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Variations in cardiovascular disease outcomes across Europe

Inequalities in care delivery and outcomes for myocardial infarction, heart failure, atrial fibrillation, and aortic stenosis in the United Kingdom

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Summary

Cardiovascular diseases are a leading cause of death and disability globally, with inequalities in burden and care delivery evident in Europe. To address this challenge, The Lancet Regional Health—Europe convened experts from a range of countries to summarise the current state of knowledge on cardiovascular disease inequalities across Europe. This Series paper presents evidence from nationwide secondary care registries and primary care healthcare records regarding inequalities in care delivery and outcomes for myocardial infarction, heart failure, atrial fibrillation, and aortic stenosis in the National Health Service (NHS) across the United Kingdom (UK) by age, sex, ethnicity and geographical location. Data suggest that women and older people less frequently receive guideline-recommended treatment than men and younger people. There are limited publications about ethnicity in the UK for the studied disease areas. Finally, there is inter-healthcare provider variation in cardiovascular care provision, especially for transcatheter aortic valve implantation, which is associated with differing outcomes for patients with the same disease. Providing equitable care is a founding principle of the UK NHS, which is well positioned to deliver innovative policy responses to reverse observed inequalities. Understanding differences in care may enable the implementation of appropriate strategies to mitigate differences in outcomes.

Keywords: Care delivery; Disparities; Cardiovascular disease; Death

Introduction

The National Health Service (NHS), which covers the four constituent countries of the United Kingdom (UK), was founded on that principle that access to and use of its services is universal and free at the point of delivery.[1] Treatment should therefore be equitable, and based on clinical need irrespective of age, sex, ethnicity or location. Cardiovascular disease (CVD) remains a leading cause of death in the UK. It is estimated that 7.6 million people in the UK are living with CVD,[2] at a total annual direct cost to the health and care system of about £9 billion, and £19 billion to the UK economy as a whole.[3]

In response to an increased recognition of inequitable care for patients with CVD in the NHS,[4] a series of policy initiatives were introduced at the turn of the millennium (Panel 1). The National Service Framework for Coronary Heart Disease was implemented to tackle inequalities in care delivery for coronary heart disease (CHD), heart failure (HF) and arrhythmias.[5,6] This was followed by publication of National Institute of Health and Care Excellence (NICE) guidelines and Quality and Outcomes Framework (QOF) indicators to incentivise

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Key messages

- Older people and women less frequently receive invasive coronary angiography after presentation with myocardial infarction.
- Older people and women wait longer for a diagnosis of heart failure compared with younger people and men, and less frequently receive evidence-based pharmacological therapies for heart failure and atrial fibrillation.
- South Asian patients do not appear to receive unequal treatment for myocardial infarction, compared with White patients, and have similar case fatality.
- The evidence base for care and outcomes by ethnic group for individuals with heart failure and atrial fibrillation is incomplete.
- Variation in care delivery between health service providers occur for each of myocardial infarction, heart failure, atrial fibrillation, and aortic stenosis—particularly with regards to transcatheter aortic valve implantation–and this is associated with variation in health outcomes.
- The UK health service has unique strengths including universal coverage by means of a public funding system, comprehensive patient-level data coverage and a culture of national clinical audit.
- Understanding differences in care may enable the implementation of appropriate strategies to mitigate differences in outcomes.

Panel 1: **Policy initiatives introduced in the 21st centruy to address inequitable cardiovascular care in the United Kingdom National Health Service.**

National Service Framework for Coronary Heart Disease

Macro-level policy from the Department of Health set out in 2000. It set national standards of service for prevention, diagnosis, treatment, rehabilitation, and outcomes for CHD, HF and subsequently arrhythmias. Delivery was organised through professional self-regulation and clinical governance, and monitored by the NHS Performance Assessment Framework, Commission for Health Improvement and National Survey of NHS patients. The goal was to reduce undesirable variations and inconsistencies in service delivery and access by delivering care in a more structured and systematic way. Overall the Framework: i) specified interventions that were considered effective, ii) identified models of care that deliver the interventions, iii) provided means to implement improved systems of care, iv) developed audit tools and performance indicators, and v) indicated milestones to assess progress by.

National Institute of Health and Care Excellence Guidelines (NICE)

NICE was instituted in 1999 to reduce variation in the availability and quality of care. NICE guides micro-level policy and guidance through evidence-based: clinical, social care, public health and medicines practice guidelines, technology appraisals, and quality standards. It also provides financial planning tools, observational data collection and a portal for shared learning for health care providers. Most pertinently to day-to-day clinical care it provides clinical guidelines and direction on which therapies are recommended for use in the NHS.

Quality and Outcomes Framework (QoF)

The QoF programme was introduced in 2004 to incentivise performance in primary care. The performance indicators are agreed as part of the General Practice contract negotiations every year. These indicators have points attached that are given to practices based on performance against these measures, which include multiple measures for each of CHD, HF and AF.

best practice in primary care in each of these disease areas. The overall goal was to ensure equal and high-quality treatment for CVD by setting out expected standards of care and recommending and incentivising efficacious and cost-effective treatments.

