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RESEARCH ARTICLE

Understanding variation in patient care: A qualitative study of hospital (non-ST elevation myocardial infarction) practices [version 1; peer review: awaiting peer review]

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Abstract

Background

Variation in care is often poorly understood but has a big impact on patients. Non-ST segment elevation myocardial infarction (NSTEMI, also known as non-ST elevation acute coronary syndrome or NSTE-ACS) is the most common form of heart attack. NSTEMI is frequently hard to diagnose, its management pathway poorly defined and there is considerable variation in clinical practice.

Methods

A qualitative study based on site visits, observation, and interviews with managers, clinicians and patients. The setting was 10 hospitals in England and Wales selected to represent variation in 30-day mortality. 199 hospital staff and 68 patients were observed; 142 staff and 53 patients were interviewed. Analysis was thematic and guided by the principles of grounded theory. We triangulated interviews, observational data and medical records and interpreted these findings with reference to national guidelines.

Results

While the majority of hospitals in our sample had specialist cardiac roles, variation in their remits, specifically their involvement in close monitoring, significantly affected patient management. Close monitoring was important in the identification and prioritisation of patients. Rapid responses with diagnostic and treatment procedures were facilitated by close monitoring but also heavily dependent on

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effective and flexible bed and catheter laboratory management.

Conclusions
Close monitoring was a key area of variation. Guidelines for NSTEMI care specify what to do, but not how to do it. These findings are especially relevant for acute conditions with diagnostic and treatment uncertainty. Detailed examples of variation in care can inform quality improvement and potentially help improve patient outcomes.

Keywords
Non-ST elevation myocardial infarction (NSTEMI), monitoring, qualitative research, acute coronary syndrome, hospital mortality, quality improvement, uncertainty

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Introduction

Unwarranted variation in clinical care has been described by Atsma and colleagues (2020) as typically 'large, omnipresent, persistent, and difficult to grasp' (Atsma, Elwyn, & Westert, 2020). Variation in patient outcomes for myocardial infarction (MI) between hospitals is a consistent finding and remains after adjusting for case mix (Yeh *et al.*, 2010). Factors identified by quantitative means may partly explain these variations: high numbers of MI patients (West *et al.*, 2010), teaching hospital status (Patel *et al.*, 2007), ward first admitted to (Moledina *et al.*, 2021a), care by cardiologists (Birkhead, Weston, & Lowe, 2006; Moledina *et al.*, 2021b) and adherence to guidelines (Chung *et al.*, 2015; Engel, Damen, van de Wulp, de Bruijne & Wagner, 2017) are associated with better patient outcomes. However, residual variation in hospital outcomes for MI remains unexplained. Qualitative research examining variation in care and outcomes for patients with acute MI identified areas of care that distinguished high from low performing hospitals. These areas included organisational values and goals, senior management involvement, broad staff presence and expertise, communication and coordination among interdisciplinary teams, and problem solving and learning (Curry *et al.*, 2011).

Research investigating variation in care for patients with MI has largely focused on ST-segment elevation myocardial infarction (STEMI), where there is a complete blockage of the coronary artery. This is relatively straightforward to diagnose with electrocardiography (ECG) and has a well-defined pathway of care including effective procedural treatment: percutaneous coronary intervention (PCI/angioplasty). Timely intervention for STEMIs has been a key focus globally and there have been clear improvements in time to treatment, supported by national initiatives in the UK (Laskey *et al.*, 2010). Variation in clinical practice for STEMI patients has therefore been reduced. Non-ST segment elevation myocardial infarction (NSTEMI, also known as non-ST segment elevation acute coronary syndrome or NSTE-ACS), where there is only a partial coronary artery blockage, is more common and has a worse prognosis than STEMI if left untreated. Diagnosing NSTEMIs is often complex and involves integrating findings from the patient's full clinical history, physical examination, ECG, and repeated blood tests to check for a rise in troponin levels (a protein that is released into the bloodstream during a heart attack). The management pathway is also less straightforward for NSTEMI patients compared to STEMIs, partly due to the lengthy process of establishing a diagnosis (Darling *et al.*, 2013; Deaton *et al.*, 2016; Gambhir, 2018; Koganti & Rakhit, 2015; Shepple *et al.*, 2016; Wu *et al.*, 2018). The variation in care for NSTEMI patients across different hospitals is large and may be linked to poor outcomes for patients.

