Southern District Health Board

A Report by the

Health and Disability Commissioner

(Case 14HDC00121)

Health and Disability Commissioner
Te Toihau Hauora, Hauātanga

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Executive summary

1. Mr A (age 29 years at the time) was admitted to a public hospital on 31 December 2013 following an accident in which he sustained a midshaft fracture of his right tibia and fibula. The following day he underwent surgical intramedullary (IM) nailing of his right tibia, and his leg was placed in a temporary below-knee plaster cast.

2. In the days following surgery it became apparent that Mr A's pain was not being managed, and increasing levels of narcotic analgesia were required. Mr A's postoperative course was of gradually increasing pain with increasing analgesic demands, restlessness, and urine retention. However, a cause of the increasing pain and distress was not identified until 4 January 2014, when a diagnosis of compartment syndrome was made.

Findings

3. The Commissioner found that Mr A's pain assessment and monitoring, most notably by the registered nurses responsible for his care, was below accepted standards. While Southern District Health Board (SDHB) has implemented suitable changes following these events, the Commissioner was critical that such measures were not in place at the time. Mr A was not provided with services in a manner consistent with his needs and, accordingly, SDHB was found to have breached Right 4(3)[1] of the Code of Health and Disability Services Consumers' Rights (the Code).

4. It was also found that there were insufficient efforts by the orthopaedics team to investigate the cause of Mr A's pain prior to 4 January 2014. This failure led to a delay in diagnosing Mr A with compartment syndrome. It was found that SDHB was responsible for this failure by multiple staff. Accordingly, SDHB failed to provide services to Mr A with reasonable care and skill and breached Right 4(1)[2] of the Code.

Complaint and investigation

5. The Commissioner received a complaint from Mrs B regarding the care provided to her son, Mr A, at a public hospital. The following issue was identified for investigation:

   - *Whether Southern District Health Board provided Mr A with an appropriate standard of care between 31 December 2013 and 4 January 2014.*

6. The parties directly involved in the investigation were:

Mr A	Consumer
Mrs B	Consumer's mother/complainant

[1] Right 4(3) of the Code states: "Every consumer has the right to have services provided in a manner consistent with his or her needs."
[2] Right 4(1) of the Code states: "Every consumer has the right to have services provided with reasonable care and skill."

Southern District Health Board	Provider
Dr C	Consultant orthopaedic surgeon/provider

Also mentioned in this report:

Dr D	Registrar
Dr E	House officer
Dr F	House officer
RN G	Registered nurse
Dr H	House officer

7. Independent expert advice was obtained from registered nurse Dawn Carey (**Appendix A**) and orthopaedic surgeon Dr Alex Rutherford (**Appendix B**).

Information gathered during investigation

Background

8. On 31 December 2013, Mr A, aged 29 years, had an accident in which he hyperextended[3] his right lower leg. Mr A felt his lower leg break.

9. An ambulance was called. The ambulance report states that on initial assessment Mr A had an obvious deformity of his right tibia[4] and fibula,[5] but good movement in his toes. Mr A was taken to the public hospital.

Treatment at the public hospital

31 December 2013

10. On 31 December 2013 at 5.19pm, Mr A was seen in the emergency department (ED) by an emergency doctor who noted that Mr A's right lower leg showed a "palpable fracture[6] proximal 1/3 tibia, with some rotation of foot". An X-ray was taken, and the emergency doctor noted that this showed a displaced rotated fracture proximal to the tibia and fibula.

11. At 7.35pm an above-knee plaster back slab[7] was applied, and Mr A was sent for a further X-ray. It was documented that there was no sign of compartment syndrome at that time.

12. Compartments are groupings of muscles, nerves, and blood vessels in the arms and legs. Compartment syndrome is a condition that occurs when swelling or bleeding occurs within a compartment (there are four compartments in the lower leg), resulting in pressure within the muscles building to dangerous levels. This pressure can

[3] Extension of a bodily joint beyond its normal range of motion.
[4] A large bone located in the lower leg, also known as the shin bone.
[5] The long, thin and lateral bone of the lower leg, also known as the calf bone.
[6] A fracture that could be felt on examination.
[7] A temporary plaster cast.

decrease blood flow to nerve and muscle cells, which can result in damage to those cells. Acute compartment syndrome can develop after a severe injury, such as a fracture. In acute compartment syndrome, unless the pressure is relieved quickly, permanent disability and tissue death may result. The classic sign of acute compartment syndrome is pain that is more intense than would be expected from the injury itself. Using or stretching the involved muscles increases the pain. There may also be tingling or burning sensations (paraesthesia) in the skin.

13. Mr A was provided with pain relief and, at 8.40pm, he was admitted to hospital and referred to orthopaedics. He was transferred to the surgical ward from ED.

1 January 2014

14. Mr A was placed on "nil by mouth" from midnight in preparation for surgery, and underwent uneventful intramedullary (IM) nailing of his tibia,[8] by an orthopaedic registrar (who was assisted by consultant orthopaedic surgeon Dr C) on the morning of 1 January 2014. His leg was immobilised in a below-knee plaster back slab. That afternoon his neurovascular examination[9] was normal and he was resting comfortably.

15. Following surgery, Mr A had increasing localised pain, and he was started on morphine via a patient controlled analgesia pump (PCA), which administered 1mg on demand with a five-minute lockout. A PCA is an electronically controlled infusion pump that delivers a set amount of intravenous analgesic when the patient presses a button. With a PCA, the patient is protected from overdose by the caregiver programming the PCA to allow the delivery of a set dose at set intervals. If the patient presses the button sooner than prescribed, the PCA does not operate. At 9pm the records state that Mr A's pain was "settled with PCA & oral pain relief". That night, however, Mr A attempted to use the PCA 53 times, and 39mg of morphine was delivered.[10]

2 January 2014

16. On the morning of 2 January 2014, Mr A was reviewed by consultant Dr C together with registrar Dr D and house officer Dr E. Dr D recorded that Mr A was comfortable and that his leg was to be elevated. At 12.30pm Mr A was seen by a physiotherapist, and it is recorded that at that stage he was feeling well with no problems.

17. Later that day (time not recorded), house officer Dr E was asked by nursing staff to review Mr A because his pain was increasing and he had had two temperature spikes. Dr E recorded that Mr A said that he had tightness and ache at the level of 6/10–8/10 on the pain scale in the area of the anterior mid shaft.[11] Dr E recorded that he discussed Mr A with the orthopaedic registrar, and that Mr A's pain was to be monitored overnight. Dr E recorded: "[I]f uncontrolled on PCA then call."