In this Series paper we summarise evidence to investigate whether care and outcomes for CVD in the UK continue to differ by age, sex, ethnicity, and geographical location (inter-hospital, local and regional) in the years following the implementation of the National Services Framework for Coronary Heart Disease (2000 to the present day).

Disease areas, indicators of care, outcomes, and data sources

We focus on four CVDs that lead to significant utilisation of cardiovascular services in the UK: myocardial infarction (MI), HF, atrial fibrillation (AF), and aortic stenosis (AS).[2] Myocardial infarction is the most frequent cause of death for men in the UK and second most frequent for women.[7] The crude incidence of both HF and AF have increased in the UK over the last 25 years; and the number of new HF and AF cases diagnosed each year now exceeds by two-fold the combined total of the four most common causes of cancer (breast, bowel, lung, and prostate).[8,9] Aortic stenosis (AS) affects approximately 5% of adults over the age of 65 years[10]; and is progressive such that survival once symptoms appear is only 3% at 5 years, a prognosis comparable to metastatic lung cancer.[11]

We investigate for evidence of variation in care by age, sex, ethnicity and geography in the attainment of standards set by the National Service Framework for Coronary Heart Disease and NICE guidelines. For MI, this includes medical treatment and revascularisation for ST-segment-elevation MI (STEMI) and non-ST-segment elevation MI (NSTEMI]) and secondary prevention. For HF, we consider utilisation of diagnostic investigations and the provision of disease-modifying pharmacotherapies. For AF, we consider the provision of oral anticoagulation for primary prophylaxis of stroke; and for AS the provision of transcatheter aortic valve implantation (TAVI). For each we report outcomes in terms of differences in mortality and/or hospitalisation amongst the cohorts within each study. The aforementioned care interventions are recommended for all patients by NICE irrespective of age, sex, ethnicity or geographical location.

We preferentially utilise reports from nationwide data sources (Panel 2; search strategy and selection criteria in Box). The UK National Cardiac Audit Programme provides reports relevant to MI, HF and AS through the Myocardial Ischaemia National Audit Project (MINAP), the National Audit of Percutaneous Coronary Interventions (NAPCI), the National Heart Failure Audit (NHFA) and the UK TAVI registry. General practitioners

Panel 2: **Nationwide data sources summarising care delivery and outcomes for myocardial infarction, heart failure, atrial fibrillation and aortic stenosis in the UK.**

Myocardial Ischaemia National Audit Project (MINAP)
MINAP is the largest single healthcare system heart attack registry in the world, originally established in October 2000 to support the National Service Framework for Coronary Heart Disease. MINAP receives data for hospital admissions in England, Wales and Northern Ireland with Type I myocardial infarction (T1 MI, inclusive of MI due to plaque erosion or rupture, fissure or dissection). Participating hospitals are required to entre data for all patients admitted with T1 MI. Data is collected within 130 fields that cover the entire patient pathway from the time the patient calls for professional help to the point of discharge. Data submissions should meet the minimum standard for data completeness. The MINAP data application used by hospital staff contains error-checking mechanisms designed to minimize common errors.

National Audit of Percutaneous Coronary Interventions (NAPCI)
In 1998 the British Cardiovascular Intervention Society (BCIS) started to collect data as a survey, a process that has developed so that since 2004 almost all centres performing PCI in the UK have recorded data about every PCI procedure performed and uploaded them to central servers for analysis and reporting. A data set of 113 fields is collected for each procedure covering all aspects of the PCI up to hospital outcomes. Data can be entered using a web-enabled interface provided by National Institute for Cardiovascular Outcomes Research (NICOR), or collected using a local database, encrypted and uploaded by NICOR. Validation is not possible, but participation in the audit is publicly reported to encourage compliance. Data are checked for range and internal consistency with an error log generated for each data upload. Prior to the publication of reports, a validation cycle provides every PCI operator their personal report so that corrections can be made.

National Heart Failure Audit (NHFA)
The NHFA enrols patients hospitalised with a primary diagnosis of HF in England and Wales. Initially, in 2007, participating hospitals were asked to provide data on at least the first 10 patients with a primary death or discharge diagnosis of HF in each month. This requirement has steadily increased and, from 2012, all hospitals in England and Wales were expected to report all unscheduled admissions due to HF to the audit. The dataset captures information about patient demographics, clinical characteristics and follow-up information. The audit is supplemented by a survey of 185 English and Welsh hospitals, included in the National Heart Failure Audit, that provide care for patients with acute HF, capturing information on hospital characteristics, including human resources (e.g. number of cardiologists), referral pathways (e.g. heart transplantation) and other organisational features.