Clinical guidance can inform criteria for assessing quality of care. Guidance covering NSTEMI care includes the UK's National Institute for Health and Care Excellence guidance (NICE, 2010, 2016; NICE 2010, 2013) and the European Society of Cardiology (ESC, Roffi *et al.*, 2016). Guidance recommends an ECG as soon as possible when patients present with chest pain and continued ECG monitoring even if the initial ECG is normal. If NSTEMI is suspected, continued monitoring is recommended and for a management plan to start as soon as an NSTEMI is suspected. An angiogram, where detectable dye is injected into the arteries, can visually aid diagnosis and NSTEMI patients at most risk of having another cardiac event or of clinically deteriorating should be offered an angiogram within a short time frame (e.g. 96 hours). Treatment of NSTEMI patients may either be with medication or the 'scaffolding' of collapsed arteries with PCI/angioplasty. Again, this is time sensitive and more likely to be effective if carried out within a short time frame. Although easily overlooked in the guidance, *early and continued monitoring* is the core activity from which other actions in NSTEMI care stem.

In this study (called 'Variation In Cardiac Care' or 'VICC'), the research team examined differences in the management of NSTEMIs in 10 UK hospitals. In a previous publication related to VICC (Deaton *et al.*, 2016) we focused on the varied roles and responsibilities of specialist cardiac and advanced practice nurses involved in the care of patients with NSTEMI. In Cramer *et al.* (2018), based on the VICC dataset, we developed a theoretical argument about the 'boundary work' (Abbott, 1988; Gieryn, 1983) of multidisciplinary teams and how this was central to the everyday organising and coordinating work of hospital staff. There were benefits for NSTEMI patients getting noticed as 'boundary objects' (Star & Griesemer, 1989) in the same way as STEMI patients. In this paper and using the same VICC dataset we focus on another key variation we found between hospitals: close monitoring. Focusing only on NSTEMI patients, we describe close monitoring differences in more detail and examine why this variation mattered. Detailed examples of variation in care can inform quality improvement and potentially help improve patient outcomes.

Methods

Design

Qualitative design, including observations of NSTEMI care, interviews with clinical staff and patients, as well as scrutiny of medical records.

Hospital sample

We used the Acute Coronary Syndrome (ACS) registry for England and Wales (Myocardial Ischaemia National Audit Project, MINAP, Herret, Smeeth, Walker & Weston, 2010) to identify a sample of 30 hospitals in the top or bottom third

of 30-day case-mix adjusted mortality for ACS. We purposively sampled eight hospitals: four from the top tertile and four from the bottom; they varied in coronary interventional facilities, teaching status, volume of cardiac admissions and geography. We piloted the field work methods in two hospitals before commencing on the main sample of eight hospitals. This pilot work gave us a greater insight into the complexity of NSTEMI care and, as a result, led us to focus exclusively on NSTEMI care in the main study. In total there were ten participating hospitals with variation in their organisation of care for NSTEMI patients (see Table 1). As a condition of the research the hospitals were not aware of their selection based on performance status for 30-day mortality. The research team was also blinded to hospital performance status until the analysis of qualitative data was completed.

Consent

Before any data collection commenced the study was approved by the South West 5 Rec, UK National Health Service ethics committee (10/H0107/75, approval gained January 2011). For each hospital we obtained initial permission from the clinical lead for cardiology before approaching staff and teams in specific wards and departments. One hospital we approached declined to take part. As this was a study involving ward observations and staff shadowing of a clinical condition needing care in multiple hospital departments, it was accepted by our ethics committee that it would be impossible to gain written consent for all participants encountered. In agreement with our ethics committee we sought informed verbal assent from all participants being observed, followed by written consent of patients, staff and carers when the researcher observed their care more closely or requested an interview.

Data collection

Data collection was conducted in five different ways: (i) observation of care for a purposive sample of NSTEMI patients from admission through to discharge (n=68); (ii) observation of staff at each site (n=199); (iii) interviews with clinicians and managers (n=143); (iv) interviews with patients including the same patients 30 days after discharge (n=53); and (v) patients' medical records (See Table 2). Fieldwork was carried out over two weeks at each hospital (June 2011 - August 2012), focusing on the processes of admission, diagnosis, treatment and discharge. The researcher, JH, had previous experience in conducting ethnographic interviews and observations in hospital settings, including research for her doctoral thesis. Staff identified and introduced likely ACS patients to the researcher early in the patient's hospital stay and the researcher then regularly visited them and asked staff about their care. The study was described to participants as trying to identify the different approaches to NSTEMI care with the aim of sharing the best practices more widely. Assurances of strict confidentiality of any critical feedback was given to all participants and, for patients, that their care would not be affected by anything they said. The researcher was White British and did not have a clinical background but was passionate about improving patient care and the potential of qualitative research to achieve this. To minimise social desirability bias, staff behaviour and accounts of care were compared with observations and accounts of care from other staff and from patients. Patient participants were purposefully selected to represent diversity of age and gender (see Table 3), with carers sometimes being included in the interviews. Staff participants were selected to represent member identified categories and variation of roles within each hospital (see Table 4). We also paid special attention to specialist cardiac nurse roles as part of the theoretical sampling strategy. Interviews with staff and patients varied with some lasting a few minutes and others lasting over one hour. Verbal data were audio-recorded and transcribed; observational data were written as field notes. The transcripts and fieldnotes were not returned to participants or hospitals for comment or correction.