[8] An intramedullary nail is a metal rod forced into the medullary cavity of a bone. IM nails are used to treat fractures of long bones of the body.
[9] Assessments of nerve function and blood flow.
[10] This shows that Mr A was trying to administer more pain relief than he was able to because of the lock-out mechanism.
[11] Towards the front of the lower leg.

18. Mr A's pain scores are documented by clinical staff on the Unstable Patient Status Observation Chart (UPSOC). There are two pain scores recorded, one at 7pm and the other at 7.35pm. The scores record Mr A's pain level at rest[12] and with movement.[13] At 11.30pm a "tick" is recorded on the UPSOC to record that Mr A was in pain, but no pain level is provided for this time.

19. On 2 January 2014, Mr A attempted to use the PCA 66 times, and 38mg of morphine was delivered (with 1mg being given at a time), although on this day the PCA was stopped (hung up) at 1.30pm and recommenced at 9.45pm. In addition to the PCA, the following oral pain relief was administered to Mr A on 2 January:

Drug	**Quantity**	**Time given**
Paracetamol	1g	2am, 8.35am, 1pm, 7pm
Tramadol	100mg	2.45am, 8.35am and 4pm
M-Eslon (morphine sulphate)	10mg	8.35am and 7.35pm
Sevredol	5mg	9.30am
Sevredol	10mg	midday, 1pm and 4.15pm
Sevredol	20mg	7.35pm and 9.35pm

3 January 2014

20. Dr C advised this Office that he became aware of Mr A's reports of increased pain during his ward round at approximately 8am on 3 January 2014. He stated that his clinical concern was the risk of complication from infection. At 8.40am Mr A was reviewed by the anaesthetic pain team, who documented that Mr A had "normal lower limb sensation in foot + able to move toes". It was also documented that the anaesthetic pain team could perform a nerve block[14] if the surgical team agreed. Dr C advised HDC that, following the anaesthetic review, he discussed with the anaesthetic consultant the option of the nerve block, "but decided not to proceed without the underlying cause of [Mr A's] pain being better understood".

21. Mr A's cast was changed in the fracture clinic (time not recorded). Dr C advised HDC that he spoke to Mr A after this but did not do a full clinical review at that time. Dr C said he recalls that Mr A said that he was feeling more comfortable. Mr A was changed to oral analgesia, and his PCA was discontinued by the anaesthetist at 1pm, in preparation for Mr A's discharge from hospital the following day.

[12] 4/10 and 5/10 respectively.
[13] 7/10 at each time.
[14] Whereby a substance is injected into or around a nerve or the spine to interrupt how pain signals are sent to the brain, thereby relieving pain.

22. A first-year house officer documented that Mr A's discharge was discussed with Dr D, and that Mr A was not for discharge the next morning.

23. At 6pm house officer Dr F recorded that Mr A had a painful right leg and his temperature had spiked to 38.5°C.[15] It is noted that Mr A had not passed urine well since admission. Dr F noted that Mr A's pain in his right leg was not well controlled, and that he was requesting to go back onto the PCA because of inadequate pain control. The pain is recorded as being a sharp "bony" pain in the front of the right lower leg, which came and went and was worse with movement. Mr A had no altered sensation and was able to move his toes. In response to my provisional opinion Mr A advised that, "at this stage he was unable to move his toes upwards".

24. Dr F inserted an indwelling catheter[16] and over 1500 mls of urine was drained. Dr F noted that Mr A should be monitored closely because of the morphine sulphate (M-Eslon) dose he had received that day. The PCA was re-commenced at 8.35pm. At 9pm Dr F reviewed Mr A again and documented that pain was still present, and that it had not improved much. At 10.55pm registered nurse (RN) RN G recorded that Mr A had complained of pain throughout her time on duty, and that multiple attempts to reposition Mr A's leg had had no effect on reducing his pain. RN G noted that at 9.40pm Mr A was asleep, and the PCA was stopped. However, at 10.10pm Mr A again complained of pain "+++". His leg was repositioned and the PCA was re-commenced.

25. The UPSOC has two "at rest" pain scores recorded for 3 January, one at 11.35am (5/10) and one at 1.45pm (4/10). No "on movement" pain scores were recorded on this day. A sedation score[17] was not recorded despite the PCA being used.[18] Mr A made 115 attempts to use the PCA and received 64mg of morphine.

26. In addition to the PCA, the oral pain relief administered to Mr A on 3 January is as follows:

Drug	**Quantity**	**Time given**
Paracetamol	1g	Midnight, 7.30am, 1.25pm, 6.05pm
Tramadol	100mg	Midnight, 7.30am
M-Eslon	20mg	6.05pm
Sevredol	10mg	1.25pm, 2.30pm, 5.45pm, 7.25pm and 8.10pm
Diazepam	2mg	8.35pm

[15] Normal body temperature is 37°C.
[16] Placed inside the body.
[17] Sedation scales assess a patient's level of sedation.
[18] A sedation score is necessary in patients receiving opioid analgesia (such as morphine), as sedation is an important predictor of respiratory depression. Morphine use can cause respiratory depression.

4 January 2014

27. At 1.14am Mr A reported to the registered nurses that he was sore "+++". He was given a bolus of morphine[19] as charted, with effect for one hour. He was then given a further bolus with no effect. At around 1.45am house officer Dr H was called to evaluate Mr A because of his increased leg pain. Dr H documented that Mr A was experiencing "on-going sharp constant pain in his right leg". It is also documented that the diagnosis of compartment syndrome was considered but felt unlikely. SDHB advised HDC that this was because of Mr A's ability to move his toes. Mr A made 316 attempts to use the PCA and, overall, received 102mg of morphine on this day.[20] Prior to 9am the UPSOC records an at-rest pain score of 9/10. There is no recording of an AVPU (alert, voice, pain, unresponsive) scale[21] or sedation score.

28. In addition to the PCA and the bolus, the oral pain relief administered to Mr A on 4 January is as follows:

Drug	**Quantity**	**Time given**
Paracetamol	1g	7.45am
Tramadol	100mg	2.10am, 7.45am
Sevredol	10mg	8.00am
Diclofenac	75mg	2.10am

29. Dr C advised that when he reviewed Mr A at 8.40am, it was obvious that Mr A was in considerable distress, which indicated a significant change in his condition since the previous day. Dr C asked that the back slab be removed so that he could inspect Mr A's leg.