The UK Transcatheter Aortic Valve Implantation (TAVI) registry
The UK TAVI registry has collected data about every TAVI procedure performed in the UK. The aim of the registry was to oversee and guide the use of TAVI in the UK, and the steering group includes representation from professional specialist societies, government, and regulators. Data can be entered using a web-enabled interface provided by NICOR. For each procedure a total of 95 variables are collected at the time of discharge from hospital, with six additional fields provided for 1-year and 3-year follow-up. Range checks are applied to appropriate fields and missing and extreme values and data inconsistencies are queried by direct contact with the TAVI centre. For data relating to procedures undertaken before the end of 2010, completeness of valid data was 99.6% for demographic data, 96.4% for risk factors, 97.4% for procedural variables and 98.5% for in-hospital outcomes.

Clinical Practice Research Datalink (CPRD)
CPRD is the largest ongoing primary care database in the world, established in 1987. It contains data for approximately 37 million patients between its GOLD and Aurum datasets, with contributing practices across the UK. The included patients are broadly representative of the UK general population regarding age, sex and ethnicity. In order to contribute to the database, general practices and other health centres must meet pre-specified standards for research-quality data ('up-to-standard'). CPRD undertakes various levels of validation and quality assurance on the daily general practice data collection comprising over 900 checks covering the integrity, structure and format of the data. The validity of clinical diagnoses recorded in the CPRD datasets has been independently investigated for a range of conditions.

in primary care remain responsible for medication prescriptions, and therefore nationwide routinely-collected primary care records allow summaries of performance for guideline adherence of pharmacotherapy for HF and AF.[12,13] Large datasets from across an entire country may provide accurate and representative estimates and trends.[14]

Myocardial infarction

ST-segment-elevation myocardial infarction

Age

Data from MINAP until 2010 showed that patients ≥85 years of age are up to 75% less likely to receive primary PCI (PPCI) for STEMI reperfusion therapy compared with those <55 years of age.[15] Older patients have higher in-hospital mortality rates—on adjusted analysis the risk of in-hospital mortality is 20-fold higher for individuals aged ≥85 years compared with individuals aged <55 years.[15]

Sex

Men admitted with STEMI more frequently receive coronary angiography (OR 1.44, 95% CI 1.05–1.97) and PCI (OR 1.62, CI 1.28–2.05) than women (even adjusting for differences in age, deprivation and comorbidities).[16] Women hospitalised with STEMI, compared with men, experience higher 30-day mortality (11.7% vs 7.5%, $p < 0.001$) and GRACE-risk score adjusted 30-day mortality (mean 9.9% vs 6.3%, $p < 0.001$; median 5.2% vs 2.3%, $p < 0.001$).[17] After weighting and adjustment for baseline characteristics, lower survival among women than men remains after adjustment for quality indicators of care (ATE 0.55, 95% CI 0.13–0.96; $p = 0.010$).[17]

Ethnicity

Evidence was not available for whether there is variation by ethnicity in provision of PPCI and mortality after STEMI.

Geography

The proportion of patients who received PPCI and lived further away from the PPCI centre increased from no cases living >30 km away in 2003/2004 to 18.3% of cases living >30 km away in 2011/2013.[18] However, there remains variation in efficiencies of STEMI care pathways in the UK, with 75.5% achieving a door-to-balloon time of less than 60 min,[19] and evidence for variation between hospitals in the provision of PPCI associated with variation in 30-day mortality.[20]

Non-ST-segment-elevation myocardial infarction (NSTEMI)

Age

Amongst patients admitted with NSTEMI up to 2010, only 14% of those aged ≥85 years receive angiography compared with 83% of those aged 18–65 years.[21] However, in 2020 83.5% of all patients admitted to hospital with NSTEMI underwent angiography with increasing utilisation in older patients.[22] Older patients with NSTEMI less frequently receive secondary prevention pharmacological therapy in hospital and within one year of admission.[1,23] A greater comorbidity burden in older patients accounts for much of this difference,[23] for example, chronic kidney disease, chronic heart failure and cerebrovascular disease rise with increasing age group amongst patients admitted with NSTEMI.[23] Whilst non-invasive management of NSTEMI is associated with worse unadjusted survival across all age groups, the benefit of an invasive management compared to conservative management strategy is attenuated in older patients after adjustment for confounders (age ≥85 years, HR 1.36, 95% CI 1.27–1.47; age 18–65, HR 1.98, 95% CI 1.78–2.19).[21]

Sex

At presentation to hospital with NSTEMI, women are older (median age 76.7 years vs 67.1 years) with more cardiovascular comorbidities than men, and more frequently classified as being at higher risk of mortality according to the GRACE score than men.[17,24] Women less frequently than men receive a statin, ACE-I/ARB, beta-blocker, P2Y12 inhibitor or dual antiplatelet therapies (82.5% vs 85.6%; 75.4% vs 78.7%; 62.6% vs 67.6%; 81.3% vs 84.8%; 87.2% vs 89.6%; respectively, all p values <0.001).[17] Women are also 28% less likely to receive angiography than men.[25] Women have worse survival after hospitalisation for NSTEMI than men, which appears to be explained by differences in baseline characteristics.[17] Of those that receive PCI for NSTEMI, being a women was independently associated with all-cause mortality at 30 days (OR 1.15, 95% CI 1.10–1.22, $p < 0.0001$) after adjusting for age, hypertension, diabetes mellitus, smoking status and previous MI.[24]