Data analysis

Data analysis aimed to identify variation in care, the possible reasons for observed differences and if and why it mattered. The interview topic guides and observations were informed by clinical guidelines available at the time of study (NICE, 2010, 2016; NICE 2010, 2013), existing literature on the quality of NSTEMI care as well as experiences at the two initial sites. We inductively identified categories from within the data, coded all of the data within these categories and used constant comparison to check items of coded data within each category for similarities and differences (Glaser & Strauss, 1967). The analytical approach followed many of the broad principles of grounded theory: simultaneous data collection and analysis; analytical codes developed from data not using preconceived logically deduced hypotheses; theoretical sampling; memo making as a bridge between coding and writing; and conducting literature reviews after developing an independent analysis. Our triangulation of data included both clinician and patient perspectives. Strong themes emerged on core areas which we felt gave us adequate information power (Malterud, Siersma, & Guassora, 2016) rather than data saturation as in such a complex clinical field, it is hard to claim full data saturation. The categories and code structure were developed by JH, HC and ME in collaboration with team members (KF, GF, CD and RJ). Half of the team had a clinical background (GF, RJ, CD, AT, HH) with specialisms in nursing (CD), cardiology (AT, GF, RJ) and general practice (GF, RJ) and the other half were non-clinicians with a variety of social science backgrounds (JH, HC, KF, ME).

Results

We found variation in the care of NSTEMI patients in several (related) domains. The focus of this paper is on the domain of *monitoring practices.* We explore the variation in monitoring practices between hospitals by way of four key

Table 1. Characteristics of participating hospitals.

Characteristic	Hospital 1 (pilot)	Hospital 2 (pilot)	Hospital 3	Hospital 4	Hospital 5	Hospital 6	Hospital 7	Hospital 8	Hospital 9	Hospital 10
Teaching status	Teaching (tertiary)	Non-teaching	Teaching (tertiary)	Non-teaching	Teaching (tertiary)	Non-teaching	Teaching (tertiary)	Non-teaching	Teaching (tertiary)	Non-teaching
Volume of cardiac admissions 2008 Low/Medium/High[†]	Medium	Medium	High	Low	High	Low	Low	High	High	Low
30-day mortality (STEMI+NSTEMI ranking) [‡]	*Middle tertile*	*Middle tertile*	*Lowest tertile*	*Lowest tertile*	*Top tertile*	*Top tertile*	*Lowest tertile*	*Lowest tertile*	*Top tertile*	*Top tertile*
Type of MI patients	STEMI & NSTEMI	NSTEMI only	STEMI & NSTEMI	NSTEMI only	STEMI & NSTEMI	NSTEMI only	STEMI & NSTEMI	NSTEMI only	STEMI & NSTEMI	NSTEMI only
Primary PCI?[§]	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Type of intervention available	Angiogram angioplasty, CABG[‖]	None	Angiogram angioplasty, CABG	Angiogram angioplasty	Angiogram angioplasty	Angiogram angioplasty	Angiogram angioplasty, CABG	Angiogram	Angiogram angioplasty, CABG	Angiogram angioplasty
Catheter laboratories on site (number)	4	0	2	2	3	1	3	1	6	2[¶]
Type of cardiology link person (total number)	ACS[#] nurse (1)	ACS nurse (1)	ACS nurse(1) + cardiologist of the week (1)	Thrombolysis Nurses (2)	Cardiac matron (1) + senior sisters (2) + junior sisters (4) + on call senior house officer (1)	Chest pain nurses (5)	ACS nurses (4) (not as key accident & emergency link but for interhosptial transfers)	ACS Nurses (5)	Unclear/No ACS nurses (only used registrars and senior house officers)	Unclear/No ACS nurses
Number of link people on duty at any one time	1	1	2	2	4	2	2	2	0	0

[†]Low = 1-249, medium = 250-499, high= 499+
[‡]Hospital variation in 30-day mortality with a final diagnosis of either ST-segment elevation myocardial infarction (STEMI) or Non- ST segment elevation myocardial infarction (NSTEMI) and adjusting for case-mix. Data are for all 236 hospitals in England and Wales with 413642 first time admissions from 1st January 2003 to 6th August 2009. These data were used for the initial sampling framework. Data rounded to the nearest whole number.
[§]Primary percutaneous coronary intervention (PCI/also known as angioplasty)
[‖]Coronary Artery Bypass Graft
[¶]Privately owned catheter laboratories
[#]Acute coronary syndrome

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Table 2. Study recruitment and type of data collected.