30. An orthopaedic registrar began to remove the back slab, and Mr A reacted strongly, saying that the orthopaedic registrar had cut him. Dr C said that he took over and removed the back slab and examined Mr A's right lower leg. His observations were:

- Obvious tense swelling and exquisite tenderness on the anterior compartment.
- Pain on passive flexion of the great toe and plantar flexion[22] of the foot.
- Unable to actively extend the great toe or dorsi-flex[23] his foot.
- There was no neurological deficit or vascular compromise.
- The other compartments of the leg were soft and non tender.

[19] Administration of a discrete amount of medication in order to raise its concentration in the blood to an effective level.
[20] The 102mg includes the morphine bolus.
[21] The AVPU scale is a system by which healthcare professionals can measure and record a patient's responsiveness, indicating his or her level of consciousness.
[22] Movement of the foot that flexes the foot or tows downward toward the sole.
[23] Bend back.

31. Dr C stated that the diagnosis was acute compartment syndrome of the anterior compartment of the right lower leg, requiring emergency decompression in the form of fasciotomy[24] of the right lower leg compartments. He said that he explained the diagnosis and the need for urgent surgery to Mr A, who consented to the surgery. The orthopaedic registrar obtained written consent and marked Mr A's leg. Dr C stated that the procedure was carried out within an hour of the diagnosis and, because of the urgency to take Mr A to theatre, there was not time to make a written contemporaneous note. A detailed dictated operation note was made immediately after the surgery.

32. Mr A underwent an emergency fasciotomy at around 9am. At surgery, compartment syndrome involving the anterior compartment was confirmed, and all four compartments in Mr A's lower leg were decompressed.

33. Mr A was transferred to the critical care unit after surgery. Mr A's respiratory status required monitoring, "given the amount of oral analgesia with PCA prior to surgery …".

34. On 4 January there is only one set of recordings, including an "at rest" pain score on the UPSOC of 9/10 prior to 9am. There is no record of his sedation score prior to transfer to the critical care unit.

Further information from Mrs B

35. Mrs B stated that at no stage was Mr A pain free but, because of the amount of morphine he had received, he was drowsy and, at times, confused.

36. Mrs B stated:

> "Surely, on-going escalating uncontrollable pain is the most significant indication of a serious problem. Although it was documented in the notes that my son was comfortable I would like to suggest to you that in fact he was drowsy and unable to function due to the amount of analgesia he was receiving."

37. In her complaint, Mrs B stated that to date Mr A had undergone eight surgical procedures.

Further information from Southern DHB

38. Reviews of the care provided to Mr A were conducted by the surgical nursing team and the acute pain service nursing team. An audit was also carried out by the Orthopaedic Department. SDHB advised that the relevant outcomes from these reviews included the following:

[24] Fasciotomy is a surgical procedure where the fascia (connective tissue fibres, primarily collagen, that form sheets or bands beneath the skin to attach, stabilise, enclose, and separate muscles) is cut to relieve tension or pressure in an area of tissue or muscle. Fasciotomy is a limb-saving procedure when used to treat acute compartment syndrome.

Surgical nursing team

a) Nurses to understand and agree that unrelenting pain that does not respond to normal pain control measures is a trigger for review by a senior specialist to exclude complications, and should be documented in the patient's notes. This was achieved by the use of the ISBAR (Identify, Situation, Background, Assessment and Recommendation) framework being reviewed and standardised across SDHB hospitals, including the development of an education tool linking the deteriorating patient information to the framework for communicating clinical concerns.

b) A new Early Warning Score Observation Chart was introduced, which standardises recording of PCA infusions in millilitres to support the accurate analysis of effectiveness of opioid pain relief. This was introduced on 13 February 2015.

c) High visibility alert stickers are to be applied to charts of patients receiving opioids to remind staff to complete pain and sedation scores to track control of pain better.

d) Registered nurses are to conduct intentional hourly rounding in the surgical wards. This is shown to support early identification of emerging issues, and was commenced in October 2014. These rounds are to be documented and audited. Registered nurses are to ask the patient the following specific questions:

   — Do you have any pain?
   — Do you need to go to the toilet?
   — Do you need repositioning?
   — Is there anything else you need? I have the time to help you.

e) Nurse education sessions to provide contemporary knowledge on orthopaedic care. SDHB advised that on 19 June 2014 Dr C presented to nurses at the public hospital on compartment syndrome.

Acute pain service nursing team

a) Education is currently underway around the intravenous opioid policy and protocols which give clear guidelines on when and how often to administer analgesia. Education is also currently underway around the recording, interpretation and management of pain, and when to seek further guidance and review.

b) A patient education pamphlet that explains how to utilise a PCA has been introduced.

Orthopaedic Department audit

a) Education was provided to registrars and house officers in the Orthopaedic Department on 20 February 2014 to support improved surveillance of indications of compartment syndrome.

b) On 1 April 2014, a specialised orthopaedic study day was conducted.

c) An intra-compartmental pressure monitor system[25] has been purchased and will be introduced with new training for medical staff.

d) Communication has been improved within the clinical team, including induction of new staff (particularly locums) to foster an understanding of the expectation to escalate any concerns to consultants.

e) SDHB has advised that further actions included a pain study day on 27 August 2014.

39. SDHB told HDC:

> "[C]linical staff involved in [Mr A's] care, together with the Directorate Leadership Team and Executive Management Team would like to convey our apology to [Mr A] and his family for the distress experienced."

Responses to provisional opinion

40. Mr A and his mother, SDHB and all of the relevant clinical staff, were given the opportunity to respond to relevant sections of my provisional opinion. Mr A and his mother responded and their responses have been incorporated into the report where relevant.

41. SDHB's responses have been incorporated where relevant.

Opinion: Southern District Health Board — Breach

Introduction

42. This report is concerned with the treatment provided to Mr A between 31 December 2013 and 4 January 2014 by SDHB.

43. Mr A was admitted to the public hospital on 31 December 2013 following an accident in which he sustained a midshaft fracture of his right tibia and fibula. The following day he had a rod surgically inserted in his leg, and his leg was placed in a below-knee back slab.

44. On 4 January 2014, Dr C reviewed Mr A at 8.40am and made the diagnosis of acute compartment syndrome of the anterior compartment of the right lower leg. Later that day, Mr A underwent an emergency fasciotomy of his right lower leg, and subsequently he has undergone numerous surgical procedures to his leg.