Ethnicity

South Asian ethnicity was associated with a 61% higher rate of angiography during hospitalisation with NSTEMI compared with White ethnicity (Table 1).[25] At discharge South Asian patients were more likely than their White counterparts to be prescribed secondary prevention medications.[28] In the community, prescription of lipid lowering therapies was 16% higher in South Asian patients compared to White patients, but 51% lower in Black African/Caribbean patients.[33] Whilst South Asian patients present at a younger age, age-stratified analyses demonstrate that South Asian men have a better prognosis than White men (HR 0.88, 95% CI 0.81–0.96).[28]

Geography

Provision of coronary angiography and revascularisation for NSTEMI has been found to vary between hospitals, with interquartile ranges of 40.5% and 21.9% respectively.[20,34] The greatest geographic variation for pharmacological secondary prevention after an NSTEMI is for mineralocorticoid receptor antagonists (16.7%, IQR 0.0–40.0%) whilst high and consistent rates are observed for the prescription of aspirin (90.1%, IQR 85.1–93.3%) and statins (86.4%, IQR 82.3–91.2%).[35] Variation in mortality after NSTEMI is mostly explained by differences in the provision of care between hospitals.[35] For the use of dual antiplatelet therapy, beta blockers and statins, comparing hospitals in the lowest quartile of provision with hospitals in the highest quartile, the risk of 30-day mortality was reduced by 12%, 16%, and 16%, respectively.[35]

Heart failure

Age

Older people are less likely to be diagnosed with HF in primary care compared with younger people (reference 55–64 years: age ≥75 years HR 0.85, 95% CI 0.83–0.87),[36] and wait longer from presentation with symptoms to diagnosis.[37] In the community, patients aged ≥75 years with HF and reduced ejection fraction (HFrEF), and without recorded contraindication or intolerance, are 20% less likely to receive a prescription of disease-modifying pharmacotherapies and 48% less likely achieve at least half of the guideline-recommended daily dose compared with individuals aged 55–64 years.[36] During an inpatient admission older patients are less

Study	Data source	Inclusion criteria	Size	Findings (South Asian vs White patients)
Myocardial Infarction				
Ben-Shlomo, 2007[26]	MINAP	Patients attending with chest pain	5486 South Asian 118,323 White	Less frequently arrive at hospital by ambulance (OR 0.64, 95% CI 0.60–0.69) but no difference in mean time between symptom onset and hospital arrival More frequently receive thrombolysis (OR 1.19, 95% CI 1.10–1.30)
Birkhead, 2009[25]	MINAP	Patients admitted with NSTEMI	13,489	More frequently receive coronary angiography (OR: 1.61, $p < 0.001$)
Kendall, 2012[27]	Sandwell and West Birmingham Hospitals NHS Trust	Patients treated for STEMI with PCI	156 South Asian 516 White	More frequently in the upper third of pre- and post-hospital PCI-related delay (OR 1.83, 95% CI 1.05–3.21)
Zaman, 2013[28]	MINAP	Patients with AMI	8251 South Asian 195,841 White	More likely to receive coronary angiography (HR 1.32, 95% CI 1.16–1.49) and more likely to receive aspirin, statin, ACE-I and beta blocker ($p < 0.05$) Lower 30-day (HR 0.85, 95% CI 0.77–0.94) and 1-year mortality (HR 0.77, 95% CI 0.73–0.82)
Heart Failure				
Blackledge, 2003[29]	Leicestershire District Authority	Patients admitted with HF	455 South Asian 3752 White	Lower risk of death (HR 0.82, 95% CI 0.68–0.99) and similar risk of death/readmission (OR 0.96, 95% CI 0.81–1.09)
Newton, 2005[30]	University Hospitals of Leicester NHS Trust	Patients admitted with first presentation of HF	176 South Asian 352 White	Lower all-cause mortality after hospitalisation during 3.5 year follow up (OR: 0.71, 95% CI 0.53–0.96)
Atrial Fibrillation				
Mathur, 2013[31]	187 GP Surgeries in South and East London	Community-dwelling patients with AF	450 South Asian 4561 White	Less often prescribed warfarin when at elevated CHADS$_2$ score (OR 0.64, 95% CI 0.46–0.89)
Potluri, 2019[32]	United Kingdom (UK) (ACALM) registry	Patients admitted with AF	1876 South Asian 51,575 White	Lower long-term risk of mortality (HR 0.62, 95% CI 0.49–0.74)

Findings summarised as reported by studies. ACALM, Algorithm for Co-morbidity, Associations, Length of stay, and Mortality; ACE-I, angiotensin converting enzyme inhibitor; AF, atrial fibrillation; AMI, acute myocardial infarction; CHADS$_2$, Congestive heart failure, Hypertension, Age >75, Diabetes mellitus, prior Stroke or transient ischemic attack [2 points]; HR, hazard ratio MINAP, Myocardial Ischaemia National Audit Project; NSTEMI, non-ST-segment-elevation myocardial infarction; OR, odds ratio; PCI, percutaneous coronary intervention; STEMI, ST-segment-elevation myocardial infarction.

