opioid administration, but with elevated risk if morphine was used as the opioid IF coupled with any renal impairment or acute kidney impairment (AKI).

(j) Due to there being much less close observation these cases are much more at risk in normal surgical wards postoperatively. In the operating theatre or a high dependency unit (HDU) close observation and monitoring is applied. It is an expectation for the Anaesthetist to be responsible for taking the lead in directing/specifying the most appropriate type of post operative care needed … namely in this case to be monitored in an HDU, and probably set up with CPAP (a mask with constant positive airway pressure) treatment.

(k) This patient appears to fit into 'Stream 3' for preoperative anaesthetic assessment as described in letter of [Dr B] 27 November 2015, meaning he should have been assessed at the preoperative assessment clinic by an anaesthetist.

(l) Although this patient was processed by 'Stream 2' (RMO assessment) the Anaesthetic Assessment Clinic nurse did indicate in the record that an 'Anaesthetic Alert' had been sent. That means in this hospital both an email sent to the scheduled anaesthetist plus a hard copy to the Anaesthesia Department. A patient with BMI 49 at least should have triggered concern, and if not already done so needed Consultant Anaesthetist review with a view to arranging HDU post operative care.

(m) There is no obvious indication that this alert had any influence on the postoperative care arrangements.

(n) I therefore stand by the advice in my report 1 Nov 2015 section 1(s) that the preoperative assessment did not meet the ANZCA PS07 standard, that this is a significant departure, but I also note there are some system processes contributing to this arrangement.

2. Your question: 'Please comment on appropriateness of WDHB's triaging system for Pre-Operative Anaesthetic Assessment'

(a) There appear to be 2 systems in place in regard to patient assessment:
  (i) Who sees the patient? Described as 'Tiers 1–3'. This is a system of obtaining initial information. Contributing to this are the medical questionnaires the patient fills in.
  (ii) A process for the responsible nurse to send an 'Anaesthetic Alert' email to the Anaesthetist (I presumed sent to the one predicted to do the case). That could fall over if done months before.
  (iii) I have interpreted 'Tier' and 'Stream' as used in the explanations to be the same.
  (iv) Note that Tier1–3 and Stream 1–3 do not align with ASA classification as described in my prior report.

(b) In the descriptions of these schedules by [Dr B] 27 November 2015 the actions for 'Stream 1' are reasonable for medically fit people having minor and some intermediate procedures. This has become common practice.

(c) 'Stream 2' patients with intermediate to major surgery and controlled medical issues are seen by a non-Anaesthetist. In theory that seems fine, but the important question is how well do non-anaesthetist Medical Officers understand the issues that may impinge on anaesthesia? They will not know what they should know unless they have been appropriately coached.

(d) However, his further description provided to you, dated 19 August 2016 para 3, does not seem to go beyond 'the Preadmission Nurse' (is this a person trained to understand and interpret anaesthesia risk?) generating an

'Anaesthetic Alert' … 'entered into a database' and with a sticker added to the notes. As described this still does not explain the role of an anaesthetist assessing and making forward plans other than the Theatre Coordinator 'collect all … for the following day', and email them. It gives no indication of an active role of the responsible anaesthetist in advance of the day of surgery. In a high risk case like [Mr A] none of that the day before surgery is of any use other than ticking database boxes — unless it is acted upon appropriately.

(e) In [Mr A's] case, with morbid obesity BMI 49, history of 'snoring', he was clearly a high risk case aside from the additional co-morbidities of hypertension, ischaemic heart disease and probable early diabetes. It is not clear in the scheme reported to you how such patients if seen by an RMO or GP get to be seen by an Anaesthetist as described for 'Stream 3'.

(f) The statement of [RN C] 24 November 2015 in the bundle of new information you provided me with, in Tab 3 plus her email to [Dr B] 30 August 2016[6] indicates they rely on the 'Anaesthesia Alert' system via email. I can see plenty of potential for that to fail — as per this case. While all levels of hospital administration and staff promote electronic communications, my bias is to suggest a personal direct communication (verbal/phone) enquiry to a qualified specialist for advice could have worked better. And if the intended recipient of the communication was on leave or similar that would let the initiator (nurse) know to try again or ask someone else.