45. SDHB and the staff involved in Mr A's care had a responsibility to take all reasonable steps to ensure that Mr A received services of an appropriate standard. SDHB staff failed to monitor and assess Mr A's pain appropriately, and a lack of critical thinking by SDHB staff led to a failure to investigate the cause of Mr A's ongoing pain adequately. This resulted in a delayed diagnosis of compartment syndrome. While I

[25] A hand-held monitor for quick, accurate and continuous measurement of compartment pressure.

acknowledge that the individual health professionals who provided care to Mr A bear some responsibility for these failures, I consider that SDHB is ultimately responsible for the failures by multiple staff members to monitor, assess, and investigate the cause of Mr A's pain appropriately.

Pain assessment and monitoring

46. Following surgery, Mr A was receiving oral analgesia and, due to increased localised pain, was started on morphine via a PCA, which administered 1mg on demand with a five-minute lockout. By the afternoon of 2 January 2014, Mr A was reporting increased pain, and attempted to use the PCA 66 times, delivering 38mg of morphine. House officer Dr E was asked by nursing staff to review Mr A because his pain was increasing and he had had two temperature spikes. Dr E recorded that Mr A's pain was to be monitored overnight, and documented: "[I]f uncontrolled on PCA then call."

47. On 3 January 2014, Mr A's reports of increased pain continued. At 6pm Mr A's temperature had spiked to 38.5°C. It is noted that Mr A had not passed urine well since admission, and that the pain in his right leg was not well controlled. At 10.55pm RN G recorded that Mr A had complained of pain throughout her time on duty, and that multiple repositioning attempts of Mr A's leg had had no effect on reducing his pain. RN G further noted that the PCA had been reconnected, but that at 10.10pm Mr A still complained of pain "+++". A sedation score is not recorded despite the PCA being used. Mr A made 115 attempts to use the PCA and received 64mg of morphine.

48. At 1.14am on 4 January 2014, Mr A reported to the registered nurses that he was sore "+++". At around 1.45am, house officer Dr H was called to evaluate Mr A because of his increased leg pain. Dr H considered the diagnosis of compartment syndrome, but felt this to be unlikely because of Mr A's ability to move his toes. Mr A made 316 attempts to use the PCA and, overall, received 102mg of morphine on this day. There is no recording of an AVPU (alert, voice, pain, unresponsive) scale or sedation score.

49. My expert nursing advisor, Ms Dawn Carey, advised that an objective "pain score" tool should always be used for assessing pain and evaluating administered analgesia. She stated: "There is a lack of evidence that the nursing staff were evaluating [Mr A's] response to the analgesia that they were administering or why he was pressing his PCA so frequently." She is critical that Mr A's pain scores were not recorded consistently prior to administration of analgesia, were not re-evaluated after the administration of analgesia, and were not always assessed on movement.

50. Ms Carey also noted that there was often a lack of a sedation/AVPU score. She advised that because of this Mr A was not monitored as expected when he was using the PCA. She stated that although the UPSOC is a useful tool to enable real-time evaluation of a patient's pain experience, it is dependent on clinical staff reviewing it and evaluating the information recorded. A sedation/AVPU score, on the other hand, would have enabled a better comparison of the effectiveness of pain relief on Mr A, to determine the effectiveness of the PCA. Ms Carey advised that she was critical of the incidents where Mr A's pain scores were not recorded consistently prior to

administration of analgesia, and were not always assessed on movement, and where ticks were used to record that he had pain. I agree with Ms Carey that increasing pain over time is a cause of concern for postoperative patients. Ms Carey stated that pain assessments should be done in conjunction with movement rather than at rest, because pain upon movement is a reliable sign of compartment syndrome. I note in particular that on 3 January 2014 there were no "on movement" pain scores recorded at all. Ms Carey advised that there were departures from accepted standards of nursing assessment, monitoring and management of Mr A's pain. However, she noted that the nurses did seek prompt and repeated medical reviews of Mr A.

51. In my view, Mr A's pain assessment and monitoring, most notably by the registered nurses responsible for his care, was below accepted standards. While SDHB has implemented suitable changes following these events — in particular, intentional hourly rounding, the implementation of the ISBAR framework along with education around communicating clinical concerns, education around documenting patients' pain/sedation scores and the use of high visibility alert stickers to remind nurses of this — I am critical that such measures were not in place at the time of these events. I find that Mr A was not provided with services in a manner consistent with his needs and, accordingly, SDHB breached Right 4(3) of the Code.

Failure to investigate cause of pain

52. My expert advisor, orthopaedic surgeon Dr Alex Rutherford, advised that the surgical procedure and immobilisation of Mr A's leg with the back slab on 31 December 2013 was appropriate. However, he noted that, although some pain after surgery would be anticipated, in a fit young man with a stabilised fracture the pain relief requirement should drop off reasonably quickly postoperatively.

53. Dr Rutherford advised:

> "The standard of care for a patient with a fracture of the tibia and fibula requires that the known potential complication of compartment syndrome be looked for whenever pain is evident."

54. Mr A's pain was not well controlled postoperatively. Mr A's postoperative course from 1 January was of gradually increasing pain with increasing analgesic demands, including the repeated attempts to use the PCA, restlessness, and urine retention from 3 January. Mr A's early increasing pain levels were not relieved by any of the attempted measures such as change of cast, change of position, and increasing pain relief.

55. While Dr Rutherford advised that "the early signs of increasing pain can be misinterpreted as pain secondary to the fracture or to surgical intervention", it became apparent the day after surgery that Mr A's pain was not being relieved, and that increasing levels of narcotic analgesia were required. Dr Rutherford advised that the methods used to control Mr A's pain, namely a PCA and narcotic augmentation of this along with oral analgesia, were appropriate. However, as they proved unable to control his pain effectively, clinicians should have put measures in place to find the cause of his on-going pain, so as to be able to treat it effectively.

56. The cause of Mr A's increasing pain and distress was not investigated adequately until the ward round on 4 January 2014. Dr Rutherford advised:

> "[T]here is a clear delay from the time [Mr A's] complaints of pain should have been taken seriously and a definitive diagnosis of the cause of his increasing pain should have been made. This should have involved removal of all constricting materials on the leg followed by a measurement of compartment pressures on all four compartments. If the skills and equipment are not available to measure compartment pressures then a review by a senior member of the team is appropriate and in most cases where the diagnosis is being entertained and cannot be ruled out clinically or on compartment pressure measurement fasciotomy should be performed."

57. While I note that Dr H considered compartment syndrome at 1.45am on 4 January, and, as advised by SDHB, made the judgement that good movement of the toes made compartment syndrome unlikely, Dr Rutherford advised me that "passive movement of the toes may be misinterpreted if the patient is able to move the toes using muscles from the unaffected compartments".