Type of data collection	Hospitals →										Total number of participants
	1	2[†]	3	4	5	6	7	8	9	10	
Patients observed	13	1	8	7	8	7	6	6	7	5	68
Interviews with patients (a sub sample of those patients observed)	*7*	*1*	*6*	*7*	*8*	*7*	*5*	*4*	*4*	*4*	*53*
Staff observed	36	14	15	14	21	20	26	13	20	20	199
Interviews with staff (some staff were interviewed but not observed)	*13*	*5*	*12*	*13*	*17*	*12*	*12*	*16*	*21*	*21*	*142*
											Total hours
Hours on site	75	23	81	84	88	80	88	80	73	60	732

[†]limited number of ACS patients and/or restricted research access.
This table also appears in Cramer *et al.* (2018). 'Who does this patient belong to?' boundary work and the re/making of (NSTEMI) heart attack patients. *Sociology of health & illness*, *40*(8), 1404–1429. https://doi.org/10.1111/1467-9566.12778. Table reprinted with permission from Wiley as part of the Copyright Transfer Agreement.

Table 3. Patient characteristics.

Patients		Number (percentage)
Gender	Female	31 (45.6%)
	Male	37 (54.4%)
	Total	**68**
Age category		
	Under 49	6 (8.8%)
	50-59	10 (14.7%)
	60-69	11 (16.2)
	70-79	16 (23.5)
	80+	8 (11.8)
	Not recorded	17 (25%)
	Total	**68**
	Mean age for females	74.1
	Mean age for males	61.9

challenges for NSTEMI care: monitoring a wide group of patients; the prioritisation of high and medium risk patients; coordinating beds and catheter laboratory slots, and timely interventional responses. Patients and staff participants are: [P1, P2]; staff [S1, S2]. The different sources of data were: interview [I]; observation [OB]; audio-recorded [AR]; and field notes [FN].

Monitoring a wide group of patients to enable identification

Monitoring a wide group of patients as they enter the hospital system and ongoing outreach work with patients and staff in multiple locations across the hospitals was part of the NSTEMI challenge. Identifying, and then closely monitoring NSTEMI and potential NSTEMI patients, was fundamental to care.

Patients arriving in the Accident and Emergency department (A&E) are initially seen by generalist staff. NSTEMI diagnosis took time to emerge and, in many cases, required cardiac specialists to combine symptom interpretation and test results. As diagnosis was often complex and protracted, close monitoring in suspected cases was also very important.

Table 4. **Staff roles of those recruited.**

Type of health professional	Cardiology specialism or non-cardiology	Staff roles	Number
Doctors			**56 in total**
	Cardiology	Directors/lead roles	4
		Consultants	26
		Non-consultant - senior house officers, registrars	15
	Non cardiology	Consultants Accident & Emergency, ambulance services	8
		Non-consultant - senior house officers Accident & Emergency, registrars	3
Nurses			**106 in total**
	Cardiology	Specialist & advanced practice nurses	14
		Matrons & senior sisters	10
		Sisters, junior sisters, ward managers & staff nurse roles (ward based)	41
	Non cardiology	Matrons & senior sisters	4
		Sisters, junior sisters, ward managers & staff nurse roles (ward based)	20
		Administrative roles (MINAP, bed coordinators)	11
		Research nurses & student nurses	6
Other health care professional			**10 in total**
		Ambulance paramedic	2
		Cardiac physiologist	2
		Cardiac pharmacist	4
		Radiographer	1
		Cardiac physiotherapist	1
Other			**27 in total**
		Nonclinical managers: Day cases catheter laboratories, catheter laboratories waiting list coordinator, cardiology business manager, rehabilitation manager	7
		Other administrative roles: Ward clerk coronary care unit, information manager, director of network, clinical trials manager, researcher	11
		Technicians: Catheter laboratory technician, cardiac pharmacy technician	3
		Assistants: Nursing assistant, health care assistant, medical support worker	5
		Accident & Emergency porter	1
Staff total			**199**

Having robust organisational arrangements whereby generalist staff (in places like A&E) could quickly, regularly and easily call on specialist cardiac staff for patients with symptoms like chest pain was essential for NSTEMI diagnosis but varied significantly across our hospital sample. Only half of the hospitals in the sample employed cardiac specialist nurses whose role focused on close monitoring to facilitate early identification of patients with NSTEMI (or possible NSTEMI). Other hospitals, for example, employed cardiac nurses whose main job was data reporting, or did not employ cardiac specialist nurses at all. In Hospital 3, the specialist nurse described how he undertook a huge variety of everyday monitoring related tasks and informal practices that might be needed in the support of identification in A&E:

I try and catch people down in A&E and before they go to the wards … [] I go through the diagnosis and look to see if there's anybody with chest pain … [emergency staff] they'll catch me and say … [] I've got this patient on [ward] I'd like you to have a look for me. [] mopping up any loose ends as well because often they're seen by junior doctors … [] And if tests are needed then I will expedite those tests. …. It's all about being proactive. … [] I can get things moving (S12, I:AR).

