QUEENSLAND COURTS

OFFICE OF THE STATE CORONER

FINDINGS OF INVESTIGATION

CITATION:	Non-inquest findings into the death of SM
TITLE OF COURT:	Coroner's Court
JURISDICTION:	Brisbane
DATE:	26 May 2015
FILE NO(s):	2014/2408
FINDINGS OF:	Ainslie Kirkegaard, Acting Coroner
CATCHWORDS:	CORONERS: Investigation, health care related death, failure to recognise and respond to clinical deterioration, surgical patient, venous thromboembolism (VTE) risk management, oxygen prescribing, clinical handover, root cause analysis

SM died on 7 July 2014 in a large regional hospital. He was 32 years of age at the time of his death. His death was reported to the coroner as a health care related death.

SM's death was initially reported to the coronial judicial registrar for review. The report referenced a recent surgical procedure (appendectomy) performed on 1 July when SM was admitted to the regional hospital's emergency department and diagnosed as suffering from a ruptured appendix. Preliminary investigation of SM's death identified clinical management issues warranting further coronial investigation.

SM's medical history and admission to hospital

Review of SM's medical records shows his only recorded medical history relates to a recent ankle injury and a history of intellectual disability.

On the afternoon of 1 July 2014, SM was admitted to a large regional hospital via the emergency department. He had been referred to hospital by his general practitioner with a two day history of nausea and vomiting and a less than one day history of abdominal pain. These symptoms were initially attributed to food poisoning.

An abdominal CT scan ordered by the general practitioner identified acute appendicitis with perforation and inflammatory change and he presented to the hospital on an emergency basis. Significantly, at the time of his admission to hospital he informed the hospital he had sprained his ankle recently and had been taking panadol osteo.

SM was immediately referred for surgical review and commenced on intravenous fluids, antibiotics and fasted whilst waiting for review. Following surgical assessment he was booked for a laparoscopic appendectomy later that evening and admitted to the surgical ward for preparation.

SM was taken to theatre at 6:52pm where he underwent a general anaesthetic and laparoscopic appendectomy. The surgery revealed SM had four quadrant peritonitis. The appendix was perforated and was removed and the abdominal cavity was washed out and a drain inserted to prevent the build-up of fluid that may become infected.

SM was prescribed venous thromboembolism prophylaxis with mechanical prophylaxis (graduated compression stockings and intermittent pneumatic compression devices) on pre-operatively. He did not receive the first dose of chemical prophylaxis (low molecular weight heparin) post-operatively until 8:00am the following morning.

SM was returned to the orthopaedic ward before midnight that evening and remained on low flow oxygen. In the early hours of 2 July he had continuing tachycardia and hypotension. His calves were checked and noted to be soft, and intravenous fluids were increased.

It was planned to get him mobilising on 2 July. He had not been mobilising around the bed much and needed encouragement to do other physiotherapy exercises (especially deep breathing exercises). The tubing for the drain was noted to be a bit twisted under the dressing and was re-dressed on 2 July to fix this.

SM had abdominal pain on 2 & 3 July that was otherwise improving although his abdomen was mildly distended.

On 3 July he showered himself sitting on a shower chair. He was noted later in the day to have low oxygen saturations (84-85%) and required oxygen via a mask to maintain his saturations at 97%.

In the early hours of 4 July SM complained of increasing generalised abdominal pain and his abdomen was noted to be distended. He was assessed as suffering from post-surgical ileus (the bowel had not resumed its normal behaviour) and a naso gastric tube was inserted leading to improvement in his condition.

Over that day and evening nursing staff and physiotherapists documented periods of moderate hypoxia when he removed his oxygen.

A physiotherapy review that day noted SM was using poor technique with the deep breathing exercises, his oxygen dependent saturation and that he was mobilising to the shower. The physiotherapist recommended that SM should mobilise with an aid and with assistance. The records show that TEDS (vasocompressive stockings) were in place that day.

SM was reviewed on 5 July by the weekend surgeon who noted the possibility of aspiration in and around operation time as an explanation for SM's continued low oxygen saturations. He continued to display tachycardia, abdominal pain and mild hypoxia. He continued to have low oxygen saturations the next day. His sharp sided abdominal pain was attributed to the bowel not yet resuming its normal function.

SM was considered to be improving when reviewed the next day as his pain levels had decreased. The surgical drain was removed but he continued to be dependent on supplemental low flow oxygen.

It seems that SM's bowel function had resumed normal function by the morning of 7 July. At around 8:35am, while mobilising to the bathroom with a staff member, SM said he felt dizzy. He was sat on a mobile shower chair and then suddenly become unresponsive. A medical emergency team attempted but despite emergency resuscitation efforts, SM was unable to be revived.

At the time it was presumed he had suffered an acute large pulmonary embolus.