58. Dr Rutherford also advised me that by the stage of Dr H's assessment of Mr A, as no diagnosis had been made of Mr A's continuing constant and increasing pain in his leg, it was wrong for Dr H to conclude that it was unlikely that Mr A had compartment syndrome. Dr Rutherford also advised that the delay in diagnosis here "cannot be attributed to [Dr H] making the wrong diagnosis as the index of suspicion and the need for diagnostic investigation should have been apparent to the Team significantly earlier". He further advised:

> "[Mr A] was examined by his Consultant on the first post-operative day and on the 3rd of January at 4pm and was reviewed multiple times by junior staff who up until the review at 1.45 on the 4th did not consider the diagnosis. I do not think there is any one individual involved in [Mr A's] care who is responsible for this delay in diagnosis, but it is a failure of the whole team to demonstrate the high index of extra suspicion that is required."

59. I agree with Dr Rutherford. In my view, the entire orthopaedic team demonstrated a lack of critical thinking. A suspicion of compartment syndrome should have been higher, prior to 4 January, when no reason for Mr A's increasing pain was evident, and appropriate investigations should have been carried out.

60. In my view, there were insufficient efforts by the orthopaedics team to investigate the cause of Mr A's pain before 4 January 2014. I consider that SDHB is responsible for this failure by multiple staff members to investigate the cause of Mr A's pain adequately, which in turn led to a delay in diagnosing Mr A with compartment syndrome. I find that SDHB failed to provide services to Mr A with reasonable care and skill and breached Right 4(1) of the Code.

Recommendations

61. I recommend that SDHB:

a) Provide a written apology to Mr A for its breaches of the Code. The apology is to be sent to HDC within three weeks of the date of this report, for forwarding to him.

b) Provide to HDC, within three months of the date of this report, a review of training provided to registered nurses in relation to pain assessment.

c) Provide an update regarding the implementation of its recommendations (outlined below), conduct a review of the effectiveness of these recommendations, and report back to this Office within three months of the date of this report, in the following areas:

i. the new early warning score observation chart;

ii. use of high visibility alert stickers to remind staff to complete pain and sedation scores to track control of pain more effectively;

iii. intentional hourly rounding;

iv. use of the intra-compartmental pressure monitor system and training around its use;

v. education around the intravenous opioid policy and protocols, which provide clear guidelines on when and how often to administer analgesia;

vi. education around the recording, interpretation and management of pain, and when to seek further guidance and review; and

vii. the use of standard framework tools to document patient progress reports.

Follow-up actions

62. A copy of this report with details identifying the parties removed, except the experts who advised on this case and SDHB, will be sent to the New Zealand Orthopaedic Association and the Royal Australasian College of Surgeons, and a copy will be placed on the Health and Disability Commissioner website, www.hdc.org.nz, for educational purposes.

Appendix A — Independent nursing advice to the Commissioner

The following expert advice was obtained from registered nurse Dawn Carey:

"1. Thank you for the request that I provide clinical advice in relation to the complaint from [Mrs B] about the care provided to her son, [Mr A], whilst he was an inpatient at [the public hospital]. I note that [Mr A] supports the complaint. 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 read and reviewed the following documentation: complaint from [Mrs B]; response and correspondence from Southern District Health Board (SDHB), [the public hospital's] clinical notes.
3. [Mr A] was admitted to [the public hospital] on 31 December 2013 following [an accident] in which he sustained a closed midshaft fracture of his right tibia and fibula. The next day he underwent surgical intramedullary nailing (IM) of the right tibia and his leg was placed in a below knee back slab. On 4 January, during a routine review by the Orthopaedic Team, [Mr A] was found to be markedly distressed due to pain. He was transferred to the operating room and underwent an emergency four compartment fasciotomy of his right lower leg under spinal anaesthesia. Acute compartment syndrome of the anterior compartment was diagnosed. Subsequent to this, [Mr A] has undergone numerous surgical procedures including debridement of all the anterior compartment muscle of his right lower leg.

I have been asked to review the nursing care of [Mr A's] pain management following his IM nailing on 1 January, and to address his mother's concerns that:

- [Mr A] was given an excessive amount of morphine over 72 hours without senior medical review.
- A PCA was restarted post-operatively one day after surgery.
- The PCA bell was hung up by nursing staff when [Mr A] reached the maximum number of PCA doses (his mother states it is recorded he pushed the button 124 times in 8 hours).
- [Mr A] was never pain-free, he was just drowsy and at times confused from the morphine.
- He was told to handle the pain despite repeatedly calling his bell asking for help.
- He was nursed in intensive care post-operatively due to his compromised respiration rate from amount of morphine/analgesia given.

4. **Review of clinical records — focussed on post operative pain reports, nursing actions and administered analgesia — and commentary**

   (i) 1 January 2014: Entries in the clinical notes (CN) suggests administered analgesia was effective in managing [Mr A's] reported pain.

Pain scores — 'at rest' — are documented on the 'unstable patient status observation chart' (UPSOC) and show a downward trend. Respiration rate and level of alertness via AVPU [A=alert, V=responds to voice, P=responds to pain, U=unresponsive] score are recorded. Whilst the 'key' to the AVPU score has not been submitted I have presumed that the recorded 0=alert. As opioids depress the central nervous system, I agree that monitoring of respiration rate and level of sedation/alertness is required.

Medications: Morphine PCA pump 1mg 'on demand' with a 5 minute lockout (Protocol A), 39 doses delivered vs 53 demands.

Paracetamol 1g given 4.30pm.

Tramadol 100mg given 1.30pm, 7.35pm.

(ii) 2 January 2014: Evening CN entries report [Mr A] complaining of increased pain and a House Officer (HO) review being sought.

(iii) The UPSOC only has two pain scores recorded — 7pm and 7.35pm. Scores are recorded for both 'at rest' and 'on movement'. Pain scores show increased pain score being reported upon movement. There is a 6 hour period when [Mr A's] AVPU or sedation score was not recorded, despite him using his Morphine PCA.

Medications: Morphine PCA pump Protocol A, 81 doses delivered vs 124 demands [stopped from approximately 1.30 to 9.45pm].

Paracetamol 1g given 2am, 8.35am, 1pm, 7pm.

Tramadol 100mg given 2.45am, 8.35am, 4pm.

MESLON 10mg given 8.35am, 7.35pm.

Sevredol 5mg given 9.30am.

Sevredol 10mg given midday, 1pm, 2.10pm, 4.15pm.