Raised troponin levels helped to identify possible NSTEMI patients. However, troponin may also be raised for other reasons such as kidney disease, making diagnosis difficult. One patient, who had kidney disease (renal failure), described his experience:

They put me on an observation ward … [] they didn't actually know with the tests and the blood tests what was wrong with me because I've got renal failure as well. … [] it can give a false reading on my bloods. Erm they did one for the heart, they did my ECG's … [] when they whittled everything down it come down to a heart attack … [] I'm having an angiogram to find out how if there's a blockage, where the blockage is (P55, Hospital 8, I:AR)

Identifying possible NSTEMI patients who may have been missed at the time of admission or who had a cardiac event while in hospital required particular approaches to monitoring also involving specialist expertise. Most, but not all, hospitals in the sample used daily lists of troponin measurements as a method to try and identify NSTEMI and possible NSTEMI patients located around the hospital. Cardiac nurses in Hospital 8 described checking troponin lists daily as a laborious but necessary fail-safe method:

It is frustrating I can visit 10 different wards in a day and none of them turn out for me … [] but I may find that one of those patients has come in with a cardiac presentation or had a cardiac event whilst they've been in and I may find that nobody else has noticed that they had a raised troponin and ECG changes (S147, cardiac nurse, I:AR).

The danger of not having specialist cardiac staff closely accessible, available and checking over patients was that NSTEMIs could get easily overlooked. One senior cardiac nurse described in some detail how she persisted with her suspicions, monitoring and investigations on behalf of an NSTEMI patient in A&E, highlighting the complexity of diagnosis and frequent need for specialist interpretation:

His initial troponin had come back at 0.93 but he had … chronic kidney disease [] … So the [general emergency] consultant that saw him … [] … He wasn't convinced it as an [MI] … [] So what we decided to do was to repeat the troponin to see if it … stayed elevated … [] I felt that it was an MI … [] it felt a little bit too high. And I didn't think we could really ignore the chest pain … [I] just didn't think that he was very good at describing his symptoms … [] So anyway, we, we repeated the troponin and it had come down to 0.48, so there had been a rise he went under [cardiologist] and when he reviewed him …. [] he said we definitely have to treat it as an MI (S150, Hospital 8, senior cardiac nurse, I:AR).

Prioritisation of high and medium risk patients enabled by close monitoring

Ongoing close monitoring of NSTEMI or potential NSTEMI patients was required to prioritise patients at medium or higher risk of another cardiac event or, to identify patients who were clinically deteriorating. Again, good access to specialist cardiac support was often critical. For instance, the lack of specialist input in A&E may have meant that a patient in Hospital 9 was not prioritised appropriately and only received an intervention at the upper time limit recommended for interventions (96 hours maximum):

A 57-year-old woman was brought to A&E and reported constant pain. She had ECG changes, a strong family history of heart disease, a big rise in troponin from 129 to 2033 and an initial diagnosis of NSTEMI. She went to catheter laboratory for an angiogram and angioplasty after 91 hours (P59, Hospital 9, OB:FN and medical notes).

Where ongoing pain is reported, risk is increased.[16] The patient in this case was told the blockage in her artery was large. In an interview she explained that her doctor thought she should have received an intervention much earlier:

I was in constant pain from when I first come in from when I had the operation done yesterday … [] the doctor downstairs was going mad, the surgeon, he said: 'By rights you should have been brought straight down as an emergency'. But they'd just been giving me paracetamol for the pain (P59, Hospital 9, I:AR).

In Hospital 9 where this patient's treatment was slow, cardiac ward staff reported an inadequate A&E triage system and poor access to specialist cardiac advice. With very little initial filtering of NSTEMI or possible NSTEMI patients, as

patients entered the hospital a wide assortment of chest pain patients were sent to the cardiac wards with staff acknowledging that a high proportion of these were being inappropriately admitted, for example, with gastric rather than heart problems. In the following example, the cardiologist refers to system as being 'crumpled' due to poor filtering and prioritisation systems at the hospital entry point in A&E:

> *Assessment of NSTEMIs is at the moment a little bit crumpled, … [] an initial triage, yeah and that might help a little bit more … [] but at the end of the day, A&E are not going to be in a position to necessarily help, they just send it up … [] the sheer number, the economy of scale has been lost within numbers and the pressure (S170, Hospital 9, I:AR).*

