CORONERS ACT, 2003

SOUTH *AUSTRALIA*

FINDING OF INQUEST

An Inquest taken on behalf of our Sovereign Lady the Queen at Adelaide in the State of South Australia, on the 24th, 25th, 26th and 30th days of May and the 22nd day of June 2011, by the Coroner's Court of the said State, constituted of Anthony Ernest Schapel, Deputy State Coroner, into the death of Rebecca Mary Lawrence.

The said Court finds that Rebecca Mary Lawrence aged 41 years, late of 1/19 Francis Street, St Agnes, South Australia died at St Agnes, South Australia on the 4th day of November 2008 as a result of acute myocardial infarction. The said Court finds that the circumstances of her death were as follows:

1. Introduction

1.1. Rebecca Mary Lawrence was 41 years of age when she died from a heart attack on the evening of Tuesday 4 November 2008. She was alone when she died.

1.2. Ms Lawrence lived on her own at Unit 1, 19 Francis Street, St Agnes. She was found dead at that address by Dr Nicholas Boon, a locum general practitioner who had been requested to attend at the premises. Dr Boon's attendance had been arranged by GP Solutions, an organisation that provides after hour locum general practitioner attendances at the homes of patients. His attendance in this instance had been in response to a telephone request made by Ms Lawrence to GP Solutions earlier that evening. Dr Boon was able to gain access to the unit through an unlocked door. He located Ms Lawrence at about 11:20pm.

1.3. Ms Lawrence had earlier that day presented with chest pain at the Emergency Department (the ED) of the Royal Adelaide Hospital (the RAH). She had been discharged with a diagnosis other than a heart attack. But it is clear that she had

experienced a heart attack by that time. After her discharge, she continued to experience symptoms during the course of that day and this had resulted in her calling a telephone health advisory service in the first instance and then GP Solutions.

1.4. Ms Lawrence's death was quite unexpected. She was only 41. She had no significant past medical history. A post mortem examination was conducted by Dr Karen Heath who is a forensic pathologist at Forensic Science South Australia. Dr Heath found that Ms Lawrence had died of an acute myocardial infarction, more commonly known as a heart attack. A number of anatomical findings made by Dr Heath are of significance. The deceased had a greater than 90% occlusion of the proximal portion of the left circumflex coronary artery. This artery supplies blood to an important area of the heart muscle, the myocardium. The artery was effectively blocked. The blockage had caused damage to the heart muscle which had in turn led to a cardiac arrest and death. The remaining coronary arteries showed minimal atheroma and blockage. Histological examination of the occluded artery showed features suggestive of a condition known as giant cell arteritis. Coronary artery atheroma and giant cell arteritis can both predispose to the development of a thrombus that might block a coronary artery. The reason for the disease and blockage found within Ms Lawrence's left circumflex coronary artery would have made no difference in a diagnostic exercise involving a suspected heart attack.

1.5. Coronary artery disease had not been diagnosed during Ms Lawrence's lifetime. Specifically, giant cell arteritis had not been diagnosed. Other than giant cell arteritis, which was a silent condition in her case, the only factor that may have predisposed Ms Lawrence to coronary artery disease was a history of smoking of approximately 6 to 7 cigarettes per day over a period of about 20 years. She had quit smoking approximately 3 years prior to her death. Although there was some history of heart disease in Ms Lawrence's family, the nature of this disease would not have been relevant to any diagnosis of Ms Lawrence's coronary artery disease or in respect of an acute heart attack. There was no evidence during Ms Lawrence's lifetime of any other predisposing factors such as diabetes or high cholesterol.

1.6. The second significant finding at autopsy was that histological examination of the lateral wall of the left ventricle, which is one of the chambers of the heart, showed changes of acute myocardial infarction of approximately 12 to 24 hours in age. Infarction is damage to the heart muscle through lack of blood supply due to blockage

of the supplying artery. The lateral wall of the left ventricle is supplied by the left circumflex coronary artery which was the diseased coronary artery in Ms Lawrence's case. Thus there is a clear connection between the blockage of that artery and Ms Lawrence's recent and acute myocardial infarction and death.

1.7. I accept Dr Heath's report verified by affidavit[1] that Ms Lawrence's cause of death is acute myocardial infarction.

1.8. As to the time of Ms Lawrence's death, records demonstrate that she had phoned GP Solutions at 8:57pm. As alluded to earlier, she was found by Dr Boon at about 11:20pm. Therefore, Ms Lawrence died sometime between 8:57pm and 11:20pm. It is not possible to pinpoint the time of death any more accurately than that.

1.9. The age of the damage to the heart muscle in this particular case had significant potential diagnostic consequences. Having regard to the histological evidence that showed changes of acute myocardial infarction of approximately 12 to 24 hours in age prior to her death, a conclusion is available that the actual damage to Ms Lawrence's heart muscle had occurred probably no later than 12 hours prior to the time she was last known to have been alive, which was just before 9pm on the evening in question. It follows that the damage to Ms Lawrence's heart in the form of a myocardial infarction had occurred by approximately 9 o'clock that morning. Her presentation to the ED of the RAH took place after that and yet she was not diagnosed as having experienced a heart attack. This failure to diagnose had extreme consequences in Ms Lawrence's case.

1.10. In a clinical setting a myocardial infarction may be detectable by way of blood tests. I need only refer here to a test that is known as the Troponin T test. The Troponin T test is able to detect within the bloodstream evidence of myocardial damage. However, evidence of such damage in the form of enzymes released into the bloodstream is usually only revealed a number of hours after the myocardial damage is sustained. It is for this reason that an initial blood test for Troponin T may not show any evidence of a myocardial infarction. However, when the test is repeated some hours later, evidence of myocardial damage should be revealed. If in Ms Lawrence's case she had been subjected to a Troponin T test during the afternoon of

[1] Exhibits C3 and C3a

the day of her death, evidence of the myocardial infarction sustained to that point in time probably would have been detected. She was not given that second test.

2. Background and reason for Inquest

2.1. Ms Lawrence was employed as a Laboratory Supervisor for the Leukaemia Unit at South Australian Pathology. As it so happens SA Pathology is housed in the same building as the RAH. Ms Lawrence was at work during the morning of Tuesday 4 November 2008, the day of her death. During the course of that morning she was observed by colleagues to be distressed. She told her colleagues that she was in pain and that the pain was across her chest. She told a colleague, Ms Rudzki[2] that she had experienced the pain on a couple of occasions on the weekend but that it had passed.