(g) The hospital has provided you a document titled 'Pre-Assessment Anaesthetic Category, ASA 1, 2, 3'. This outlines recommendations of who should see various types of patients — eg ASA 3 cases can be seen by Anaesthetist or Medical Officers. Most of the items on that sheet are appropriate. However, it is silent on the subject of morbid obesity, as applied to the current case. I note this was last reviewed in 2004. It could do with a review taking into account the above.

(h) Like the systems in many hospitals, this DHB's guide identified that Anaesthetists should see those patients with severe systemic disease and 'difficult intubation'. My question is do non-anaesthetists (Nurse, Resident Medical Officer or GP) accurately recognise a difficult airway? In my experience many do not. The WDHB location would be no worse than quite a few others. Some training of RMOs or GPs doing these assessments as to what might make a difficult airway or intubation should be helpful. Although there were a few notes that airway difficulties arose postoperatively (eg the resuscitation) in this case, I am not suggesting they were contributory to the final outcome.

[6] Noting the information provided is from memory only, about what she thought would/should have been in the memo.

3. 'Standard analgesic protocol' at WDHB:

(a) The Pain Relief Prescription by [Dr B] is a sub-question of yours to me regarding pre-anaesthetic assessment and whether such assessment informed an adjustment of the treatment and dose to suit the condition and co-morbidities of this patient.

(b) The Anaesthetist's first response 31 July 2015 to this question via letter of [the] CEO to [HDC] stated: 'M-Eslon was prescribed in routinely used doses to provide constant pain relief'. It states that this is 'based on international standards'. Elsewhere she quoted the Anaesthesia Head of Department's advice that m-Eslon (Oral Slow Release Morphine) given in this case 'conformed to International Standards'.

(c) I have not yet found international reports recommending use of Slow Release Morphine as used in this case — ie commencing before the surgery as a premed, nor in a daily dose as high as was prescribed for this case. The oral opioid Oxycodone is described in some reports[7,8] as was Pethidine in older literature.

(d) [Dr B's] idea and attempt to provide 'constant pain relief' is of course commendable. They have incorporated the Multimodal Analgesia concept. Gabapentin preoperatively as in this case is consistent with literature recommendations. It is the choice of which opioid drug, its timing and dose that I will analyse below.

(e) In a contrary view, much of recent ERAS literature describes using 'opioid sparing' measures,[9,10,11] rather than routinely administering standard opioid doses. Some recommendations include avoid opioids completely, which in my opinion is hard to achieve routinely. Also the surgeon instilled local anaesthetic inside [Mr A's] knee, a further measure against post operative pain which is opioid sparing.

(f) I could find only one report so far, from a New Zealand group,[12] which mentions mEslon slow release morphine. It was in a list of opioids available for use, but they did not address how often it was used in their hands. I did

[7] den Hertog A, et al. Pathway controlled fast track rehabilitation after total knee arthroplasty: a randomised prospective clinical study evaluating the recovery pattern, drug consumption, and length of stay. Arch Orthop Trauma Surg (2102) 132:1153–1163

[8] Auyong DB, et al. Reduced length of hospitalisation in primary total knee arthroplasty patients using an updated ERAS orthopaedic surgery pathway. Journal of Arthroplasty 30 (2015) 1705–1709.

[9] Christelis N, et al. An enhanced recovery after surgery program for hip and knee arthroplasty.MJA 202 (7), 20 Apr 2015, p363 ditto

[10] Auyong DB, et al. As above

[11] Stowers MDJ, et al. Review article: perioperative care in enhanced recovery for total hip and knee arthroplasty. J. of Orthopedic Surgery 2014;22(3):383–92

[12] Stowers MDJ et al. Enhanced recovery after surgery in elective hip and knee arthroplasty reduces length of hospital stay. ANZ J Surg 2016 86(2016) 475–497. See Table S2

find two reports which included slow release oxycodone, which I will address further below.

(g) I should point out that most but not all of these references were published following this case.

(h) Many ERAS protocols also recommend using local nerve blocking techniques to help achieve 'opioid sparing', although in this case I would anticipate considerable difficulty achieving that on account of the morbid obesity, so there is no criticism of [Dr B] for omitting that treatment.