Sevredol 20mg given 7.35pm, 9.35pm.

(iv) 3 January 2014: CN entries report [Mr A] being reviewed at different times by an Anaesthetist and on-call HO. The reviews were sought due to poor pain control. [Mr A] was also reviewed by his Orthopaedic Consultant in between the additional reviews. Treatments to manage his pain included bolus doses of Morphine and prescription changes. I have presumed that the additional bolus Morphine doses — 15mg and 3mg — were administered via the PCA pump and are therefore recorded in pump totals. As [Mr A] had expressed a wish for discharge, his PCA 'was hung' for a period of time during the day and oral analgesia was used to manage his pain experience. At approximately 8.30pm due to unresolved pain he was recommenced on the Morphine PCA (Protocol B). RN documentation at 10.55pm reports him as … *c/o pain all duty …* and that the PCA was ineffective at managing his pain experience. The PCA is reported as being 'hung' again for

approximately 30 minutes as [Mr A] was more sedated … *rousable to touch* ... I note that his respiratory rate is recorded as 12, which is within the normal range for an adult.

The UPSOC has two pain scores 'at rest' recorded — 11.35am and 1.45pm. AVPU or sedation score is not recorded, despite the PCA being used.

Medications: Morphine PCA pump Protocol A, 104 doses vs 167 demands.

Morphine PCA pump Protocol B — 2mg 'on demand' with an 8 minute lockout — commenced at 9am, ?78 (difficult to read photocopy) vs 239 demands.

Paracetamol 1g given midnight, 7.30am, 1.25pm, 6.05pm.

Tramadol 100mg given midnight, 7.30am.

MESLON 20mg given 6.05pm.

Sevredol 10mg given 1.25pm, 2.30pm, 5.45pm, 7.25pm, 8.10pm.

Diazepam 2mg given 8.35pm

(v) 4 January 2014: CN documentation report the on-call HO reviewing [Mr A] in the early hours due to complaints of pain. Nursing entries report little to no effect being gained from administered analgesia. Following the morning Orthopaedic Consultant ward round, [Mr A] underwent an emergency fasciotomy and transferred to Critical Care Unit (CCU) post this. CN entry reports CCU admission as he required monitoring of ... *respiratory status given amount of oral analgesia* with *PCA prior to surgery* ...

There is only one set of recordings including 'at rest' pain score — 9/10 — prior to 9am on the UPSOC. There is no recording of AVPU or sedation score prior to CCU.

Medications: Morphine PCA pump Protocol B, 102 doses delivered vs 316 demands. Presumed to include bolus given at 1.14am.

Paracetamol 1g given midnight, 7.45am

Tramadol 100mg given 2.10am, 7.45am.

Sevredol 10mg given 8am.

Diclofenac 75mg given 2.10am

5. **Comments**

(i) In my opinion, an objective 'pain score' tool should always be used when assessing pain and evaluating administered analgesia. An objective assessment tool provides opportunities for the RN to dispel common myths about pain and analgesia; explain the role of analgesia; and evaluate whether the prescribed analgesia and dose is effective or not. Part of determining possible causes of symptoms requires an objective evaluation of the patient

response to administered interventions. There is a lack of evidence that the nursing staff were evaluating [Mr A's] response to the analgesia that they were administering or why he was pressing his PCA so frequently. I am critical of the incidences where [Mr A's] pain scores were not consistently recorded pre administration of analgesia; were not re-evaluated post administration of analgesia; were not assessed 'on movement' and where 'ticks' were used to record that he had pain. I consider that these omissions constitute a departure from the expected standards of nursing care.

(ii) In my opinion, [Mr A] was not monitored as expected when he was using a PCA — lack of sedation/AVPU score. I consider that this is a departure from the expected standards of nursing care.

(iii) I consider that [the public hospital's] 'Unstable Patient Status' OC (UPSOC) is a well designed form in relation to monitoring patients' pain scores and their use of PCA. The forms have space for recording pain 'at rest', 'on movement', delivered PCA doses, and the amount of times that the patient presses the PCA — 'total demands'. Maintaining such documentation can enable good 'real time' evaluation of a patient's pain experience and whether the prescribed opioid PCA is effective. However, the UPSOC is just a tool and dependent on clinical staff reviewing it and evaluating the information recorded.

(iv) In response to [Mrs B's] concerns —

- On 3rd January, [Mr A] was reviewed by the pain team Anaesthetist in the morning and his Consultant in the afternoon. Both these clinicians would be considered to be a 'senior medical review'. The dose and frequency of Morphine administered by nursing staff was in keeping with the prescription by the Anaesthetist. There is a lack of evidence that [Mr A's] Consultant was aware of the quantity of analgesia that [Mr A] was requiring, or 'demanding' in relation to his PCA. I note that his PCA was 'hung' when he was reviewed on 3 January. I can also not determine whether a RN was present during this review to discuss nursing concerns. In my opinion, effective patient advocacy requires the RN presence during reviews.
- Whilst I consider that the need to recommence [Mr A's] PCA one day post operatively would necessarily be a cause for concern, the trend of increasing pain disproportionate to the injury — stabilised fracture in a male with no other injuries — should have caused concern.
- I agree with [Mrs B's] concerns that her son's pain experience was worsening rather than improving. In my opinion, increasing pain over time is usually a cause of concern in all post operative patients. Patients post fracture, sprain or orthopaedic surgery are all at risk of acute compartment syndrome (ACS). For this patient group, I consider that 'pain assessment' should always be done in conjunction with movement. Pain upon movement is viewed as a reliable sign of ACS[26]. In my opinion,

[26] Altizer, L. (2004). Compartment Syndrome, *Orthopaedic Nursing*, 23(6), 391–396. Harvey, C.V. (2006). Complications, *Orthopaedic Nursing*, 25(6), 410–412.

nurses caring for orthopaedic patients should be cognisant of the signs and symptoms of ACS.

- There is no reportage supporting [Mr A] being told 'to handle' his pain, however there is certainly evidence that causes for his continuing and increasing pain were poorly evaluated.

6. **Clinical advice**

Registered nurses are accountable for ensuring that all health services that they provide are consistent with their education and assessed competence, meet legislative requirements and are supported by appropriate standards[27]. In my opinion, there were mild–moderate departures from the expected standard of nursing assessment, monitoring, and management of pain. RN standards require more than continuing to administer ineffective interventions without critical thinking. Mitigating my criticism is the prompt review and repeated reviews that the nursing staff sought for [Mr A].