2.2. Ms Rudzki went with Ms Lawrence to the ED of the RAH. Ms Rudzki remained with Ms Lawrence until she was discharged mid afternoon.

2.3. Ms Lawrence was seen by nurses and medical staff at the ED of the RAH to whom she described symptoms that included chest pain that involved a burning sensation across her throat. She described to staff two similar episodes over the weekend that had woken her but which had quickly resolved in about a minute. The present episode was described as being much more severe and was described by her as being 7/10 in terms of pain severity. The episode had lasted approximately 30 minutes. Ms Lawrence was subjected to a number of tests that included an ECG and blood tests including a single Troponin T test. These tests were administered with a possible cardiac origin of her pain in mind. The results of these tests were regarded as negative and that is certainly the case in respect of the Troponin T test. More of the ECG result later.

2.4. Ms Lawrence was ultimately discharged from the ED of the RAH that afternoon. She was provided with a discharge letter that described her presenting problem as having been CVS-CHEST PAIN-FOR LAST HOUR TIGHTNESS RADIATES TO NECK. The letter suggested that her diagnosis was unspecified chest pain but that it was thought that the burning sensation was due to reflux and that no cardiac cause could be identified. There was also a suggestion in the letter that in due course she should be seen as an outpatient once her family medical history had been clarified.

---

[2] Exhibit C5a

2.5. Ms Rudzki accompanied Ms Lawrence back to their lab at SA Pathology. Ms Lawrence told Ms Rudzki that the doctors thought that she may have been suffering from gastric reflux for which they had given her Somac. Ms Lawrence decided to go home. It appears that she arrived home in the mid to late afternoon. Ms Lawrence remained at her St Agnes unit from that time forward, except for the possibility that she may have left her premises at one point to obtain Gaviscon, a gastric preparation that can be purchased without prescription.

2.6. It is evident that during the course of the evening Ms Lawrence continued to experience symptoms. On two occasions she telephoned Healthdirect Australia to obtain some advice about her condition. The first call commenced at approximately 7:12pm. The second call commenced at approximately 8:35pm. The calls were received by two different operators, both of whom appear to have been registered nurses. As I understood the evidence this service does not actually provide medical intervention. Rather it provides advice as to the course of action that a person might take having regard to their reported symptoms. I shall come to the details of these calls in a moment because, fortunately, there are sound recordings of each call. Suffice it to say at this stage, although Ms Lawrence reported further episodes of chest pain and appeared concerned, neither of the calls resulted in Ms Lawrence seeking any further urgent treatment such as might have been provided by ambulance conveyance or personal presentation to a hospital ED. It appears that as a result of the first call she left her premises and bought the Gaviscon.

2.7. At about 8:19pm, which was between the two calls made to Healthdirect Australia, Ms Lawrence emailed an acquaintance by the name of Samantha James in which she stated that she had been to 'casualty' that morning with chest pains but that they had performed many tests and had not found anything wrong with her except that it must have been reflux. She referred in the email to episodes since the previous Friday night. She also referred to the fact that she had telephoned a health care line and they had suggested that she try Gaviscon. She mentioned in the email that she had just gone out and bought that product but that there had been no improvement. She said that she would probably see a doctor the following day, if not that night.

2.8. In fact Ms Lawrence telephoned GP Solutions at 8:57pm and it was during this call that an arrangement was made for the doctor to attend her unit. That doctor would be Dr Boon. By the time of his arrival at Ms Lawrence's home she was deceased.

2.9. In this Inquest I examined the circumstances in which Ms Lawrence had presented at the ED of the RAH and in which she had been discharged without any diagnosis of a cardiac nature when undoubtedly her symptoms at that point in time had been cardiac related. In the course of my examination of that issue I investigated whether all relevant protocols and procedures, and all necessary and routine tests, had been administered prior to her discharge.

2.10. I also examined the circumstances in which Ms Lawrence made the three telephone calls to two different services and the circumstances in which Ms Lawrence unfortunately did not elect to seek more urgent medical treatment than what could be provided by the GP Solutions locum service.

3. The RAH 'Suspected Ischaemic Chest Pain Management Guidelines'

3.1. At the time with which this Inquest was concerned there was in existence, for use in the RAH ED, a document entitled RAH Suspected Ischaemic Chest Pain Management Guidelines (the RAH Guidelines). This document was tendered to the Inquest[3]. There is an updated version of this document which was also tendered to the Inquest[4]. The RAH Guidelines document consists of a chart that sets out the various pathways of examination and treatment in the management of chest pain. The chosen pathway of examination and treatment depends upon the level of risk of a cardiac event at which the patient is perceived to be. The RAH Guidelines differ from those utilised by other hospitals and services, such as the Flinders Medical Centre protocol[5] and the ICCnet protocol[6], in that the RAH Guidelines contain what can be described as a 'very low risk' pathway of examination and treatment. Ms Lawrence came to be evaluated and discharged by reference to this pathway.

3.2. All of the various pathways under the RAH Guidelines involve one or more ECG tests and at least one Troponin T test. With the exception of the very low risk pathway, all pathways involve repeat Troponin T tests. This is due to the fact that, as alluded to earlier, myocardial damage may not become apparent in the bloodstream for several hours after the damage is sustained. Where a patient is regarded as being at very low risk, it will mean that only one Troponin T test will have been administered prior to discharge. A patient will not be regarded as being at very low risk unless both the

[3] Exhibit C13a
[4] Exhibit C16
[5] Exhibit C18
[6] Exhibit C12

ECG and Troponin T tests are negative. Additionally, for the patient to be regarded as being at very low risk and therefore suitable for discharge, the 'very low risk criteria' as identified in the RAH Guidelines must also be satisfied. These criteria are set out in the box below.