Table 1: **Summary of studies comparing care and outcomes for South Asian and White patients with myocardial infarction, heart failure, and atrial fibrillation in the UK NHS.**

likely receive appropriate pharmacotherapy.[38,39] Over the last 20 years mortality has declined for individuals aged <80 years with HF, but not among older individuals due to an increase in non-cardiovascular mortality (especially from infections and dementia).[12] Similarly, hospitalisation rates after HF diagnosis have increased over the last 20 years, more so for individuals aged ≥80 years, reflective of increased rates of admissions for non-cardiovascular disease events and recurrent acute heart failure presentations.[12,40]

Sex

Women, compared with men, are 9% less likely to be diagnosed with HF in primary care,[36] and wait longer from presentation with symptoms to diagnosis—with over a quarter of women waiting more than four years to receive a HF diagnosis.[37] In the community, women with HFrEF are 13% less likely than men to be initiated on disease-modifying pharmacotherapies and 24% less likely to achieve at least half of the guideline-recommended daily dose.[36] Whilst mortality has historically been higher in men with HF than women, the mortality gap between the sexes in the first year following diagnosis was no longer significant by 2016.[40] Furthermore, median survival after hospital admission has improved more in men than women over recent years,[41] and women and men now have similar rates of hospitalisation within one year of HF diagnosis.[12,40]

Ethnicity

There is an absence of reports using nationwide data to analyse for variation in pharmacological therapy or investigations by ethnicity. A single centre study in the Midlands from 2004 demonstrated that there was no difference in utilisation of beta blocker and ACE-Is/ARBs between European and non-European patients with HFrEF.[42] A number of single centre studies in areas of high ethnic diversity show that survival is better after first HF hospitalisation in South Asians compared with White patients in both the short and long-term (Table 1),[29,30,42] even after correcting for the presentation of South Asian patients at a younger age.[30]

Geography

Only 5% of variation in adherence to NICE guidelines for investigation of HF in the community is attributable to inter-practice variation.[43] However, for patients admitted with HF, fewer than half of hospitals achieve at least 90% adherence for prescription of three disease-modifying therapies in the context of HFrEF.[39]

Atrial fibrillation

Age

Though prescription of oral anticoagulation has increased amongst all age groups since the introduction of direct oral anticoagulants (DOACs),[44,45] patients at elevated risk of stroke who are aged ≥85 years are 28% less likely to receive oral anticoagulation than individuals a decade younger,[46] and the presence of dementia is a strong predictor of receipt of aspirin instead.[47] All-cause mortality within the first year of AF diagnosis has declined over the last two decades, but both non-cardiovascular and cerebrovascular mortality have failed to decline in those aged ≥80 years.[13] Rates of hospitalisation within one year of AF diagnosis have also increased by 39% in patients aged 80 years or older, but not in septuagenarians.[13]

Sex

Data up to 2019 suggests that there was a minimal sex-determined gap in oral anticoagulant prescribing for stroke prophylaxis, with 66% of women and 69% of men receiving either a DOAC or warfarin.[47] Amongst patients with AF, all-cause mortality within one year of diagnosis is slightly higher in men than women (RR 1.06, 95% CI 1.03–1.10).[13]

Ethnicity

Whilst data from South and East London showed that warfarin prescription did not vary by ethnicity (Table 1),[31] contemporary national data suggests that Black patients, compared with White patients, were more likely to receive no treatment than oral anticoagulation.[47] Follow-up of 400,000 patients in the UK Algorithm for co-morbidity, Associations, Length of stay and Mortality (ACALM) registry demonstrates that South Asian patients have a lower frequency of AF hospitalization compared with White patients (0.8% [1876/243,363] vs 4.5% [51,576/1,151,222], $p < 0.001$) after adjustment for baseline characteristics,[32] though it cannot be distinguished whether this relates to inferior access to care or better disease trajectories. White ethnicity has also been reported to be associated with a 38% higher long-term mortality risk compared with South Asian patients hospitalised with AF,[32] but non-cardiovascular comorbidities were not considered during adjustment, cause-specific mortality was not reported, and Kaplan–Meier curves diverged from inception suggesting potential survivorship bias.

Geography

There is geographic variation in prescription of oral anticoagulation for eligible patients with AF, with data till the end of 2019 demonstrating that, compared with London, prescription of oral anticoagulation was 42% higher in the South West and 26% higher in the West Midlands.[47]

Aortic stenosis

Age

The mean age of patients treated with TAVI has remained steady at about 83 years, with no evidence of a change to treat younger patients by 2016.[48] In those aged >85 years, survival of patients undergoing TAVI matches the general population within 3 years.[49]

Sex

The sex-distribution of TAVI procedures in the UK has remained stable since inception, with 46% of patients treated being women.[48]

Ethnicity

A retrospective single centre cohort study of patients undergoing TAVI demonstrated that Asians (including South Asians and Chinese individuals) were 3 years younger than white patients with more comorbidities and a worse functional status.[50] When adjusted for age, rates of TAVI for the overall population were not different between those of Asian and White ethnicity.

