Institution: Queen Mary University of London

Unit of Assessment: A1 (Clinical Medicine)

Title of case study: Improving clinical services for coronary artery disease

1. Summary of the impact

Timmis' collaborative research group (straddling four major institutions) focuses on healthcare delivery as it affects cardiovascular outcomes. The group's research in patients with suspected angina has delivered four key impacts:

a. National implementation and validation of rapid access chest pain clinics in hospitals in England and Wales – a model that has been replicated widely in other countries;
b. Paradigm change in diagnostic testing that has informed national guidelines;
c. Identification of inequity in access to healthcare and healthcare decisions that has informed national guidelines; and
d. New research to restore equitable management of patients with suspected angina.

2. Underpinning research

2a: Background

Coronary artery disease remains the leading cause of premature death in the UK and elsewhere in the developed world. In the UK, mortality is particularly high among people of south Asian origin (Indian, Pakistani, Bangladeshi, Sri Lankan), though whether this reflects increased susceptibility to coronary disease, increased case fatality, or both, has been a subject of intense debate. Less contentious has been the benefits of treatment which, regardless of ethnicity, are greater the earlier after diagnosis it is started.

The relevance of this in east London during the 1990s, where South Asians accounted for more than a third of the catchment population, was reflected in the long waiting times for outpatient appointments in people with suspected angina and the inevitable treatment delays this implied. Timmis responded by piloting a one-stop chest pain clinic in 1995, but while this accelerated diagnosis by provision of same day testing, it did little to reduce outpatient waiting times, which were the major determinant of diagnostic delay. Timmis took the decision to abandon the conventional appointment system and instead to provide a novel open-access service, allowing patients with suspected angina a consultant opinion within 24-48 hours of referral. So was established one of the first rapid access chest pain clinics in 1997, which provided the starting point for national implementation and an extended programme of outcomes research.

2b: Multicentre prognostic validation of rapid access chest pain clinics

The electronic registry Timmis designed for the new rapid access chest pain clinic at Newham was made available to five other clinics across UK and provided the data source for an SDO-funded multi-centre validation study in 2002-4 incorporating over 8,000 patients [1]. The study showed that cumulative mortality rates over five-year follow-up were significantly higher in patients diagnosed with angina compared with non-cardiac chest pain, confirming the efficacy of rapid access chest pain clinics for risk stratifying new referrals. Less reassuring was that 32% of all cardiovascular events occurred in patients diagnosed with "non-cardiac chest pain" – often after a normal exercise ECG – indicating much scope for improving the diagnostic process.

2c: Exercise ECG for prognostic assessment in rapid access chest pain clinics

The exercise ECG has been the most widely used non-invasive test for risk assessment in patients with suspected angina. In Timmis *et al*'s multicentre study of rapid access chest pain clinics, it was used in about half of all patients. Having shown that many patients with normal exercise ECGs went on to experience coronary events, the research team undertook a new prognostic study, which on the one hand confirmed previous reports that an abnormal exercise ECG is predictive of increased risk, but on the other showed that it added almost nothing to the prognostic information provided by simple clinical assessment [2]. They concluded that better tests were needed to

improve risk stratification among patients with suspected angina, a conclusion that was soon reflected in national guidelines (see below).

2c: Rapid access chest pain clinics: inequity by gender and ethnicity

One of the group's key research findings was how inequity blights every stage of the management pathway from initial referral, through patient selection for coronary angiography, and on to patient uptake of coronary bypass surgery. Their recent ecological cohort analysis showed inequitable access to treatment in rapid access chest pain clinics [3]. They confirmed important inequity in the way patients were managed in these clinics by showing that patients appropriate for diagnostic coronary angiography, using expert criteria were only half as likely to receive it if they were South Asian or female [4]. The potential for harm was reflected in a multivariate analysis showing that patients appropriate for angiography who did not receive it were around twice as likely to suffer fatal and non-fatal coronary events compared to patients appropriately investigated.