A. Very Low Risk Criteria

The absence of all the +ve LR features and the presence of 2 or more of -ve LR features = very low risk. *(See below)*

Positive Features	LR+
• Radiation to both arms	7.1
• Age >80 years	3.5
• 3rd heart sound	3.2
• Radiation to right shoulder	2.9
• Radiation to left arm	2.3
• History of MI	2.3
• Cardiovascular risk factors including diabetes	
• Previous known Coronary Artery Disease (CAD)	

Negative Features	LR-
• Clearly pleuritic chest pain	0.2
• Pain clearly reproducible with palpation	0.2
• Sharp or stabbing pain	0.3
• Positional chest pain	0.3

The box contains a list of positive features and negative features that are designed to assist the clinician to assess the risk of the patient's chest pain being of a cardiac origin. All of the positive features must be absent for a patient to be classed as very low risk. If one of the positive features is present, then the patient should not be classed as very low risk and they will be subjected to one of the other diagnostic pathways under the Guidelines. Where all of the positive features are absent, regard must nevertheless also be had to the presence of negative features. The negative features relate to the type of chest pain as described by the patient. If two or more of the negative features are present, the patient may be classified as being at very low risk provided that no positive features are present. It will be seen from the Guidelines that a patient will not be classified as being at very low risk unless both the ECG and

single Troponin T test are negative, there is an absence of all of the positive features contained within the very low risk criteria box and there are two or more negative features present.

3.3. The Guidelines contemplate that where a patient is classified as being at very low risk, they may be discharged with referral for outpatient investigations. If a patient is not classified as being at very low risk, the patient will be admitted to a general or monitored bed for further tests and evaluation, including repeat ECG and Troponin T tests.

3.4. I heard evidence from a number of sources that, notwithstanding a disclaimer within the RAH Guidelines document itself that the information and protocols in the document are offered only as a guide to clinical practice, the protocols and guidelines were meant to be followed. As will be seen presently, Ms Lawrence's evaluation pursuant to the Guidelines was flawed in two different respects.

4. Ms Lawrence's presentation to the Emergency Department of the RAH

4.1. Ms Lawrence is recorded as having been triaged at the ED of the RAH at 11:33am[7]. A nursing assessment timed at 11:35am records her presenting complaint as 'chest pain for the last hour that radiated to the neck with burning and tightness'. Her blood pressure was elevated but this is in keeping with a level of anxiety and is not of itself diagnostic. In any case her blood pressure descended to normal levels during her time in the ED.

4.2. An ECG was performed at 11:34am. An ECG provides electrical recordings that are designed to reflect what is taking place within the heart. The ECG examines heart rhythm and may detect cardiac abnormalities such as ischaemia and acute myocardial infarction. The computer printout of the ECG reported minimal ST elevation in the inferior leads but that it was an otherwise normal ECG. A further ECG was performed at 12:36pm. The computer printout reported this ECG to indicate ST elevation but was described as an otherwise normal ECG. Both ECGs were signed off by a nurse who has written on the second ECG that there was no change from the first ECG. A single ECG might be diagnostic of a cardiac abnormality. As well, changes from one ECG to another might also be diagnostic of a cardiac abnormality.

[7] Exhibit C10, page 6

I was told in evidence that the computerised report of an individual ECG has limited utility. Rather, the ECG trace itself should be examined by an experienced clinician in order to determine whether there are any diagnostic features of the individual ECG. Furthermore, successive ECG traces should be examined for evidence of any diagnostic change between one and the other.

4.3. An X-ray was taken of Ms Lawrence's chest which reported that the heart and lungs were normal. This was not considered to be in any way significant in terms of Ms Lawrence's presentation or diagnosis.

4.4. Blood tests were also taken. According to the observation chart, the blood appears to have been taken at 12 noon[8]. The Troponin T result was reported as <0.02[9]. This is not an abnormal level and is not diagnostic. The Troponin T report states as follows:

> 'A troponin of less than 0.02ug/l in the clinical situation of possible myocardial ischaemia should be followed by a second estimation in 6 to 10 hours to exclude the possibility of an acute coronary syndrome.'

This observation is reflective of the fact that the relevant enzyme produced by myocardial infarction may not be detectable in the bloodstream for several hours after the infarction. The observation is also consistent with the relevant pathways of diagnosis and treatment as set out in the Guidelines, with the exception of the very low risk pathway. The Troponin T test was not repeated in Ms Lawrence's case.

4.5. Following Ms Lawrence's nursing assessment she was seen by a medical student working within the ED who has recorded in more detail Ms Lawrence's presentation at that point in time. This examination appears to have commenced at about 12:15pm[10]. It was recorded that Ms Lawrence presented with a burning sensation across the throat and the top of her chest after having morning tea. Two similar episodes over the weekend were described. It was on this occasion that she described the pain severity as being 7 out of 10. It is also recorded that the pain in her case was associated with her experiencing palpitations and being flushed in the face. She is recorded as having denied any nausea, dizziness, other pain, swallowing difficulties or a bitter taste in her mouth. As far as other symptomatology is concerned it was recorded that she had experienced no previous chest pain, no shortness of breath and

[8] Exhibit C10, page 24
[9] Exhibit C10, page 31
[10] Exhibit C10, page 12

no cough. It was also recorded that she had no problems with her bowels or urinary output, no abdominal pain and had no history of reflux[11].

4.6. Within the notes of this examination it is revealed that Ms Lawrence described her past smoking habit. She also expressed a belief that her mother had experienced problems with a chamber in her heart but was unsure of what the condition was called. She also said that her mother had AF, which is an abbreviation for atrial fibrillation. It is recorded that Ms Lawrence said that she had been told that the condition was hereditary and that her brothers had been tested. In the event, nothing turns on an actual family history of heart disease or a belief on Ms Lawrence's part of any such history as the medical records of Ms Lawrence's mother[12] have revealed cardiac disease of a nature that is not relevant to Ms Lawrence's clinical presentation and cause of death.

4.7. The note relating to Ms Lawrence's evaluation at this stage suggests that Ms Lawrence's chest pain had subsided. It was recorded that she was lying comfortably in bed and not in any distress or pain.

4.8. The medical student recorded a queried diagnosis of reflux.

4.9. Ms Lawrence was then examined by Dr Davinder Singh Gill. Dr Gill provided a statement to police dated 21 January 2011[13]. He also gave evidence in the Inquest. At the time with which this Inquest is concerned Dr Gill was a registrar working in the RAH ED. Dr Gill had attained his basic medical degrees from the Adelaide University in 2001. Dr Gill is now a consultant physician at the Women's and Children's Hospital ED. His sub speciality as a physician is in the field of paediatric emergency medicine.