(i) It is a well known fact that the CNS depressant effects of other sedating agents are ADDITIVE to that of opioids, increasing the risk of opioid induced ventilatory impairment (OIVI) by using them.

(j) Gabapentin is an excellent component in multimodal attempts to reduce postoperative pain. But because it has CNS depressing effects opioid doses can be scaled back. The term 'opioid sparing' is used to describe one of its functions, because opioid is the riskiest component of post op analgesia.

(k) […]

(l) The new documents you provided included the record for [Mr A's] 2004 first Total Knee Joint replacement, when he was younger and with lower BMI. I calculated ~60mg/24hrs oral morphine equivalents were given by PCA.[13]

(m) That compares with the administration by 'routinely used doses' this time, being 90mg/24hrs, or approx 50% more. Even though the patient is now 10yrs older, with an increased BMI. I stand by my previous description of this being 'bold' for a morbidly obese 74yrs BMI 49 gentleman.

(n) The big difference by giving morphine as a slow release oral tablet is that IF the adverse effect on ventilation (OIVI) developed THEN it cannot be stopped. Unlike the IV PCA method, which can be discontinued in that event. One has to wait till the whole (internal, within the gut) delivery finishes 8–12 hrs later. I recognise it is popular in ERAS methods to avoid IV fluids and intravenous administrations as far as possible, but there is this downside as illustrated in this case.

(o) I wish to correct my earlier report paragraph 2 (w), in line with the correction of 01:55 time on record to 13:55 in 24 hour clock format for [Day 2], as indicated in the statement of [RN H], 30 November 2015, paragraph 5 in the new documents you supplied. The episode of significant hypotension, coupled with hypoxia (85%) and no supplemental oxygen happened in the early afternoon of first post operative day [Day 2]. All comments about

[13] That time morphine was by small intravenous increments using a PCA. It is necessary to calculate **oral morphine equivalents** in order to compare with this subsequent operation. Ratio x5 for IV:Oral morphine used for calculation.

sedation scoring during normal night sleep time are irrelevant for this case when put into the corrected time context. The fact the early warning score (EWS) of 3 that afternoon was not recognised nor acted upon is covered elsewhere in reports to you.

(p) The recordings therefore show [Mr A] was both hypoxic and hypotensive during the early afternoon of first postoperative day. If medical attention had been sought at that time I expect a blood gas sample would have shown an elevated blood CO_2 indicating OIVI. That would have necessitated intensive care type management, ESPECIALLY as the slow release oral morphine could not be terminated. The morning slow release morphine tablet would have still continued delivering more morphine (internally).

(q) Given the EWS of 3 in that situation the remainder of the SR morphine prescription should have ceased, or at least administration withheld. However a further slow release morphine (m-Eslon) tablet was given that evening at 20:30hrs, coupled with the 2 additional benzodiazepine sedatives described in (k) above.

(r) The continued administration of prescribed morphine doses after the AKI was recognised would not have been the sole responsibility of the Anaesthetist, even though he had prescribed those medications. Those with continuing medical responsibility for the patient should have recognised the need to strike out further doses of all these medications. That aspect of care usually belongs to the Surgical Team, although in larger hospitals anaesthetists along with specialised nurses deliver acute pain management review and advice (Acute Pain Service).

(s) In [Mr A's] case, there was another reason to cease any further morphine administration specifically on account of the acute kidney injury (AKI) first recognised on the afternoon of the first post operative day ([Day 2]) when the routine Creatinine blood test taken at 10:14 became available.

(t) The issue of which opioid to give orally for analgesia takes on more importance in the elderly population where renal function is often diminishing, and becomes critically important with acute kidney injury (AKI).

(u) Morphine is metabolised by liver to metabolites (waste products) which rely on kidney excretion to be removed (M3G and M6G). If not removed, they cumulate for long periods. Some are active and can also depress CNS and respiratory function just like the parent morphine does (ie cumulative and additive). This poses significant danger, and is the reason for monitoring with Sedation Scores to help detect this early as one part of the early warning

systems (EWS).[14] In this regard I quote from the ANZCA publication 'Acute Pain Management: Scientific Evidence':[15]

> 'Both M6G and M3G are dependent on the kidney for excretion. Impaired renal function, the oral route of administration (first pass metabolism), higher doses and increased patient age are predictors of higher M3G and M6G concentrations … with the potential risk of severe long-lasting sedation and respiratory depression'.[16] (emphasis mine)

(v) In the case in question all those adverse criteria were met by the time the AKI had occurred. The significant dose of slow release morphine already on board could not be quickly terminated. This is analogous to filling a bath with the plug still in — instead of the normal situation where incoming drug administration replaces what can leave via the 'kidney plughole', in equilibrium.