Timmis *et al* have responded proactively to these findings by incorporating a contemporary set of appropriateness criteria into a decision tool for guiding investigation of patients with chest pain. They have conducted an electronic simulation study showing that the decision tool, blind to gender and ethnicity, contributed positively to clinical judgement [5] and are now taking this tool into the clinical setting in a NIHR-funded validation pilot. A further contribution has been an examination of the fixed beliefs of physicians about differences in the symptomatic expression of angina by ethnicity and gender. Contrary to conventional teaching, the prognostic correlates of typical and atypical chest pain in South Asians and women were no different from whites and men in a cohort recruited from the rapid access chest pain clinic, reminding clinicians that presenting symptoms should be interpreted independently of ethnicity and gender in this setting [6]. This advice has now been incorporated into international guidelines.

2e: Ongoing research

Timmis' research into chest pain clinics utilizing electronic patient records represents the start of an ongoing programme for which his group has received substantial funding. Through linkage of national electronic registries recording primary care, heart attack (MINAP), hospital admission (HES) and mortality (ONS) data the research has now extended to embrace the lifetime progression of coronary disease from first symptom to death. Exemplar studies, all in preparation for publication, include the first risk model for stable angina developed in real-world practice, analysis of inter-hospital variation in 30-day heart attack mortality and international comparison of heart attack mortality (UK vs Sweden). New grants include 2008 NIHR Improving quality of care in angina and heart attack (£1.8 million); 2008 Wellcome Insights into CVD from linking datasets (£1.2 million); and 2012 MRC eHealth Informatics (£4.3 million).

3. References to the research

Six papers listed of >30 relevant from this group 1993-2013. Queen Mary researchers in **bold**.

1. **Sekhri N**, **Feder G**, Junghans C, Hemingway H, **Timmis AD**. How effective are rapid access chest pain clinics? Prognosis of incident angina and non-cardiac chest pain in 8762 consecutive patients. *Heart* 2007; 93: 458-63.
2. **Sekhri N**, **Feder G**, Junghans C, **Eldridge S**, Umaipalan A, Madhu R, Hemingway H, **Timmis AD**. Incremental prognostic value of the exercise electrocardiogram in the initial assessment of patients with suspected angina: cohort study. *BMJ*. 2008; 337: a2240.
3. **Sekhri N, Timmis AD**, Hemingway H, **Walsh N, Eldridge S**, Junghans C, **Feder G.** Is access to specialist assessment of chest pain equitable by age, gender, ethnicity and socioeconomic status? An enhanced ecological cohort analysis. *BMJ Open* 2012; 2: e001025.
4. **Sekhri N, Timmis A**, Chen R, Junghans C, **Walsh N**, Zaman J, **Eldridge S**, Hemingway H, **Feder G.** Does inequity of access to investigation affect clinical outcomes? A prognostic study of coronary angiography for suspected stable angina pectoris. *BMJ* 2008; 336: 1058-61
5. Hemingway H, Chen R, Junghans C, **Timmis A, Eldridge S**, Black N, Shekelle P, **Feder G**. Appropriateness criteria for coronary angiography in angina: reliability and validity. *Annals of Internal Medicine* 2008; 149: 221-31.
6. Zaman MJ, Junghans C, **Sekhri N**, Chen R, **Feder GS, Timmis AD**, Hemingway H.

Presentation of stable angina pectoris among women and South Asian people. *Canadian Medical Association Journal* 2008; 179: 659-67.

4. Details of the impact

4a. National implementation and validation of rapid access chest pain clinics in hospitals across England and Wales

The rapid access chest pain clinic established and systematically evaluated by Timmis *et al* in east London led to a radical change in health policy when it became the service model for the Cardiovascular National Service Framework in the early 1990s [7]. The next decade saw a national roll-out of chest pain clinics which gradually became established in almost every hospital in England and Wales. Their prognostic validation study, which has been cited 68 times (Google Scholar), informed the NICE Guideline for Stable Angina (CG126) by providing reliable estimates of angina mortality rates [8].

Rapid access chest pain clinics are now a central component of cardiovascular healthcare delivery in the UK, and have been endorsed by the Cardiac Tsar: *"Across England, there is now a network of over 160 rapid-access clinics in which 96% of patients are seen within 2 weeks of referral…. Sekhri et al from the east London…. vindicate the development of the rapid-access model beyond the delivery of improved waiting times."* [9].