I acknowledge that the SDHB response recognises that there were team failures in care provided to [Mr A] and I agree. I note and agree with the SDHB response that the nursing care provided to [Mr A] could have been improved in relation to pain management, communication strategies, escalation of concerns, and patient advocacy. I would also recommend that clinical education sessions on pain assessment and ACS are also considered."

Further expert advice was obtained from registered nurse Dawn Carey:

"1. Thank you for the request that I provide additional clinical advice in relation to the complaint from [Mrs B] about the care provided to her son, [Mr A], whilst he was an inpatient 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 agree to follow the Commissioner's Guidelines for Independent Advisors.
2. I have reviewed the response from [the public hospital] dated 6 August 2014 and my preliminary advice.
3. In my preliminary advice I considered that the nursing care provided to [Mr A] was a mild–moderate departure from expected standards in relation to assessment and management of pain, and monitoring of a patient when using a PCA. The specifics of my criticism are detailed in section 5 of my preliminary advice.
4. The provider response provides commentary from Consultant Orthopaedic Surgeon, [Dr C]. Concern was expressed that my preliminary advice does not note [Dr C's] morning ward round reviews on 2 and 3 January. As a Nursing Advisor, the focus of my clinical advice is the nursing care of [Mr A]. I noted

Miller, N.C. & Askew, A.E. (2007). Tibia fractures: An overview of evaluation and treatment, *Orthopaedic Nursing*, 26 (4), 216–223.

[27] Nursing Council of New Zealand (NCNZ), *Code of conduct* (Wellington: NCNZ, 2012). Standards New Zealand (NZS), *8132:2008 Health and disability (general) services standards* (Wellington: NZS, 2008).

events in the clinical notes that related to the focus and scope of my advice. This is recorded is section 4 of my preliminary advice — *focused on post operative pain reports, nursing actions and administered analgesia.*

The provider response provided a table detailing its analysis of [Mr A's] PCA use. It explains that the submitted recordings on the 'Unstable Patient Status' (UPS) chart had ongoing cumulative totals for [Mr A's] Patient Controlled Analgesia (PCA) Morphine pump and that I reported these 'totals' in my preliminary advice as if per day. I accept the difference. While cumulative totalling still does not balance the figures recorded on the UPS and the figures provided in the additional provider response, both of our reported figures do illustrate that [Mr A] was pressing his PCA button more frequently than the pump was set to administer analgesia. Nursing staff were also administering opioid and non-opioid oral analgesia — MESLON, Sevredol, Tramadol, Paracetamol — at regular intervals. I expressed criticism of lack of pain assessment and analgesia being administered without evaluation of its effectiveness. I also expressed criticism of inadequate monitoring — lack of sedation/AVPU score — when [Mr A] was using a PCA.

The provider also used a different term 'attempts' to identify [Mr A] pressing his PCA pump during the 5 minute 'lock out' period while I referred to these occasions as 'demands'. In my opinion, either 'demands' or 'attempts' are valid terms, in so far as they relate to a patient pressing the PCA button.

I note and agree with the education and care improvement initiatives that [the public hospital has] completed in response to this complaint.

5. Following a review of the additional response, I remain of the opinion that there were mild–moderate departures from the expected standard of nursing assessment, monitoring, and management of pain in this case.

Dawn Carey (RN PG Dip)
Nursing Advisor
Health and Disability Commissioner
Auckland"

Appendix B — Independent clinical advice to the Commissioner

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

"You have asked that I provide expert advice to the Commissioner on [Mr A's] complaint about the care he received at [the public hospital]. In addition to my general comments on care provided to [Mr A] you have asked me specifically to answer the questions below.

1. Based on [Mr A's] complaints of pain and temperature spikes, should he have been reviewed by a Registrar or Consultant earlier?

2. Was it reasonable for the House Officer to conclude that it was unlikely [Mr A] had compartment syndrome on examination at 1.45am on the 4th of January 2014?

3. Was [Mr A's] pain appropriately managed, and should the Anaesthetic Pain Team have been involved in [Mr A's] care after initial review on the morning of 3rd of January 2014?

4. Do I agree with the SDHB urgent audit findings?

I have been provided with complaint letters from [Mr A] and his mother, the initial response to HDC from the SDHB dated 14 March 2014 including the audit report of the 8th of January 2014. Also a further response to HDC from the SDHB dated 7th of April 2014 and [Mr A's] clinical file from the SDHB and his file from [another] DHB.

Complaint Background

[Mr A] was admitted to [the public hospital] on the 31st of December 2013 following [an accident] in which he suffered a midshaft fracture of his right tibia and fibula. This was initially immobilised in a plaster back slab and the following morning he underwent closed intramedullary nailing of the tibia. The leg was placed in a below knee back slab with a view to keeping the ankle dorsiflexed.

The following day [Mr A] had increasing localised pain and was started on a PCA pump that night. Over the next two days [Mr A's] pain levels increased and he was reviewed by the Anaesthetic Pain Team at 8.40am on the 3rd of January at which time [Mr A] complained of tightness around the ankle and the bone feeling sore. It was noted that he was able to move his toes and he had normal lower limb sensation in the foot. An increased level of analgesia was prescribed.

He was seen by the House Surgeon multiple times during the day of the 3rd with complaints of unrelieved pain and requiring catheterisation because of the inability to pass urine.

[Mr A] was again reviewed on the morning of the 4th of January at 1.45am because of unrelieved post-operative pain and although the diagnosis of Compartment syndrome was considered at that stage, it was felt unlikely because of his ability to move his toes. On the ward round on the 4th of January the Orthopaedic Team found [Mr A] in marked distress due to pain and urgently took him to theatre for a presumed diagnosis of compartment syndrome. At surgery compartment syndrome involving the anterior compartment was confirmed and all

four compartments in [Mr A's] lower leg were decompressed. Subsequently it has become clear that all the muscle in the anterior Compartment of the lower leg has been non-viable.

[Mr A] has undergone numerous surgeries in [two] Hospitals to debride the non-viable muscle in the anterior compartment.

Opinion

[Mr A] suffered a fracture of his mid shaft of tibia and fibula on the 31st of December 2013. His subsequent management of immobilisation of the fracture and subsequent internal fixation with closed intramedullary rod the following day was appropriate. Immobilisation of the leg with a back slab to maintain the ankle in a neutral position was also appropriate.

It was anticipated that there would be some pain after surgery related both to the original fracture and to the surgical manipulation and narcotic relief given for this pain, was again appropriate. It is anticipated however that in a fit young man with a stabilised fracture that pain requirements should drop off reasonably quickly post operatively. Once it was apparent that [Mr A's] pain was not being relieved and increasing levels of narcotic analgesia were being required, it is imperative that a diagnosis of the cause of that pain be made.