Geography

There is an 11-fold variation between NHS England Clinical Commissioning Groups in TAVI numbers per million patients.[11] Furthermore, the median time from referral to TAVI across TAVI centres varies from 9 weeks to 35 weeks, and delays in treatment result in approximately 500 avoidable deaths per year in the UK.[11]

Summary

There is evidence to suggest that older people and women less frequently receive guideline-recommended treatment for MI, HF and AF (Fig. 1) South Asian patients do not appear to receive unequal treatment when presenting to hospitals with MI and thereafter have case fatality rates similar to White patients. Notably, variation in care delivery between health providers occur for each of MI, HF, AF and AS and this is associated with variation in mortality.

This Series paper also serves to emphasise areas where data is incomplete. Overall, the majority of reports available in the literature related to care for MI, a finding consistent with previous summaries of cardiovascular care delivery (Fig. 2).[14] With the burden of mortality from CHD in decline in the UK, but HF and AF emerging as epidemics,[2,8,9] it is important to refocus research towards these areas. Furthermore, whilst research studies and annual reports from National Cardiac Audits provide consistent evidence for differences in care by age, sex and location, the evidence base for ethnicity for HF and AF is comparatively scarce. Ethnicity information is routinely collected in the UK NHS,[51] so this appears to be an important missed opportunity. Furthermore, reports on ethnicity generally relate to South Asian populations, who make up the largest ethnic minority in the UK (4.9%),[52] but with very little information on care delivery and outcomes for Black patients. For example, though it has been demonstrated that Black patients less frequently receive guideline-recommended oral anticoagulation for stroke prophylaxis in AF,[47] how this relates to outcomes in the UK is unknown.

Recommendations to narrow inequalities in cardiovascular care and outcomes

Geographical inequalities

Continue and enhance nationwide cardiovascular care registries

An understanding of geographic variation in cardiovascular care delivery was only possible because of mature UK nationwide CVD registries. We recommend further reports investigating for inequalities in care and outcomes for people with HF, AF and AS, and that ethnicity-specific reporting is undertaken (Panel 3).

Operationalise cardiac networks and optimise workforce planning and care pathways

Our data support the recommendation from the Cardiology Getting it Right First Time Programme National Speciality Report that networks of hospitals (dictated by function and local need) should work together to ensure that their communities may access various tiers of service on an elective and emergency basis.[53]

Unequal staffing in cardiovascular services between different geographical areas—across doctors, cardiac physiologists, advanced care practitioners and