4b: Paradigm change in non-invasive investigation of chest pain

The exercise ECG had been the most widely used non-invasive test for investigation of patients with suspected angina. Timmis *et al*'s *BMJ* 2008 study, however, was instrumental in the paradigm change reflected in the NICE Guideline on Chest Pain of Recent Onset, which recommended that the exercise ECG should no longer be used for diagnosing angina, there being a newer generation of more effective diagnostic tests now available [10]. In the NICE Guideline on Management of Stable Angina that followed soon afterwards, the study informed further recommendations about use of prognostic testing in patients with angina [8]. These findings received extensive press coverage and generated considerable public interest [11].

4c: Restoring equity by gender and ethnicity to diagnosis and management of angina

By reporting relations between typicality of symptoms and prognosis by gender and ethnicity, the team's 2008 *Canadian Medical Association Journal* paper [6] destroyed the longstanding myth that symptoms are commonly "atypical" in women and south Asian patients with suspected angina. This myth has almost certainly played a damaging role in the widely reported under-treatment of women and south Asian patients, which in turn must have contributed to unnecessary morbidity and mortality.

Based on those findings, the 2010 NICE Guideline on Chest Pain of Recent Onset now states: *"Do not define typical and atypical features of anginal and non-anginal chest pain differently in men and women (or) in ethnic groups"* [10].

The findings have received strong professional endorsement. For example, Tony Delamonthe, Deputy Editor of *BMJ*, said in response to the team's 2008 *BMJ* paper: *"in some cases, it's reasonable to conclude, these inequalities kill"* [12].

4d. National recognition

Timmis' work in utilising electronic registry data for evaluating chest pain clinics has resulted in:

- 2009 – Short-listed for the BMJ Group Award for Outstanding Achievement in Evidence-Based Healthcare [13]
- 2009 – Chair NICE Guideline group for Investigation of Chest Pain [10]
- 2011 – Chair NICE Guideline group for Management of Stable Angina [8]

4e: International spread (examples)

Australia's first public rapid assessment clinic for chest pain has reduced outpatient waiting times from months to days, the clinic claims. Based at MonashHeart, in south-east Melbourne, the clinic opened in July 2012. Director, Professor Ian Meredith, said more than 1,500 patients had been treated in the 12 months of its operation. *"There are certainly instances where lives have unequivocally been saved and heart attacks have been prevented,"* he said [14].

Canada. *"Rapid assessment chest pain clinics… have proven effective in expediting consultation with reduction in hospital admissions for patients with atypical pain syndromes"* [15].

5. Sources to corroborate the impact

7. Department of Health. National Service Framework for Coronary Heart Disease: Modern standards and service models. London: Department of Health, 2000. www.gov.uk/government/publications/quality-standards-for-coronary-heart-disease-care
8. NICE Guideline 2008: Management of Stable Angina (CG126). http://publications.nice.org.uk/management-of-stable-angina-cg126
9. Boyle RM. Value of rapid-access chest pain clinics. *Heart* 2007; 93: 415-416.
10. NICE Guideline 2010: Chest Pain of Recent Onset (CG 95). www.nice.org.uk/guidance/cg95
11. Public engagement on investigation of chest pain (examples from extensive press coverage):
    - *Daily Telegraph* March 2010: NHS told to replace outdated tests that miss patients at risk of heart attacks. www.telegraph.co.uk/health/healthnews/7504376/NHS-told-to-replace-outdated-tests-that-miss-patients-at-risk-of-heart-attacks.html
    - ABC News (USA): November 2008: EKG not a strong predictor of heart disease http://abcnews.go.com/Health/Healthday/story?id=6250728&page=2
    - CBC News (Canada) November 2008: ECG tests no better than physical for predicting heart disease www.cbc.ca/news/health/story/2008/11/13/heart-ecg.html?ref=rss
12. Delamothe T. How the NHS measures up. *BMJ* 2008; 336: 1469.
13. BMJ Group Awards 2009: www.cawt.com/Site/11/Documents/News/BMJWinnersBrochure2009.pdf
14. 'Clinic cuts chest pains waiting times. *Canberra Times*, Australia. July 26 2012. www.canberratimes.com.au/national/clinic-cuts-chest-pains-waiting-time-20120725-22ras.html
15. Knudtson ML, Beanlands R, Brophy JM, *et al*. Treating the right patient at the right time: Access to specialist consultation and noninvasive testing. *Canadian Journal of Cardiology* 2006; 22: 819-24.