Autopsy findings

An external examination and full internal autopsy (excluding the head) were performed on 10 July 2014. The autopsy revealed a large saddle embolus in the pulmonary trunk, originating from deep vein thrombi in the right calf (which was noted to be 2.5cm larger than the left calf) which the pathologist considered caused the death. Microscopic examination showed changed in the both the embolus and deep vein thrombi consistent with a few days' duration.

There was no evidence of active peritonitis in the abdominal cavity. There was residual chronic inflammation in the area where the appendix had been removed.

The pathologist identified SM's post-operative state, previous infection/inflammatory state obesity and immobility as risk factors for the development of deep vein thrombosis.

Independent clinical review

Taking these findings into account, the focus of the coronial investigation was the appropriateness of the identification and management of SM's risk of developing venous thromboembolism.

An independent doctor from the Department of Health Clinical Forensic Medicine Unit reviewed SM's hospital records. The reviewing doctor noted that SM was receiving prophylactic doses of the blood thinner heparin as 5000U subcutaneously twice a day during his admission and was wearing graduated compression stockings. This was considered to be appropriate protective dosing and management to reduce the risk of pulmonary embolus and deep venous thrombosis.

However, while the reviewing doctor was satisfied that SM received appropriate prophylaxis for venous thromboembolism, the management of his persistent low oxygen saturations from 3 July was not appropriate.

The reviewing doctor did not consider that the chest x-ray findings noted as a collapsed area of lung explained the persistent low oxygen saturations and SM's high oxygen requirements. The reviewing doctor would have expected the treating team undertake a blood gas analysis at some point after 3 July to assist in identifying a possible cause. In retrospect, the collapsed lung and persistent low saturations may have been explained by an earlier pulmonary embolus.

Noting SM's obesity and his recently twisted ankle and associated immobility prior to admission to hospital, the reviewing doctor suggested this may be the period in which the deep vein thrombosis and pulmonary embolism started to develop rather than during the hospital admission.

The reviewing doctor considered that earlier diagnosis of the pulmonary embolism would have resulted in consideration of full (rather than prophylactic) anticoagulation which may have changed the outcome for SM.

Outcomes of clinical review undertaken by the local Hospital & Health Service

The local Hospital & Health Service (HHS) commissioned a root cause analysis (RCA) of the care SM received during his admission. This is a systemic analysis of what happened and why and is designed to make recommendations to prevent adverse health outcomes from happening again, rather than to apportion blame or determine liability or investigate an individual clinician's professional competence. It is conducted by a review team who had no involvement in the patient's care.

The coroner received the RCA report on 5 May 2015.

The RCA concluded that SM received timely and appropriate surgical treatment and prophylaxis for venous thromboembolism (VTE) (having VTE prophylaxis commenced, mechanical preoperatively and chemical postoperatively) – the RCA

team assessed SM as a low risk for VTE, the recommended prophylaxis for this risk group being to consider low molecular weight heparin and graduated compression stockings, both of which SM received. He received twice daily heparin and had graduated compression stocking insitu throughout the entire admission. An intermittent pneumatic compression device was used intraoperatively and in the immediate post-operative period, then removed to allow SM to mobilise.

I note the RCA team's suggestion that appropriate prophylaxis would include a first dose of chemical prophylaxis either pre-operatively or intraoperatively. SM did not receive the first dose of heparin until 8:00am the next morning. However, this was not considered to be a contributing factor to his death.

I note the RCA team could find no evidence in the medical record of a documented VTE risk assessment by the treating surgical team. This represented a failure to comply with the hospital's VTE Prophylaxis procedure. Consequently, the RCA recommended undertaking a quality improvement project to improve the compliance and completion of a documented risk assessment for VTE prophylaxis.

The RCA concluded that there was a definite failure to identify a deterioration in SM's condition, the continual and unrestricted use of oxygen masked the underlying concern that an otherwise healthy 32 year old man with no medical history could not maintain adequate saturations without oxygen.

The RCA also concluded that had the early warning observation tool been completed properly, it would have flagged SM for medical review more frequently, highlighting the persistently low saturations, periods of hypoxia and oxygen use. In addition, had HHS had an oxygen administration and management procedure in place, there would have been set administrative guidelines and escalation timeframes, and SM's oxygen reliance may have been flagged early and investigated.

The RCA report contains a detailed discussion of the factors identified as contributing to SM's death:

Failure to complete early warning observation form (Q-Adult Deterioration Detection System, Q-ADDS) including correct addition of scores and clinical escalation

The RCA team noted certain observations not recorded on every occasion, some observations were not trended, some scores were not documented, on a number of occasions the scores were not added up correctly. When scores did flag at a higher level, on many occasions interventions were not documented and it was not clear if escalation occurred as per the requirements of the Q-ADDS chart.