Hospital 5 stood out as having the most effective systems for NSTEMI patient triage and prioritisation. Part of this system included having an overnight cardiac registrar checking A&E and other wards for possible NSTEMI patients. While specialist cardiac support in the other hospitals was often reduced significantly at nights and weekends, in Hospital 5 the 24/7 integrated cardiac specialist approach meant that the overnight registrar helped to identify and prioritise NSTEMI patients and had a robust morning handover. Where all the other hospitals had daily ward rounds (or sometimes less frequently in the case of Hospital 4), Hospital 5 had two multidisciplinary ward rounds per day. In the following quote, a nurse explained how the overnight registrar doctor (or 'reg') duty system worked. The quote highlights how closely cardiac specialists worked with generalist staff and describes a clear process for double checking decisions with senior colleagues:

> *We have a registrar that comes on at 8 o'clock at night until they've done patient triage in the morning … If it's an NSTEMI, ECG no changes, patient stable, the reg will say they're happy for them to go to the admissions unit or might say I'm not quite happy with this patient I want them to go to coronary care …. If they get anyone in that is [troponin] positive for NSTEMIs, [A&E staff] ring the night reg, and the night reg goes down and reviews the patient … [so] at night the cardiac patients are seen reviewed and medications appropriate started and plans made on the night shift so that group of patients aren't waiting until 8 o'clock [am] for a consultant to see them before a plan starts … [If] you've got a NSTEMI who's having dynamic ECG changes [marker of increased risk of poor outcome] he'd ring the on-call cardiologist and say do you want to put him in the lab tonight? So the on-call team would come in for that if they're unstable (S97, senior cardiac nurse, Hospital 5, I:AR).*

Certain categories of NSTEMI patients were not considered for prioritisation. Two hospitals automatically excluded patients over the age of 85 from cardiac wards, unless there were exceptional reasons. This conflicts with ESC guidance that older people benefit equally from intensive management (ESC 5.8 web addenda, Roffi *et al.*, 2016; Kaura *et al.*, 2020). For example, in Hospital 5 we traced the care of one 87year-old woman with a diagnosis of NSTEMI who stayed on a care of the elderly ward. On this ward she did not see a cardiologist, nor have her planned echocardiogram and did not benefit from the close cardiac monitoring necessary for the medical management of her condition. She died shortly after leaving hospital (P34, OB:FN and medical notes).

Close monitoring dependent on flexible catheter laboratory and bed management

Effective monitoring of an NSTEMI patient included being able to respond quickly and appropriately to changing patient needs. Making an accurate diagnosis with angiogram and, where appropriate treating disease with angioplasty, were both sometimes needed. As well as differences in the availability of specialist cardiac staff to support timely and appropriate responses, there were also considerable differences between hospitals in their ability to access catheter laboratory facilities (where angiograms and angioplasty were carried out), and in their bed management systems.

Guidelines recommends an intervention window of 96 hours.[14,15,16] However, the wide variation in the availability and number of diagnostic and treatment facilities limited hospitals' ability to respond within that window. Some hospitals had no catheter laboratories (Hospital 2), some hospitals only had facilities and trained staff for angiogram diagnosis (Hospital 8) and some hospitals had capacity and staff for both angiograms and angioplasty (Hospitals 1,3,4,5,6,7,9,10 – see also Table 1). NSTEMI patients needing angiogram/angioplasty who were initially admitted to smaller district hospitals with limited or no interventional facilities, required transfer to a hospital which did have the facilities. For patients needing transfer, delays in treatment (or worse, no treatment) were regularly reported. In one smaller hospital, although they had catheter laboratories and offered both angiograms and angioplasty, half of the six patients observed went home without their planned angiograms (Hospital 4, OB:FN). In one hospital the cardiologist highlighted regular delays when transfers were needed between hospitals:

> *If the patient comes from another [district] hospital it is not rare that the patient receives his cath [procedure in a catheter laboratory] after 4 or 5 days (S56, cardiologist, Hospital 3, I:AR).*

One patient described their frustration at having to wait in a smaller district hospital to be transferred to a larger hospital with better facilities:

There was a lot of people back and forth seeing to me at one time. And they said I'd had the heart attack … [] one of the arteries was closed … [] so they said then that they can do the angiogram tests up there [district hospital]. But if I needed any work done they can't put stents in [also known as PCI or angioplasty] …. this is why they transferred me down here [larger hospital] … I came in yesterday, the ambulance was booked for 9.15 in the morning …. [] but they didn't come until about 7.30. Night. It was a long, quite a long wait. (P49, Hospital 7, I:AR)

Being admitted to a larger ('tertiary') hospital with all the facilities within the same hospital, however, did not always mean that required interventional work was available for NSTEMI patients. In the larger hospitals there was competition from STEMI patients who were always prioritised over NSTEMI patients in accessing a slot in the catheter laboratory.