4.10. Dr Gill asked Ms Lawrence to repeat the history that she had given to the student and he then examined her. Dr Gill formed a view that Ms Lawrence was possibly suffering from gastric reflux. He noted that Ms Lawrence's blood tests, including the single Troponin T test, were normal.

4.11. In his statement to police, Dr Gill states that the results of the first ECG test had been assessed by another doctor in the department who had written in the top right-hand

[11] Exhibit C10, page 14
[12] Exhibit C13b
[13] Exhibit C13

corner of the report a notation to the effect that the ECG demonstrated a normal sinus rhythm and that Ms Lawrence was currently experiencing no pain. In his statement Dr Gill said that he did not recall if he saw the actual printed result of the first ECG but was aware of the doctor's notations. He thought it appropriate that a medical student could conduct the initial assessment of Ms Lawrence. As far as the second ECG taken at 12:36pm is concerned, Dr Gill suggested that this also showed Ms Lawrence to be in a normal sinus rhythm and that it showed 'no changes'. This assessment is the same as that endorsed on the second ECG, apparently by a nurse.

4.12. In his evidence before me, Dr Gill stated that he himself looked at the first ECG as well as the second. Irrespective of whether Dr Gill actually examined the actual traces in either or both ECGs, he was to a degree influenced by reports in both instances that Ms Lawrence had a normal sinus rhythm. The difficulty with this, however, is that a normal sinus rhythm may well exist even in a patient who is experiencing a cardiac episode and is of itself really diagnostic of nothing. It does not eliminate the possibility of heart disease. Dr Gill volunteered in his evidence that the nurse who had endorsed the second ECG as demonstrating no change was, to his knowledge, the cardiology nurse and to that extent Dr Gill relied on that endorsement as an indication that there had been no change from one ECG trace to the other. Dr Gill explained to me that he believed that cardiology nurses are highly trained and are heavily involved in assessing patients and deciding whether or not they are at risk of ischaemic heart disease[14]. Regardless of whether or not that is the case, it would hardly absolve a medical practitioner of any responsibility personally to evaluate an ECG or series of ECGs by reference to the ECG traces and not just by reference to the printed summary at the top.

4.13. In the course of his evidence before me Dr Gill was asked to evaluate the two ECG traces. Within the first ECG he identified features that he described as very subtle abnormalities but which at the time he had interpreted as being within normal limits. In his evidence Dr Gill marked on the ECG traces three features that he believed to constitute abnormalities. When asked in evidence to examine the second ECG, Dr Gill at first said that he could not '*genuinely appreciate any difference between the two*'[15]. However, he then acknowledged that the three subtle abnormalities that he said he could identify in the first ECG were no longer present in the second ECG. He

[14] Transcript, page 49
[15] Transcript, page 46

told the Court that he appreciated that a change from one ECG to the other might be of diagnostic significance when considering the possibility of a cardiac ischaemic event. He said:

> 'A change might mean that there is a dynamic process occurring, and the changes in the ECG reflect that.' [16]

He acknowledged that it was of concern to him that he had missed the changes from the first ECG to the second ECG.

4.14. Dr Gill made a number of other important acknowledgements in his evidence. Firstly, he acknowledged that the notation that there was no change in the second ECG, made by the person whom he believed to be the cardiology nurse, was not correct[17]. Secondly, he said that if on 4 November 2008 he had seen the changes from the first ECG to the second ECG he would have been alerted to the possibility of an ischaemic event. It would have made him *'worry more about an ischaemic'* event[18]. Thirdly, he acknowledged that if he had noticed the changes especially in the context of Ms Lawrence's clinical presentation, he would have referred her to the general medical team or to the cardiology team with an expectation that she would be admitted to hospital and have repeat ECG tests and repeat Troponin T blood tests done and that she may have been admitted to a monitored bed. These acknowledgements are of considerable importance as they recognise the fact that the ECG changes should have been identified at the time and that if they had been so identified, Ms Lawrence's diagnostic pathway would have dictated that a second and probable diagnostic Troponin T test would have been administered[19].

4.15. There is a further acknowledgement by Dr Gill that his state of expertise on 4 November 2008 was such that if he had noticed the differences between the two ECGs, his professional knowledge would have enabled him, even as a trainee physician, to have appreciated the significance of those changes and to have acted accordingly by referring the matter to the medical team. Dr Gill also acknowledged that he had appreciated the significance of single and repeated Troponin T testing.

4.16. The acknowledgements made by Dr Gill concerning the changes in the ECG traces as between one test and another separated by an hour, were supported by the evidence of

[16] Transcript, page 47
[17] Transcript, page 49
[18] Transcript, page 48
[19] Transcript, page 48

a cardiologist who was engaged by counsel assisting the coroner to perform an independent expert overview of Ms Lawrence's treatment. That expert was Dr Leon Zimmet. I will come to Dr Zimmet's evidence in more detail in a moment, but suffice it to say at this point that Dr Zimmet was of the view that there were significant and diagnostic changes as between one ECG and the next. The changes in and of themselves, regardless of the operation of the Guidelines, would in his view have prevented Ms Lawrence's presentation as being characterised as merely 'very low risk' and ought to have resulted in her receiving further diagnostic evaluation.

4.17. In Dr Gill's statement to police he suggested that by reference to the Guidelines his opinion was that Ms Lawrence presented as a very low risk of a cardiac episode and, accordingly, that it was appropriate to discharge her with a referral for outpatient investigation. This decision was reached after consulting one of the ED's consultant physicians. The conclusion that Ms Lawrence was at very low risk was erroneous even having regard to the text of the Guidelines. While Ms Lawrence's presentation admittedly did not involve a positive feature that would have rendered her being considered as other than at very low risk, she had failed to demonstrate at least two of the negative features. In his statement Dr Gill regarded Ms Lawrence as demonstrating one negative feature, namely positional chest pain, having regard to the fact that the pain altered upon her change of position. In his evidence before me Dr Gill acknowledged that there was no other negative feature that would have enabled Ms Lawrence to be viewed as being at very low risk. Thus by reference to the Guidelines, she should not have been discharged but should have been subjected to the usual diagnostic pathways that would have involved a second and probably diagnostic Troponin T test.