(w) I draw your attention to Stowers et al 2016[17] supplement table (attached) in which they do include m-Eslon slow release morphine as one of the possible opioids, but with two significant differences to how it was prescribed in this case:

i It was for commencement on first postoperative day, after initially using IV increment opioid (PCA or IV morphine protocol), and

ii dose 20–40mg in 24 hours, but allowance for some extra via rapid release short duration morphine (Sevredol) tablets if required. It is an assumption I have made, as it is not explicit, that they would apply boundaries and/or limit criteria for decision to continue administration based on a sedation scoring scheme.

(x) This should be seen in contrast to [Mr A] who received 90mg in 24 hours (more than double).

(y) Oxycodone, another strong opioid suitable for this purpose, does not have active metabolites and therefore it does not rely on kidney excretion for terminating its effects. Therefore it is more suitable for patients with, or likely to have, reduced kidney function (eg elderly).

(z) By the anaesthetist's own admission the m-Eslon was a standard dose and not adjusted to this patient's condition. I therefore stand by my previous

[14] But note AVAPU or AVPU are not sensitive enough — see later comments for future improvements.
[15] Schug SA, Palmer GM, Scott DA, Halliwell R, Trinca J; APM:SE Working Group of the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine (2015), Acute Pain Management: Scientific Evidence (4th edition), ANZCA & FPM, Melbourne. Page 73.
[16] Although I have quoted from the most recent edition, these facts have been known for a long time, and are described in 1980s reports as well as the earlier 3 editions of this handbook, which has been made available to every ANZCA Fellow.
[17] Stowers MDJ et al. Enhanced recovery after surgery in elective hip and knee arthroplasty reduces length of hospital stay. ANZ J Surg 2016 86(2016) 475–497. See Table S2.

opinion that this was a case of treating with a standard one-size-fits-all protocol in respect of the doses of morphine prescribed. I submit that is less than a specialist anaesthetist should have done, and not what peers would expect to be done.

(aa) It is relevant to note that in NZ there has been a campaign by 'higher authorities' to influence prescribers to avoid oxycodone prescribing in favour of morphine. This is based on politico-economic factors, not clinical-scientific ones. I cannot tell what impact that has had on the choice of opioid at this hospital, but suggest opioid drug choice, its timing, and criteria for continued administration in the ERAS protocol be revisited.

4. Your question: other matters in this case/recommendations for improvement?

(a) Early Warning System (EWS) Sedation Score: relevance to opioid pain relief.

(b) In the new documentation provided there are WDHB charts that still leave me concerned as to whether the best solution to the problem has been arrived at — although no fault on their part as it has been controversial.

(c) I note the old chart which I assume was applicable to the case under discussion has been resubmitted, in Tab 4, identified STAT No. 0052 EWS Chart August 2011. This chart had 3 different systems of conscious state assessments (GCS, CNS Level, AVAPU and a Sedation Score but in an unsuitable form).

(d) In addition they supplied a copy of 'New Adult Early Warning Score and Vital Sign Chart' with a staff education timetable ahead of launch on 12 October 2015, based on Wellington Hospital version. I note replacement of 'AVAPU' with 'AVPU'.[18] I also note there is a regional use of this, so any improvement change needs buy-in wider than just this hospital.