Closely related to being able to secure a slot in a catheter laboratory, hospital bed management was essential to support patients with the appropriate level of cardiac care, especially after interventional treatment. Hospitals managed their beds in various ways and we identified several different methods that appeared to be effective. For example, in Hospital 7, bed meetings took place four times per day and it was compulsory for all staff to attend these meetings. In many hospitals however, ineffective bed management practices at times undermined patient care:

There are times when they say 'we've got no beds' … [] if you just speak to the bed manager you're just one of several people wanting a bed (S170, Hospital 9, cardiologist, I:AR).

In Hospital 5 a bed management system had been devised that was led by nurses and was very flexible and placements were not dependent on the approval of doctors (which often slowed how soon a bed could be secured). Referred to in Hospital 5 as 'patient flow', one fieldwork diary entry captured this constant need to juggle bed spaces according to patient needs:

Bed management overseen by nurses, constantly re-negotiated. No Dr's authority needed. Had case last night where man did not wake after catheter laboratory sedation so needed intensive cardiac care bed urgently. Bed plans change minute to minute (Hospital 5, OB:FN).

Close monitoring within an integrated system for timely interventional responses

Having a whole system approach facilitated responding in a timely manner. By this we mean the NSTEMI patient journey had been well thought through and there was a cumulative effect of having robust bed and catheter laboratory systems, underpinned by regular ward rounds as well as cardiac specialist input. For example, a patient case in Hospital 5 illustrates a seamless process for screening and swiftly treating patients. This patient was quickly found a bed in a specialist ward, his ongoing pain was under close and repeated review by specialist cardiac staff and there was a rapid interventional response:

One 72-year-old patient came back to hospital with chest pain having been discharged earlier that day. He was seen in A&E by a cardiologist and immediately given a bed in a cardiac specialist ward. Later that day a consultant reviewed his case and, unsure whether the ongoing pain was due to earlier angioplasty or angina, discussed the case with another cardiologist and agreed to an angiogram. Next day at the 8am ward round his symptoms were reviewed by a consultant, specialist cardiac nurse and night cardiac registrar and he had an angiogram later that day (P32, OB:FN and medical notes).

By contrast, in Hospital 4, bed management challenges, lack of an integrated cardiac system, and the limited access for NSTEMI patients to the catheter laboratories hampered timely intervention. In Hospital 4 there was a particular problem around beds because they had dual condition wards where both cardiac and respiratory patients were placed. Having dual conditions in one ward meant that there was sometimes confusion over which patients needed monitoring for which conditions and ultimately the responsibility for individual patients. On occasion, cardiac doctors missed seeing their patients on ward rounds. For example, one 82-year-old NSTEMI patient stayed for nine days in Hospital 4 but went home without her planned angiogram and two important medications missing. The nursing staff said that she had been missed on a ward round and this patient confirmed that she had only seen the doctor once:

Patient: I've been here some 8 days today and I've been having scans on my liver and me kidneys and blood tests and scans and x-rays … [] I am hoping today that they have all the answers whether it's go home or have the angiogram … []

Researcher: Have you seen a cardiologist yet, have you seen the heart doctor?

Patient: Yes I saw him last week, I've seen him once … [] the big mojo (laughs) that's the one we are waiting for the decision (P27, Hospital 4, I:AR).

Discussion

Close monitoring, often including good access to cardiac specialists, was a key area of variation. Specialist monitoring of potential NSTEMI patients helped manage the uncertainty and complexity of diagnosis. Active monitoring to identify undiagnosed patients (e.g. checking lists of repeat troponin measurements) and to prioritise patients required both specialist cardiac roles for interpretation and appropriate follow up. UK national guidelines recommend using clinical judgement to decide how often monitoring should be done until a firm NSTEMI diagnosis is made (NICE 2010, 2016), but they neither address how this monitoring should be organised, nor do they promote the important role cardiac specialists can play. We found that NSTEMI patients could be disadvantaged by initially presenting at smaller district hospitals with more limited or no interventional facilities and that catheter laboratory and bed management either inhibited or facilitated timely intervention. Apparently taking 12 years to achieve, with its integrated cardiology system approach, Hospital 5 stood out as having many of the best examples of monitoring and response, although patients in older age groups did not necessarily benefit. Aside from the recent Covid-19 pandemic which has impacted on treatment times for all heart attack patients (Gluckman *et al.*, 2020), delays for NSTEMI patients getting a diagnostic angiogram, for example, are not improving significantly compared to STEMI patients (Wu *et al.*, 2018). Looking at variation in care across hospitals can provide insights into how to provide timely interventions for conditions such as NSTEMI (Atsma and colleagues, 2020).