4.18. The ED physician whom Dr Gill had consulted prior to Ms Lawrence's discharge was Dr Christopher Angley. Dr Angley also gave evidence in the Inquest. Dr Angley has worked as a medical practitioner within the RAH ED for many years having progressed from being an emergency registrar to an emergency consultant. He obtained his original medical degrees from the Adelaide University in 1983. He did not examine Ms Lawrence nor did he examine the ECGs. Dr Angley acted upon Dr Gill's description of Ms Lawrence's presentation and reports by the latter that the ECG results, the chest X-ray and blood tests were all normal. Dr Angley stated in his evidence that he did not believe that in his discussions with Dr Gill he had suggested

that the Guidelines be applied[20]. In any event, Dr Angley stated that Dr Gill informed him that he did not think that the chest pain was of cardiac origin. In a note that Dr Angley made about these events on 12 November 2008 he stated that:

> 'Dr Gill and I felt that there was no serious or sinister cause for her symptoms, and there was no indication for urgent referral or admission.'

Notwithstanding the note, it is evident to me that Dr Angley, for the most part, in reality relied on the view of the patient that Dr Gill had already formed and did not in any meaningful way apply his own mind to the diagnosis.

4.19. Dr Angley did say in evidence that he may have been concerned if at the time he had gained an appreciation of the fact that Ms Lawrence's chest pain had been described in terms of 'tightness'. He suggested that such a description would be a '*bit of a red flag*'[21].

4.20. When asked to examine the ECGs, which he had not examined at the time, Dr Angley suggested that there did not appear to be any significant ST elevation in the first ECG and that in any case the first ECG was not open to easy interpretation because of a wandering baseline. He suggested that any ST depression was also of no great significance[22]. He suggested in effect that it would be difficult to regard the ECG pattern as consistent with myocardial infarction. When asked to examine the second ECG and, in particular, by comparing it with the first, he suggested that the second ECG was easier to interpret as the baseline was flatter, but suggested that he would be generally less worried about the second ECG. He regarded any changes from one to the other as '*very subtle*'[23] and suggested that the explanation for changes would be provided by the fact that the baseline wander in the first ECG had settled down. In short, Dr Angley did not believe that the ECGs were of diagnostic significance. The expert cardiologist, Dr Zimmet, was to disagree with Dr Angley's interpretation of the ECG results. I indicate here that I prefer the evidence of Dr Zimmet which I will come to in a moment.

4.21. I find that the decision to discharge Ms Lawrence was essentially that of Dr Gill. As revealed in his statement his reasons for discharging Ms Lawrence are essentially as follows:

[20] Transcript, page 102
[21] Transcript, page 105
[22] Transcript, page 110
[23] Transcript, page 112

> 'I was unsure about the exact nature of the patient's pain and consulted with Dr Chris ANGLEY who was the on duty emergency Consultant, describing the case to him. He expressed to me that he felt that a cardiac cause of the chest pain was unlikely and we agreed to discharge her home. I counselled Ms LAWRENCE and told her that we weren't certain of the cause of her pain, however gastro-oesophageal reflux was a possibility. I suggested commencing a trial of therapy for that, consisting of the oral medication Pantoprazole. I prescribed this and was aware that a take home pack of the medication was provided. I advised her that if the pain reoccurred or became more severe we would be happy to re-assess her and that she should speak to her family regarding the medical history to decide if she should subject herself to cardiac testing as an outpatient.'[24]

It is apparent from that paragraph and from Dr Gill's evidence as a whole that he was neither certain that Ms Lawrence had been suffering from gastroesophageal reflux nor certain that she was not experiencing a cardiac cause for her chest pain. Regardless of Dr Gill's actual state of certainty or otherwise as far as any diagnosis is concerned, what is clear is that the ECG results alone should have dictated Ms Lawrence's admission and further testing. As well, and quite independently of the ECG interpretation, if the Guidelines had been followed correctly this also would have dictated the same course of examination and treatment.

5. Ms Lawrence's phone calls to Healthdirect Australia

5.1. The name of this service is taken from the headings on the documentary reports relating to each of Ms Lawrence's telephone communications[25]. Mr Coppola of counsel who appeared at the Inquest on behalf of the entity operating this service informed the Court that the name of that entity is Telehealth Services.

5.2. I have already referred to these calls of which there are digital recordings[26] as well as a transcription made by the Court reporting service[27].

5.3. In each instance Ms Lawrence telephoned an operator employed by this service. In each instance it is apparent that the operator was a registered nurse.

5.4. The essential features of the first call made at about 7:12pm are firstly that Ms Lawrence made it clear that she was suffering from chest pain that 'radiated' to her

[24] Exhibit C13, page 5
[25] Exhibits C19a and C19b
[26] Exhibit C19
[27] Transcript, page 212

neck and secondly that she had already been evaluated in respect of those symptoms at a hospital. At one point she told the operator:

> 'They did a chest X-ray and an ECG and took bloods and they said it was all fine.' [28]

She explained that the possible diagnosis at the hospital had been reflux but that she did not usually suffer from either indigestion or reflux. It is plain from hearing the recording and from perusing the transcript that the operator placed some considerable weight on the fact that Ms Lawrence had been medically evaluated earlier in the day. The operator at one point said that she did not think that Ms Lawrence needed to rush out anywhere at this stage because of the fact that she had already been seen that day. She did suggest that, provided Ms Lawrence did not experience a worsening of her symptoms, she should see a general practitioner. Ms Lawrence herself suggested that she might go to the Modbury Hospital casualty department and it is clear that the operator agreed that that would be a good course of action. The operator suggested that Ms Lawrence might need to be careful, even if her symptoms did sound suggestive of heart burn. She suggested that the need to be careful was due to the fact that the pain might still be cardiac related. In that context the operator is heard to say *'but, given that you've had all those tests'* - as if to say that there was good reason to believe the tests may well have determined that her symptoms were not cardiac related. In short, while the symptoms that Ms Lawrence described in this telephone call in the normal course of events probably should have prompted the operator to advise Ms Lawrence either to call an ambulance for herself or to present at an ED, it is understandable that such advice would not have been given having regard to the revelation that Ms Lawrence had already been evaluated in a hospital setting and had undergone the usual tests. In this regard it is to be noted that Ms Lawrence had specifically said that she had undergone blood tests. A registered nurse, as the operator was, might have legitimately assumed from this that the blood testing referred to by the caller had involved repeat Troponin testing.