(e) This controversial subject led to expert submissions to the Australian Commission on Safety and Quality in Health Care (ACSQHC). The problem is that for opioid pain treatment, especially intravenous opioids by PCA, the categories of 'AVPU' do not have sufficient definition or resolution to detect early enough the onset of opioid induced ventilatory impairment (OIVI). Please find attached an article 'The Development of the Adult Deterioration Detection System (ADDS) Chart' from ANZCA Bulletin, September 2011, authored by a group very experienced in administration of opioids for post operative pain relief. I also refer back to my coverage of this subject in the Addendum to my earlier report, dated 14 November 2015. Unfortunately my report then was written after and when I was unaware of the changes made by WDHB. I strongly recommend that the hospital(s) look at the enclosure with this report, the reference in the addendum to my earlier report, then reconsider which Sedation Scoring system to use going forward. The one described in my Addendum is actually easy for nurses to understand and apply the criteria.

[18] A=Awake, V=respond to verbal, P=respond to pain, U=unconscious

5. Re: Urine output measurement in this case, and ERAS protocols.

(a) I wish to withdraw any implied criticism in my previous report about lack of urinary catheter and urine output monitoring for this case.

(b) To explain that further I note there are some centres who promote this habit within ERAS protocols. So it is a matter of judgement whether that should apply across the board or only to low risk cases. I suggest not every patient would be suitable for a 'standard' ERAS protocol. In support of that opinion I refer to an Australian 2015 study [19] in which approximately half of their ERAS group did have urinary catheter, although they do not describe criteria for who should have one.

(c) Further, Stowers 2016[20] NZ group's data measured compliance with removal of IDC (urinary catheter) on first postoperative day as one of their ERAS criteria. They do use urinary catheters, but plan for them not to be prolonged after first morning (POD1).

(d) Whether or not urinary catheter is used is not the anaesthetist's sole call. ERAS depends very much on team decision making and distribution of different responsibilities across that team. Certainly a difference in anaesthesia type can alter the arguments for/against a urinary catheter (ie GA vs spinal). In my experience surgeons are more against urinary catheter use than anaesthetists.

(e) In examining whether there was a role towards the final outcome in this case by not having a urinary catheter, my conclusion is that even if one had been used according to the Stowers et al[21] protocol with removal on postop day 1 ('IDC out POD1' in Table 2 attached), the time scale of events in [Mr A's] case suggest the dropping off of urinary output could still have gone undetected until after its removal. Curiously the record reports 'PUing with bottle' on the day of surgery. But as he was unable to void by the end of the next postoperative day it appears his prostatic obstruction (for which he received Terazocin, as shown in the community medicine list) was revealed by the bladder scan and subsequent drainage of ~500mls when catheter inserted.

(f) Acute kidney injury was analysed thoroughly in the Christelis et al report,[22] and does not appear to correlate with non-use of urinary catheter, where elevation of creatinine occurred in AKI independent of urine output.

[19] Christelis N, et al. An enhanced recovery after surgery program for hip and knee arthroplasty.MJA 202 (7), 20 Apr 2015, p363.
[20] Stowers MDJ et al. Enhanced recovery after surgery in elective hip and knee arthroplasty reduces length of hospital stay. ANZ J Surg 2016 86(2016) 475–497. See Table S2.
[21] ditto
[22] Christelis N, et al. An enhanced recovery after surgery program for hip and knee arthroplasty.MJA 202 (7), 20 Apr 2015, p363.

(g) Your attention is drawn to the fact I have quoted literature around these aspects which is more recent than the 2014 case under consideration, but with a view to consideration of practices going forward.

6. Regarding development of AKI in [Mr A]:

(a) [Mr A's] creatinine at pre-assessment 6 weeks earlier was normal.

(b) The commonest cause of AKI would be hypovolaemia (from unreplaced loss of blood volume) and/or hypotension (low blood pressure in a normally hypertensive person).

(c) From the anaesthetic record I cannot see anything untoward regarding blood loss/fluid management during the operation or PACU. I cannot see evidence of hypotension preoperatively nor in PACU.

(d) There was definitely a decompensation of BP by mid-afternoon on first day postoperative. The records make multiple references to having to reinforce the dressings on the operation site — due to bleeding. Patients in this age group tolerate blood loss poorly compared to a younger person, so absolute volume of loss is not the only factor. Haemoglobin 134 measured on POD1 would not have caused me concern however, so not all the information aligns for this possibility. Although I could find no proof of cause, a possibly unrecognised amount of bleeding following the operation (as tourniquet was used during the operation) may have contributed to AKI.

I am happy to clarify any matters related to the above on your request."