For example, on 2 July 2014, SM scored between 4 and 6 a total of 13 times over 24 hours. Of these occasions, two scores were not documented and seven were added up incorrectly. During a four hour period in the middle of the night, SM was incorrectly scored a 3 on five occasions, only requiring low level action. When recalculated by the RCA team, SM was actually scoring between 4-6 which would have required one to two higher levels of action including consultant involvement. Due to the incorrect scoring, SM was never escalated as a patient of concern or as requiring medical review.

On 3 July, the highest SM flagged was a 4 on two occasions. However, there was a significant hypoxic event in the evening. The nursing note records that his saturations were 78% on room air but this was not recorded on the Q-ADDS form. If it had been, it would have been outside the parameters requiring a medical emergency call. The nurse encouraged deep breathing and coughing in the first instance and when this did not raise the saturations adequately, oxygen was administered via nasal prongs. SM's saturations increased to 88%, this set of observations were recorded scoring a 4 and the medical officer on for the surgical team was contacted. By the time the medical officer spoke to the nurse she had initiated higher levels of oxygen via a Hudson mask and SM's saturations were 95%. The medical officer is noted as "happy" with this but requested the saturations be monitored. SM was not escalated as a patient of concern to be monitored overnight by the Hospital At Night team. Approximately 12 hours later, SM experienced another hypoxic episode where his saturations were 80% on room air. Nursing staff documented this in the medical records and on the Q-ADDS chart, indicating that oxygen was applied via nasal prongs with saturations improving to 90% and encouraging deep breathing and spirometry. The medical team were made aware, they had just reviewed SM over one hour earlier and it appears no further medical review occurred that day.

The RCA team was concerned about the failure to use the patient deterioration detection system appropriately in SM's case.

Failure to investigate persistent low oxygen saturations

Review of the nursing documentation shows that nursing staff reported the significant desaturation episodes to medical staff. However, review of the medical documentation reveals that SM's persistent low saturations and periods of hypoxia were not mentioned in any review or assessment documented throughout the admission, other than on one occasion.

On 5 July, during a general surgical ward round, documentation was made of low saturations and decreased breath sounds at base of lungs. The clinical impression was documented as mild hypoxia, potentially due to aspiration or post-surgical atelectasis. The medical plan included mobilisation, sit out of bed all day, repeat chest x-ray and continue chest physiotherapy. There is no medical documentation regarding the low saturations. Prior to this in the early hours of 4 July, SM had been diagnosed with an ileus. A chest x-ray at this time identified lower lobe atelectasis and the Surgical Registrar ordered chest physiotherapy and triflow spirometry. It was noted that the pre-admission x-ray also noted atelectasis in the lung bases.

The RCA team considered, with hindsight, that despite evidence in the medical records and on the Q-ADDS chart of persistent low saturations and episodes of hypoxia, nursing staff reports and the patient requiring continuous oxygen for six days, this did not raise a flag with the treating team that something was not right.

During the RCA process, it was suggested that the treating team may not have had a clear picture of the extent of the persistent low saturations and periods of hypoxia due to ad hoc attendance at ward rounds and handover practices. At the time, surgical handover did not have a formal structured approach, the medical and surgical registrars on overnight give handover to team members present at the time before

finishing their shift. The surgical ward round commences but medical officers leave this round at different stages to commence theatre list or clinics, meaning the medical officer completing the ward round, including outlier patients may not have been present to directly hear the handover from night staff.

It was also suggested that having attributed the low saturations to post-operative pain, SM's reluctance to mobilise, identifying the atelectasis (this initiating physiotherapy, spirometry and encouragement to sit out of bed and mobilise) and diagnosis of an ileus on day 3, may all have shifted focus away from other potential issues including the oxygen saturations and potential deep vein thrombosis.

The RCA team noted an arterial blood gas was not done and in hindsight should have been, but it was evident that at the time hypoxia and low saturations were not under consideration by the medical team and consequently, this particular investigation was not undertaken.

Further, the RCA team noted there was no evidence that SM's VTE risk was reassessed post-operatively. His reduced mobility post-operatively should have triggered a reassessment.

Use of oxygen to manage low oxygen saturations without questioning/investigating the cause

Another area of concern identified by the RCA team was the use of oxygen – at no point during SM's admission was it documented that a medical officer requested oxygen be applied or removed. It appears that oxygen was applied and changed between low flow via nasal prongs and high flow via Hudson mask at nursing staff discretion. The RCA team considered that while it is accepted that oxygen is applied by nursing staff to increase and support oxygen saturations in the first instance, it required medical intervention and investigation to identify the underlying cause. It is documented in most cases that nursing staff reported to medical staff the significant periods of hypoxia or shifts with continual low saturations. However, there is no evidence that this raised significant concerns or action.