5.5. As for the second call at about 8:35pm Ms Holdsworth of counsel for the RAH makes the point that a typed questionnaire[29] that appears to have been referred to and utilised by the operator in the course of this call erroneously states that Ms Lawrence had indicated no symptoms of chest pain that had involved the neck as well as the chest. However, it is plain from the recording and from the transcript that Ms Lawrence

[28] Transcript, page 229
[29] Exhibit C19b

clearly indicated that she had had chest pain that went up to her neck. It is equally clear that the operator, again a registered nurse, appreciated that fact regardless of what is recorded on the document to which Ms Holdsworth refers. During this call the operator specifically asked Ms Lawrence whether the latter thought she needed an ambulance, to which Ms Lawrence answered negatively saying *'I'm alright at the moment'*.

5.6. It is true that Ms Lawrence appears to have been distressed during this second call and expressed concern that she was on her own. However, as with the first telephone conversation the operator here appears to have placed considerable significance on Ms Lawrence's earlier presentation at the RAH. The operator made specific enquiries of Ms Lawrence as to whether there had been an evaluation concerning Ms Lawrence's heart. Her enquiries included questions concerning the taking of blood pressure and blood samples, and the operator concluded by saying *'no, I don't think it's your heart because they checked everything this morning'*[30]. As with the first call, the operator as a registered nurse would not unreasonably have assumed that the usual protocols had been appropriately applied to Ms Lawrence, including repeat blood tests if necessary. On two separate occasions during this call the operator referred Ms Lawrence to different locum services, one of which was no doubt GP Solutions.

5.7. As with the first call, in the normal course of events the symptoms that Ms Lawrence described to the second operator, that included reference to a *'really bad cramp inside my chest and then it goes up to my neck'*[31], would have resulted in the operator suggesting that the caller should re-present at the hospital either by ambulance of by way of self presentation. However, the circumstances were unusual insofar as it was clear during this call that Ms Lawrence had already presented at hospital and had been evaluated and apparently cleared of cardiac disease.

[30] Transcript, page 241
[31] Transcript, page 239

6. The involvement of GP Solutions

6.1. GP Solutions is a medical deputising service that assists general practitioners to coordinate patient services after normal working hours. The entity has a number of locum doctors registered with the service. On a given night several doctors perform locum services arranged by GP Solutions throughout metropolitan Adelaide.

6.2. The service provided by a locum doctor involves an attendance at the home of the patient.

6.3. The service is usually activated by a call being made by the patient to GP Solutions operators.

6.4. The operator who took Ms Lawrence's call at 8:57pm was Rebecca Hunt. Ms Hunt gave a statement to the police dated 23 January 2011[32]. She also gave evidence in the Inquest. Unfortunately by the time witness statements were taken from her and from her supervisor, a digital recording of the telephone conversation was no longer available. However, a computerised record of the call and of the despatching of a medical practitioner to Ms Lawrence's address, and which consists of four screen dumps that have been tendered in evidence[33], was still available. Ms Hunt was neither a medical practitioner nor a registered or enrolled nurse. However, according to her statement, in February 2007 she had commenced studying medical science at the Flinders University. She also has a senior first aid certificate and an advanced resuscitation qualification. She has had experience working in clinical environments.

6.5. It is clear that locums arranged through GP Solutions do not provide an emergency medical service. Rather, calls requiring an urgent response are transferred to the ambulance service. Alternatively, the operator would strongly recommend to the caller that he or she arrange that for themselves or make their own way to hospital.

6.6. Documentation relating to the responsibilities and duties of a GP Solutions operator was tendered to the Inquest[34]. One such document concerns the prioritisation of patients and acts as a guide to urgency for non-clinical staff at GP Solutions. A Category 1 case is said to include a complaint of chest pain as made by the caller. In such as case the recommended course of action would be for a triple zero call to be

[32] Exhibit C14
[33] Exhibit C15b
[34] Exhibits C15 and C15a

made to the ambulance service. Another document that forms part of GP Solutions' documentation[35] stipulates that if a patient were to refuse referral to the ambulance service, but instead requests a doctor to attend their address, then the call is to be immediately despatched to a doctor with the call endorsed 'refused casualty' or 'refused ambulance' as the case may be.

6.7. In this particular case Ms Hunt told the Court that Ms Lawrence's request was for a doctor to come to her home in respect of her complaint of chest pain. According to Ms Hunt's witness statement, she asked Ms Lawrence a series of questions including whether she had any pain in her back, left arm and neck, and she denied pain in any of those areas. Ms Lawrence explained to Ms Hunt that she had been to a hospital where she had been diagnosed as having reflux and had been given medication for this. Ms Hunt was under the impression that the visit to the hospital had been recent. According to Ms Hunt's recollection, the reason Ms Lawrence wanted a doctor to attend at her home was that the medication she had already been given had not had the desired effect and that she wished to receive further medication and a review by a visiting doctor.

6.8. In her evidence before the Court Ms Hunt also said that she had asked Ms Lawrence whether she wanted to return to the hospital. This had been declined. She said that Ms Lawrence did not sound distressed.

6.9. In her evidence Ms Hunt also suggested that Ms Lawrence's response to whether or not she had also experienced neck pain as part of her overall presentation was in the negative. This seems rather surprising in light of the fact that she had mentioned pain radiating to her neck, not only in the hospital but also in the two previous calls to Healthdirect Australia. I am not satisfied that Ms Lawrence made any such negative indication in this call.

6.10. Ms Hunt also said that Ms Lawrence stated with some conviction that Ms Lawrence had actually been diagnosed with reflux. If this was indeed said with any conviction it is also surprising, given that in the previous calls Ms Lawrence appeared to entertain some uncertainty about that diagnosis in light of the fact that she had never had experienced any such thing in the past.