Good coordination across diverse hospital teams is associated with reductions in overall length of stay for heart attack patients (Madell, Villa, Haywood, & Le Comte, 2015). One key study by Curry *et al.* (2011) that examined care for STEMI and NSTEMI patients, identified the importance of strong communication and coordination across disciplines and departments and empowered nursing staff. While there are some similarities between the findings of Curry and colleagues' study and this one, the specific challenges of NSTEMI identification and diagnosis were not recognised. The importance of cardiac specialists being involved early in the diagnosis and the prioritisation of NSTEMI patients has been recognised elsewhere (de Belder 2012; Comer, 2021; Koganti & Rakhit, 2015; Stukel *et al.*, 2010) including specialist nurse roles (Cramer *et al.*, 2018; Deaton *et al.*, 2016; Tierney *et al.*, 2013). Other studies highlight the importance of frontline staff flexibility and autonomy (Cramer *et al.*, 2018; Taylor, Clay-Williams, Hogden, Briathwaite, & Groene, 2015) and the need to resolve the catheter laboratory and bed space competition NSTEMI patients face from those with STEMI (Bellenger, Eichhofer, Crone, & Curzen, 2004; Koganti & Rakhit, 2015). However, care must be taken so that the trend towards recommending ever increasing specialisation is done with proper attention to the crucial and complementary generalist roles and their ongoing training.

A major strength of this study was being able to observe the delivery of care as well as interview staff and patients about it. Other strengths included blinding of our research team to hospital performance indicators and including some smaller district hospitals (with limited intervention facilities) in the study. The inclusion of these smaller hospitals is important because many NSTEMI patients are cared for in district hospitals for some or all of their acute care. A limitation was that we visited hospitals for a relatively short period so would have been unable to detect possible changes or temporal variation in care. While our analysis of care is linked to evidence-based guidelines and based on careful triangulation between observations of patient care and clinical work, interviews and patient notes, our findings are hypothesis-generating and would benefit from further work testing the relationship of NSTEMI care to patient outcomes. In the time since data collection for this study occurred, a more sensitive blood test to check for troponin levels has come into use. This allows NSTEMI in some patients to be ruled out more swiftly, potentially reducing the number of patients admitted to hospital for observation. Nonetheless the data and findings on variation remain highly relevant to the ongoing challenges of diagnosis and management of patients with NSTEMI.

Conclusions

Variation in care offers us a window into practices that could be improved (Atsma and colleagues, 2020). Cardiovascular disease is still a major cause of premature death and morbidity in developed countries and the proportion of NSTEMIs is increasing relative to STEMIs (Sanchis-Gomar, Perez-Quilis, Leischik, & Lucia, 2016). Many of the best examples of monitoring and response were dependent on the availability of cardiac specialists. Their role, whilst being labour intensive and harder to link to outcomes, is often recognised as crucial in connecting and coordinating care. These specialists are, however, also vulnerable to funding cuts. The example of monitoring in NSTEMI care is relevant to other acute conditions with diagnostic and treatment uncertainty, particularly in patients with multiple morbidities. Findings from the application of qualitative and observational methods can potentially inform quality improvement (Leslie, Paradis, Gropper, Reeves, & Kitto, 2013).

Data availability

Underlying data

The underlying data are not publicly available due to their containing information that could compromise the privacy of research participants and due to data security restrictions.

The research was given ethical approval on the condition that participants confidentiality would be maintained. We assured our committee 'the absolute anonymisation of all data will protect the privacy of all patients'. Given the nature of the work the only reasonable way to ensure this confidentiality for both patients and staff is to not make data publicly available and to exercise care and caution of data requests. For example, we consider the data related to individual patient care such as patient's medical notes to be too identifiable and in interviews, critical reflections of management and hospital care were discussed. Due to the small number of hospitals involved in the study, staff could be easily identified by their roles as there was often only one matron or specialist nurse role per hospital. The MINAP data on hospital performance (30-day mortality after admission) is not openly published and we do not have permission to disclose this. In our application to the MINAP committee we stated the research team would 'not publish the hospital's identity in any way or publish any linked information about individual hospitals and their outcome group (e.g. good or poor)'. We were specifically asked by our NHS ethics committee not to divulge to the participants that the research was looking at poor performing hospitals as well as top performing ones. The anonymised data that support the findings of this study are, however, available on request to bona fide researchers and will be considered on a case-by-case basis. We will consider, for example, requests for anonymised data that supports particular claims made by the authors. Approvals for such requests will require the consideration of the study team's ethics committee but may also require some reassurance from the requesting researcher's ethics committee on their planned use of data. Requests to access the data should be directed to South West-Frenchay UK National Health Service ethics committee, previously known as South West 5 Rec (frenchay.rec@hra.nhs.uk).

Extended data

Zenodo: Topic guide and observation guide for Understanding Variation in Patient Care. https://doi.org/10.5281/zenodo.6360572 (Cramer *et al.*, 2022).

This project contains the templates for the interview questions and observation guides used in this research.

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