Compartment syndrome is an evolving condition in which the pressures within a myofascial compartment increase usually after trauma. This may come on gradually, but as pressures increase so does pain as the blood supply to the involved muscle diminishes and ischaemia sets in. It requires a high level of suspicion as the appropriate treatment is to decompress the compartment before significant ischaemia has occurred.

Pain is the primary symptom of pending compartment syndrome and other signs such as pain on passive movement of the toes may be misinterpreted if the patient is able to move the toes using muscles from the unaffected compartments.

There is no doubt that the increasing pain requirements and distress displayed by [Mr A] should have led to review by a Registrar and/or Consultant at an earlier stage.

The House Surgeon who reviewed [Mr A] at 1.45am on the 4th did at least consider compartment syndrome. He made the judgment that good movement of the toes made compartment syndrome unlikely. As mentioned above this can be misconstrued if normal compartments are functioning giving some movement of the toes without necessarily affecting the ischaemic compartment.

The overall picture of [Mr A's] post-operative course is one which there has been gradually increasing pain with increasing analgesic demands, restlessness, urinary retention and finally concerns of respiratory depression all building up to a crescendo on the evening and early morning of the 3rd of January. A diagnosis as to the cause of this increasing pain and distress has not been made until the ward round of the 4th of January where it was clear that there was evidence of an established compartment syndrome.

The diagnosis of developing compartment syndrome is obvious in hindsight, whereas the early signs of increasing pain can be misinterpreted as pain secondary to the fracture or to surgical intervention. Notwithstanding the above however there is a clear delay from the time [Mr A's] complaints of pain should have been taken seriously and a definitive diagnosis of the cause of his increasing pain should have been made. This should have involved removal of all constricting materials on the leg followed by a measurement of compartment pressures in all four compartments. If the skills and equipment are not available to measure compartment pressures then review by a senior member of the team is appropriate and in most cases where the diagnosis is being entertained and cannot be ruled out clinically or on compartment pressure measurement fasciotomy should be performed. On occasions this may result in fasciotomy being performed unnecessarily, but the morbidity from a fasciotomy performed unnecessarily is minimal as against the morbidity of fasciotomy not being performed at all or at such a late stage that muscle necrosis has occurred.

Was it reasonable for the House Officer to conclude that it was unlikely [Mr A] had compartment syndrome on examination at 1.45am on the 4th of January 2014?

[Mr A] continued to have pain on the evening of the 3rd of January sufficient to warrant the night House Surgeon to review him at 1.45 in the morning. This Doctor documents that there has been ongoing sharp constant pain, but the heart and respiratory rate were normal. There was satisfactory movement of the toes and sensation was intact. This Doctor has made the judgment call that compartment syndrome was unlikely.

Again with the benefit of hindsight there has been no diagnosis made of [Mr A's] continuing constant and increasing pain in his leg thus it was wrong to conclude that it was unlikely that [Mr A] had a compartment syndrome. The delay in diagnosis here however cannot be attributed to the night House Surgeon making the wrong diagnosis as the index of suspicion and the need for diagnostic investigation should have been apparent to the Team significantly earlier.

Pain Management

[Mr A's] pain was not able to be controlled effectively largely because of the developing compartment syndrome. The modalities used for his pain control namely a PCA, narcotic augmentation of this along with oral analgesic were appropriate, but again it should have mandated that diagnostic measures were put in place to find out the cause of his ongoing pain. The Pain Team offered to do a sciatic nerve block which might have been quite effective in relieving [Mr A's] pain, but would have further delayed the diagnosis of compartment syndrome. Furthermore [Mr A] was reviewed later that afternoon by the Orthopaedic Consultant who should have been aware of the analgesic requirements of [Mr A] at that stage.

Southern DHB Audit

The SDHB's audit findings are:

1. The need for House Surgeon and Registrar training regarding the recognition of compartment syndrome and the need for a high index of suspicion.

2. The need for free communication between not only the medical, but nursing and medical team members regarding patients who are unstable or not responding to management intervention. There should be no reluctance on the parts of individuals to contact other team members under any circumstances.

3. The need to have a second compartment pressure monitor device readily available to the Orthopaedic Registrar, staff and emergency room staff. I agree totally with these findings.

Standard of Care

The notes provided to me show clearly that [Mr A] has had early increasing pain levels which have not been relieved by any of the measures such as change of cast, change of position and increasing pain relief. There have been no diagnostic manoeuvres performed to ascertain the cause of [Mr A's] pain up until the day of the 4th of January when it was evident that he had well established compartment syndrome. Subsequently after decompression of all four compartments it had become obvious that the entire muscle of the anterior compartment of his leg had become necrotic and required debridement. He is left with a significant disability as a result.

The standard of care for a patient with a fracture of the tibia and fibula requires that the known potential complication of compartment syndrome be looked for whenever pain is evident and should there be evidence of impending compartment syndrome prompt fasciotomy performed to avoid the long term sequelae that [Mr A] unfortunately has suffered.

There is therefore a departure from the standard of care which I regard as moderate.

Diagnoses which are glaringly obvious in hindsight are not always so clear at the time and I note that [Mr A] was examined by his Consultant on the first post-operative day and on the 3rd of January at 4pm and was reviewed multiple times by junior staff who up until the review at 1.45 on the 4th did not consider the diagnosis. I do not think there is any one individual involved in [Mr A's] care who is responsible for this delay in diagnosis, but it is a failure of the whole team to demonstrate the high index of extra suspicion that is required.

[Mrs B] in her complaint letter made the very valid points that the most significant symptom of developing compartment syndrome is pain, more intense than would be expected and that numbness and paraesthesia are late signs of compartment syndrome.

[Dr C] in his post-operative instructions advises 24 hours IV antibiotics, neurovascular observations, elevation, weight bearing as tolerated, sutures out in two weeks' time, X-rays the following day. This I would suggest is a standard post-operative protocol used throughout the country for similar conditions. These instructions however do not require the team to look for signs of increasing compartment pressure however nor do they mandate diagnostic measures be instituted if pain is not relieved by change of position, splitting of casts etc."

Further advice received on 16 December 2014

"I have read the response provided by [Southern] DHB and feel that the DHB has made the appropriate changes to ensure as much as possible that this failure of care will not happen again. I have no reason after reading this response to change the advice given previously nor does the report raise any further issues."