[35] Exhibit C15a, page 38

6.11. I accept that Ms Hunt did ask Ms Lawrence whether she would like to return to the hospital for a further review and that she declined. I think it likely that Ms Hunt would have asked that obvious question and I think it likely that Ms Lawrence opted for the visit by the locum doctor as opposed to going along with the suggestion that she return to the hospital or, indeed, that she should call an ambulance. The fact that there was discussion about Ms Lawrence already having been to the hospital is supported by one of the computerised notations relating to this call.

6.12. In many ways the circumstances of this call are similar to those pertaining to the earlier two calls to Healthdirect Australia. It is evident that Ms Lawrence's chosen course of action was again affected by the knowledge that she had already been to a hospital. This piece of information I find was undoubtedly imparted to Ms Hunt. In spite of reservations about some of the content of Ms Hunt's evidence as indicated above, I accept Ms Hunt's evidence that she suggested that Ms Lawrence's returning to the hospital was an option that she should consider and that Ms Lawrence declined. In my view it is likely that the reason Ms Lawrence declined the suggestion that she return to hospital was that Ms Hunt did not press the suggestion to any significant degree because there was an absence of any strong suspicion on the part of either woman that Ms Lawrence was suffering from a cardiac based condition.

6.13. I intend making a recommendation that telephone health lines and locum services of the kind that GP Solutions provides recommend to callers who seek advice about chest pain that the caller should immediately either call an ambulance or take themselves to hospital and that they should do so regardless of whether there has been any recent presentation to hospital.

7. The evidence of Dr Leon Zimmet - cardiologist

7.1. The circumstances of Ms Lawrence's death, and in particular her presentation at the ED of the RAH on 4 November 2008, were examined by an independent expert, Dr Leon Zimmet. Dr Zimmet is a cardiologist. He is a Fellow of the Royal Australasian College of Physicians and has been so since 1976. He is a co-owner of the entity known as SA Heart situated amongst other places at the Ashford Heart Centre. He was the senior visiting cardiologist at Flinders Medical Centre from 1974 to 2001 and was the senior visiting cardiologist at the Repatriation General Hospital during the same period.

7.2. Dr Zimmet examined the RAH casenotes and, in particular, the ECG traces.

7.3. Dr Zimmet told me in evidence that although the baseline in the first ECG was not stable, there was a suggestion of an inferior ST elevation in three leads, as well as ST depression in two leads. The second ECG revealed minimal ST elevation inferiorly and that the ST depression in the anterior leads had resolved. This ECG could be regarded as normal. Dr Zimmet explained, however, that the changes were of diagnostic significance. He said '*I think it would certainly suggest that the pain that was occurring was cardiac in nature*'[36]. Indeed, ECG changes together with chest pain would place the patient in the high risk category[37]. Dr Zimmet expressed the view that on the basis of the ECG findings Ms Lawrence should have been kept in hospital for further examination and testing, specifically for a second Troponin T test[38].

7.4. Dr Zimmet was especially of the view that a second Troponin T test should have been performed some hours following the first. Given the fact that upon histological examination the myocardial infarction was 12 to 24 hours old as identified at autopsy, Dr Zimmet expressed the view that a subsequent Troponin T test would have revealed evidence of a myocardial infarction. He said that in such an event a diagnostic angiogram would have established the existence of Ms Lawrence's blocked artery. A stent could then have been inserted to open up the artery.

7.5. Dr Zimmet also commented upon Ms Lawrence's symptomatology. He stated that the quality of her pain as she described it, the length of time the pain lasted and the radiating nature of the pain were in his view clinically indicative of possible ischaemic chest pain or pain due to coronary artery disease. He suggested that there were two things that can cause burning chest pain. One is a heart attack, the other is some form of oesophageal reflux. Dr Zimmet suggested that one would have to rule out a heart attack before one labelled Ms Lawrence as having reflux disease. I note here also that it is plain that Ms Lawrence had not experienced reflux in the past. It is also clear that her pain was a wholly new experience for her.

7.6. In Dr Zimmet's opinion, all of this meant that having regard to the fact that only one of her coronary arteries was affected, Ms Lawrence could have been treated

[36] Transcript, page 141
[37] Transcript, page 170
[38] Transcript, page 143

successfully. In effect, Dr Zimmet placed Ms Lawrence's chances of survival as being very high, had her myocardial infarction been identified. Dr Zimmet also suggested that there may not have been any significant deficit in Ms Lawrence's quality of life, even taking into account the damage to the heart muscle that had been sustained. He suggested that she had good prospects of recovery.

7.7. Dr Zimmet also commented upon the RAH Suspected Ischaemic Chest Pain Management Guidelines and suggested that they had not been followed. If the Guidelines had been followed, this was again reason for the patient to have been kept in hospital for further examination and, in particular, for Troponin T testing. Dr Zimmet also suggested that in any event the quality of Ms Lawrence's chest pain and the length of time it had persisted meant that Ms Lawrence could not have been regarded as being at very low risk[39].

7.8. I accept the evidence of Dr Zimmet in its entirety. In particular I prefer his analysis of the ECG tests to that of Dr Angley. Dr Zimmet is a cardiologist and his daily work involves the analysis and examination of ECGs and an evaluation of their significance.

8. Conclusions

8.1. Ms Lawrence died on 4 November 2008 as a result of an acute myocardial infarction.

8.2. Ms Lawrence presented at the ED of the RAH at approximately 11:30am on the morning of the day of her death. She had been experiencing chest pain which I find was symptomatic of an acute myocardial infarction.

8.3. Ms Lawrence was subjected to two ECG examinations taken one hour apart from each other. The two ECG examinations were individually assessed as indicating no abnormality. In addition, no diagnostic changes as between the first and second ECGs were identified.

8.4. In fact the two ECGs, when examined together, and when examined in the context of symptomatology consistent with an acute cardiac event taking place in Ms Lawrence, should have been regarded as of diagnostic significance. She should have been considered as being at high risk of her presentation having a cardiac origin. The

[39] Transcript, page 148

results of the two ECGs when examined together, and in conjunction with Ms Lawrence's symptoms, should in themselves have dictated a course of action whereby she was subjected to admission to hospital for further testing.

8.5. Ms Lawrence was also subjected to a blood examination. The blood sample was taken at 12 noon. The results of this blood test were assessed to be within normal limits. In particular, the Troponin T level was normal and not indicative of an acute myocardial infarction.