SM was on oxygen for the entire six days following his surgery, with the exception of a number of occasions when oxygen was removed for the shower and he desaturated requiring oxygen to be applied. The RCA team considered the administration of oxygen for SM lacked any management. This flagged the need for some formalised guidelines as the HHS does not have a procedure on oxygen management or administration. This is despite a project commenced in 2012 regarding oxygen prescribing culminating in Medication Management Committee endorsement of a project brief, procedure and medical record sticker to pilot the initiative in the respiratory ward.

Consequently, the RCA recommended the implementation of oxygen prescribing within the HHS and changes to the national Inpatient Medication Chart to facilitate oxygen prescribing.

Fractured handover process

SM was flagged with the Hospital At Night (HAN) team as a patient of concern on two occasions. The HAN team comprises senior clinical nurses, Medical Registrar and a

Medical Resident who provide a rapid response and escalation of patients requiring medical assessment and treatment overnight.

The first flag was only hours after SM's operation when he triggered medical officer review. He was reviewed by the Medical Registrar who identified an episode of tachycardia and hypotension as the cause and ordered an immediate fluid bolus and for SM to be reviewed by the treating team in the morning.

The second flag resulted in escalation to the HAN team due to pain, abdominal tension and distension. SM was reviewed by the HAN medical officer who spoke with the Surgical Registrar and instigated interventions while awaiting the Surgical Registrar's arrival. The Surgical Registrar diagnosed an ileus, inserted a nasogastic tube and made SM nil by mouth. This was the same night as the hypoxic episode of 78% but this is not documented in the review either by the HAN medical officer of the Surgical Registrar. The Surgical Registrar ordered chest physio and triflow spirometry but on review by the RCA team, this was likely in response to the chest x-ray findings which identified lower lobe atelectasis and right lower lobe collapse.

It is worth noting that SM had been an "outlier" since his admission, as he was a general surgical patient on an orthopaedic ward. For his entire admission he was only flagged as an outlier by the HAN team on three occasions over the last three days and only reviewed by HAN once.

The RCA report explains that the HAN clinical nurse consultant receives handover at commencement of their shift from the Central Patient Flow Unit (CPFU) which will identify any patients of concern, late returns from theatre, patients outlying from a specialist ward or Medical Emergency Calls. The HAN nurse then rounds on each ward to identify any additional patients not flagged by the CPFU. The RCA team noted that SM was never escalated as a patient of concern during these rounds – it was suggested that the triggers for HAN escalation at that time may not have prompted nursing staff to consider mentioning SM

The RCA report notes the HAN program is currently being reviewed including the triggers for escalation to include any patient with a Q-ADDS score of 4 or more. Had this applied during SM's admission, SM would have triggered a HAN review on a number of occasions, escalating him for closer monitoring and thorough medical handover processes, highlighting the need for the treating team to undertake further investigation of the cause of low saturations.

The RCA team was concerned that at the time of SM's admission, there was no system whereby a serious event in the preceding 24 hours is flagged so that any clinical review following the event must consider the serious event as part of their assessment and management. The proposed changes to the HAN escalation triggers would have triggered SM as a patient of concern which in turn would have been highlighted in the Patient Flow system notifying medical and nursing staff.

The RCA team also noted that SM had not been escalated to the then newly established Coordinated Care Stream Night Nurse Unit Manager. Had this occurred, it may have been the link between the ward and the HAN team. Review of the Coordinated Care Stream position will include changes such that this position will

attend the evening HAN handover to ensure effective handover of patients who will require input throughout the night.

Finally, the RCA team recommended the development and implementation of a structured clinical handover process for all specialties to encompass all shifts to ensure all staff within their specialties receive the same handover at the same time.

I note that the Chief Executive of the HHS has accepted all of the RCA recommendations.

Findings required by section 45, Coroners Act 2003

Identity of the deceased: [*de-identified for publication purposes*]

How he died: SM died from pulmonary embolism originating from deep vein thrombosis in the right calf six days after undergoing emergency surgery at a large regional hospital to treat ruptured appendicitis. I am satisfied that while the identification and management of SM's risk of developing this venous thromboembolism was appropriate, there was a definite failure by the treating team to identify and appropriately investigate the cause of his persistent low oxygen saturations. The evidence supports a finding that this failure arose from a combination of systemic issues which resulted in a failure to identify and escalate SM for earlier and more frequent clinical review. However, I am satisfied the local Hospital & Health Service has undertaken a thorough investigation of these issues (failure to use established early warning observation tool – Q-ADDS – correctly, lack of oxygen prescribing procedure, fractured handover processes) and is taking action to implement appropriate action to address them in response to the circumstances of SM's death.

When he died: 7 July 2014

Where he died: *[de-identified for publication purposes]*

Cause of death:
1(a) Pulmonary embolism
1(b) Deep vein thrombosis right calf
2 Ruptured appendicitis (surgically treated)

Ainslie Kirkegaard
Acting Coroner
Brisbane
26 May 2015