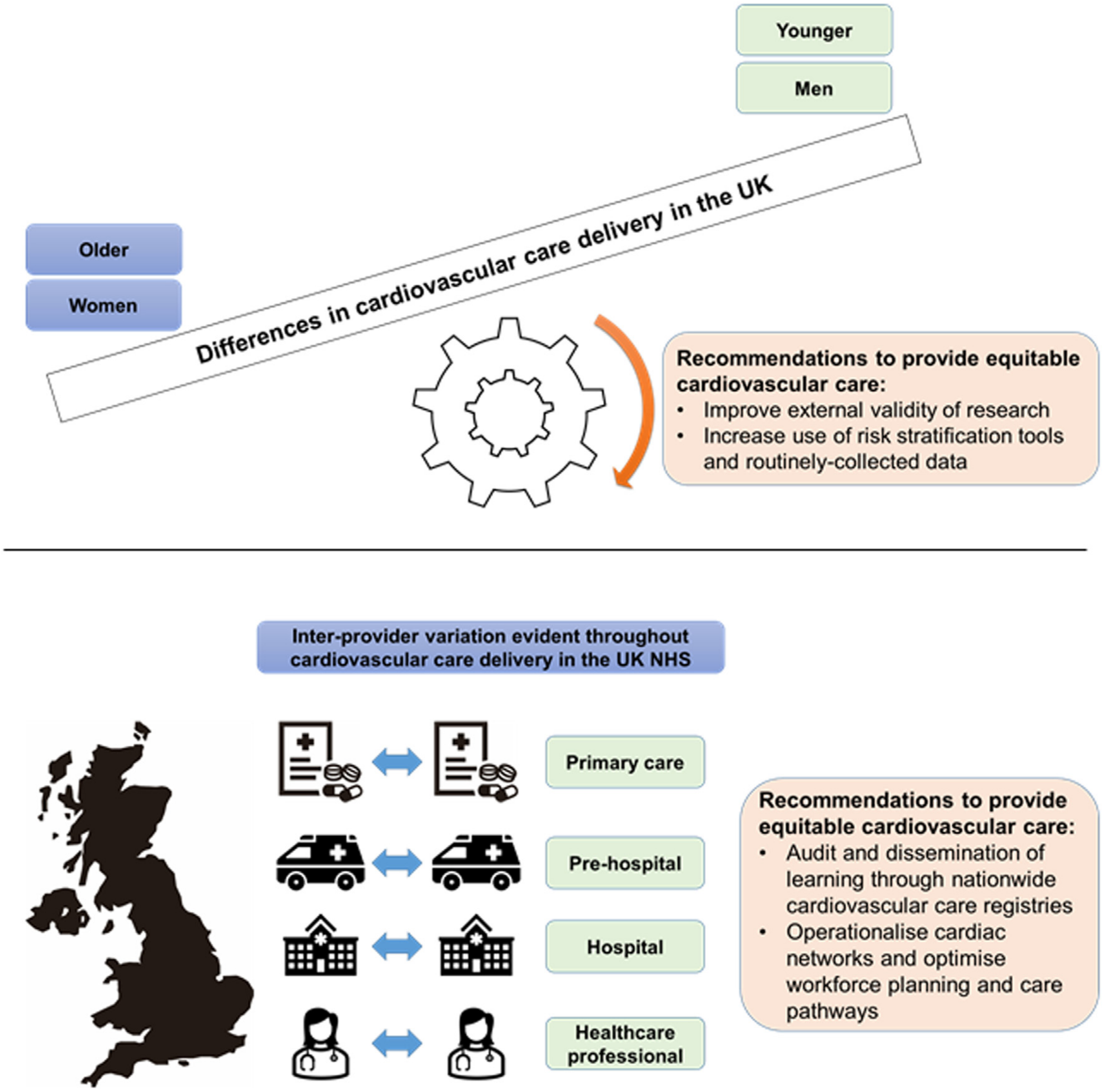

Fig. 1: Differences in cardiovascular care delivery and recommendations to reverse observed trends. Persistent differences in care delivery for myocardial infarction, heart failure, and atrial fibrillation are evident in the UK NHS for older people and women, and between health providers. Understanding these differences may enable innovative tailored policy responses.

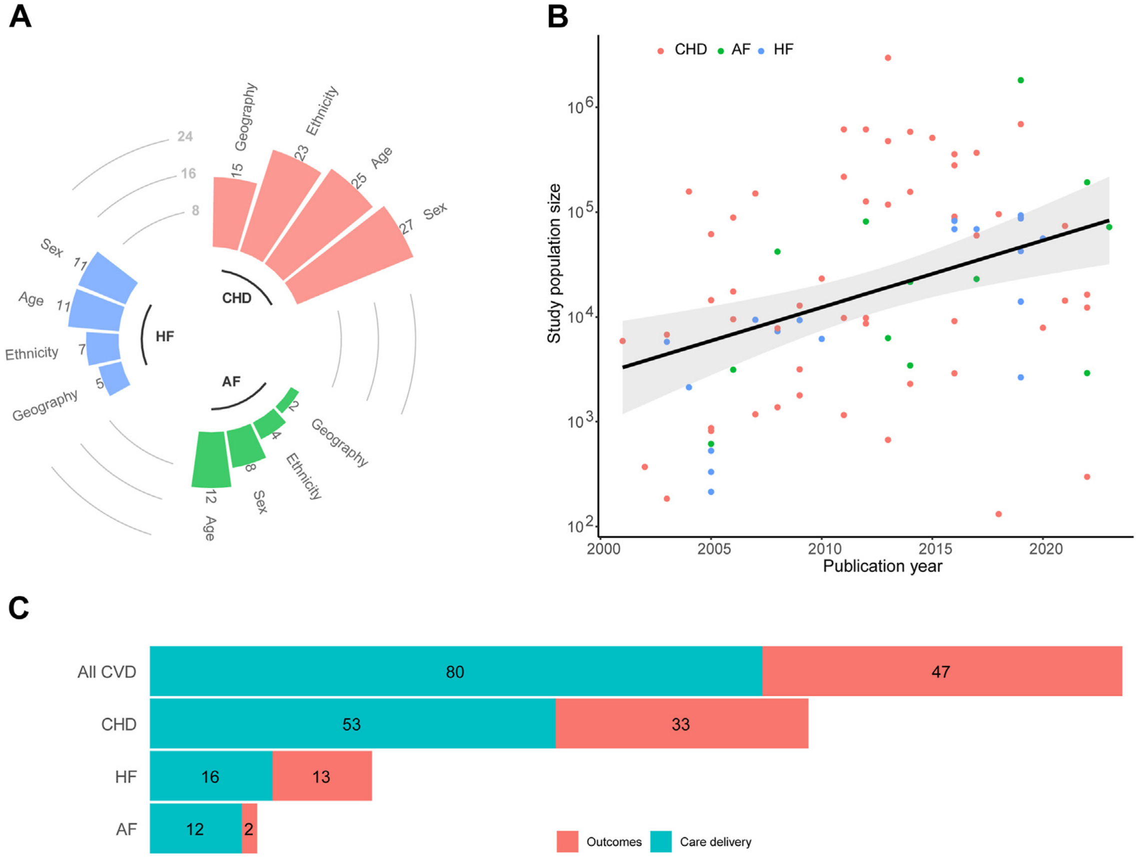

Fig. 2: Summary of included studies according to disease area, inequality investigated, population size and publication year. The majority of studies pertain to coronary heart disease and comparisons of care and outcomes by age and sex. Due to increasing availability of nationwide data sources the population size used for analysis has increased over the last two decades, which may improve the generalisability of findings.