8.6. Ms Lawrence was assessed as being at very low risk of an acute cardiac event. This assessment was incorrect insofar as the very low risk criteria for her to be so characterised were not met.

8.7. As a result of the ECG and Troponin T tests being regarded as negative, and because of Ms Lawrence's erroneous characterisation as being at very low risk of a cardiac event, she was discharged from the hospital without further examination or evaluation.

8.8. Ms Lawrence should have been admitted to a general if not monitored bed in the hospital and been subjected to further examination. In particular Ms Lawrence should have been subjected to a further Troponin T test after several hours.

8.9. If Ms Lawrence had been admitted to a general or monitored bed at the RAH, and had been subjected to a further Troponin T test, there is high degree of probability that the further Troponin T test would have revealed evidence of an acute myocardial infarction having taken place.

8.10. Had an acute myocardial infarction been identified by further testing, there is a high degree of probability that the blockage in Ms Lawrence's affected coronary artery would have been identified by way of an angiogram and then cleared, with the probable result that Ms Lawrence would not have died.

8.11. Although some myocardial damage had occurred in Ms Lawrence's heart, it may not have significantly affected her quality of life.

8.12. I find that Ms Lawrence's death would have been preventable if Ms Lawrence's symptoms had been properly evaluated, the results of the two ECG examinations had

been properly understood at the time and/or that the Guidelines had been strictly followed.

8.13. Ms Lawrence's death may also have prevented if, as a result of either of the two telephone conversations she had with operators at Healthdirect Australia, she had called an ambulance to her home or had presented again at an emergency department of a hospital. If she had done either of those things, her acute myocardial infarction may well have been diagnosed and her life may have been saved.

8.14. Ms Lawrence's death may also have prevented if, as a result of the telephone conversation she had with the operator at GP Solutions, she had called an ambulance to her home or had presented again at an emergency department of a hospital. If she had done either of those things, her acute myocardial infarction may well have been diagnosed and her life may have been saved. I would add in this regard that if she had gone to hospital, and even if she had experienced her cardiac arrest there, measures that might have saved her life, such as defibrillation, would have been available. As it was, Ms Lawrence had no chance of surviving a cardiac arrest at home.

8.15. I find that the outcomes of Ms Lawrence's telephone conversations with operators at Healthdirect Australia and with the operator at GP Solutions were all significantly contributed to by Ms Lawrence's knowledge of the fact that having already been examined at the ED of the RAH that day, no evidence of heart disease had there and at that time been identified. Ms Lawrence's reluctance to seek further more urgent medical attention than what could be provided by a locum GP service was in my view probably the result of her having been reassured by that knowledge. Furthermore, the outcomes were also significantly contributed to by knowledge on the part of the telephone operators in each instance that Ms Lawrence had been so examined.

9. Recommendations

9.1. Pursuant to Section 25(2) of the Coroners Act 2003 I am empowered to make recommendations that in the opinion of the Court might prevent, or reduce the likelihood of, a recurrence of an event similar to the event that was the subject of the Inquest.

9.2. I received into evidence the affidavit of Associate Professor Geoffrey Hughes who is the Director of the Emergency Department and Director of Critical Care Services at

the RAH. Associate Professor Hughes annexed a revised version of the RAH Guidelines that were promulgated following a root cause analysis exercise conducted by the RAH in respect of Ms Lawrence's death. The affidavit goes on to explain that emergency physicians in the Department regularly teach chest pain management to resident medical officers and interns. This includes extra sessions on ECG testing which I take to mean ECG interpretation. The affidavit asserts that there are at least two consultants available between 8am and midnight, 7 days per week to provide supervision and support to junior staff.

9.3. Dr Zimmet was critical of certain aspects of the Guidelines, even as amended. He regarded it as essential that the document refer to the quality of chest pain and the duration of the pain as relevant considerations in any classification exercise relating to an assessment of very low risk. He also regarded the failure of the document to refer to coronary artery risk factors such as diabetes as an important omission.

9.4. I also heard oral evidence from Dr Robert Dunn who is the Clinical and Academic Director of the Emergency Department at the RAH with responsibility for oversight of clinical practice, education and research and the training of junior doctors and doctors training to become specialists in the field of emergency medicine. Dr Dunn explained the nature of the RAH Guidelines and made the point that they are guidelines that are expected to be followed. Dr Dunn disagreed with suggestions made by Dr Zimmet that the list of positive features within the RAH Guidelines needed to be expanded. He also disagreed with any suggestion that the very low risk pathway needs to be deleted.

9.5. I make the following recommendations directed to the Director of the Emergency Department and Director of Critical Services at the Royal Adelaide Hospital:

1) That reconsideration be given to including within the RAH Acute Coronary Syndrome - Management Guidelines for Patients Presenting to Emergency Department (Chest Pain) specific reference to risk factors such as diabetes and, in addition, to the quality and duration of chest pain as being important considerations in assessing whether patients are at very low risk;

2) That instructions be given to all medical staff working within the Royal Adelaide Hospital Emergency Department that (a) the requirements and protocols set out within the Guidelines should be strictly adhered to and, in

particular, that a direction be given to such staff to strictly adhere to the requirements of the very low risk criteria, and (b) that regardless of whether the very low risk criteria are satisfied, medical staff should only discharge patients where there is in existence an alternative explanation for their chest pain and where the explanation has a high degree of certainty;

3) That ongoing training and education be provided to medical staff regarding chest pain management, including ECG interpretation;

4) That a direction be given to junior medical staff, including registrars, that a patient who has presented with chest pain should not be discharged by virtue of the very low risk pathway unless and until (a) the patient has been examined by a medical practitioner at consultant level and (b) any ECG examination or examinations have been sighted and evaluated by a practitioner at consultant level;

9.6. I direct the following recommendations to Telehealth Services, GP Solutions and the Chief Executive Officers of any other organisations that provide similar services:

5) That telephone operators providing advice to callers or who arrange locum medical services for callers, should advise callers who seek advice about chest pain to immediately call an ambulance or take themselves to hospital and that they should do so regardless of whether there has been any recent presentation to hospital.

Key Words: Hospital Treatment; Emergency Departments; Locum Services

In witness whereof the said Coroner has hereunto set and subscribed his hand and Seal the 22nd day of June, 2011.

Deputy State Coroner