Panel 3: Recommendations for future national policies and efforts to address inequalities in care and outcomes for cardiovascular disease by age, sex, ethnicity and geography.

Geographical inequalities

Continue and enhance nationwide cardiovascular care registries

- Utilise registry data to further explore inequalities in care and outcomes for people with HF and AF.
- Provide ethnicity-specific reporting as standard across the six National Cardiac Audits.

Operationalise cardiac networks and optimise workforce planning and care pathways

- Enact networks of hospitals (dictated by function and local need) with the aim to ensure a comprehensive coverage for all levels of cardiac services to members of the public across the country.
- Ensure capacity by redistributing available roles across each nation and upskill, empower, and extend non-medical graduate roles within appropriate governance structures.
- Develop integrated teams that span primary and secondary care.

Inequalities for older people, women and ethnic minorities

Improve external validity of research

- Targeting research trials to hitherto underrepresented groups and power them to enable sex-specific analyses.
- Support the proliferation of pragmatic data-enabled trials to improve recruitment of a more representative population by improving accessibility to data, reducing costs and standardising the definitions of outcomes in health systems data.

Increase the use of risk stratification tools and leverage routinely-collected data

- Partnerships among providers, healthcare organizations, and researchers could generate novel guideline structures and implementation strategies for clinical decision tools, which can improve clinical decision making by providing objective assessments of risk and benefit.

physician associates—can lead to unequal provision of care. Redistribution of available roles and upskilling across the community and hospital-based workforce to ensure equal capacity is essential. This may be facilitated by the development of integrated cardiovascular services. To achieve this, services need to share management and governance structures, and staff should be able to move freely across care systems where possible, using a 'staff passport' system.[53] Furthermore, with primary care under immense pressure, extending the role of pharmacists in the community to provide medication advice and prescribe and titrate within defined boundaries and governance structures should be supported.[53]

Inequalities for older people, women and ethnic minorities

Improve external validity of research

Women, older people and ethnic minorities have historically been under-represented in the seminal trials that have shaped guidelines,[54] which may lead to concerns that universal extension of study results to clinical practice may be inappropriate. In the UK, data are systematically and routinely collected for the populace regarding hospital healthcare utilisation and mortality alongside comprehensive nationwide CVD registries—providing a platform for pragmatic and/or decentralised trials which can improve recruitment from hitherto underrepresented groups. To realise this opportunity, there is a need to improve accessibility to data, reduce costs and standardise outcome phenotypes in health systems data—including agreeing best practice for the derivation, format, and storage of phenotyping algorithms.[55] The British Heart Foundation Data Science Centre is working with the UK research community, data collators and funders to further understand and overcome these challenges.[55,56]

Increase the use of risk stratification tools and leverage routinely-collected data

Risk prediction tools are intended to estimate prognosis in an unbiased and reliable way, and to provide objective outcome probabilities,[57] which may overcome inaccurate and subjective risk-benefit assessments which may lead to discrepant care.[58] Although the use of such tools is recommended by international clinical practice guidelines,[59,60] they are not adequately implemented in clinical practice.[61] Partnerships among providers, healthcare organizations, and researchers could generate novel guideline structures and implementation strategies for clinical decision tools with the potential to improve patient care and outcomes.[62] For example, 98% of the UK population are registered in primary care with an electronic health record,[63] so a decision support aid that utilises this platform could more accurately inform the use of diagnostics in primary care with the potential to shorten delays in diagnosis.[64]

Limitations

We recognise the potential limitations of our work. First, our findings may be confounded by indication.[65] It is possible that clinicians are appropriately applying clinical judgement in not providing intensive treatment for some older patients and women, especially those that are frail, or have extensive co-morbidity. For example, for older, frail patients, recent randomised controlled trial evidence suggests that an initial conservative strategy in NSTEMI is not inferior to an invasive strategy.[66] Furthermore, women are more likely to have MI in the absence of obstructive coronary artery disease (MINOCA) and so may have been investigated with non-invasive methods before considering and invasive strategy,[67,68] and for this cohort recommendations for pharmacological treatment are less well defined.[59] With regards to secondary prevention and antiplatelet medication after MI, or disease-modifying pharmacotherapies for HFrEF, issues such as hypotension, renal impairment, increased bleeding risk and polypharmacy are more frequent in older patients (and many women presenting with these diseases are older than men).[23] Adherence of medications is also worse in patients who are older, women or more comorbid.[69,70] This may mean that the differences in care we report may be understandable.

Second, socioeconomic status is a major confounding factor for the observed discrepancies in care between groups–including personal, social, cultural, financial, and organisational barriers to access.[47] People must first recognise their eligibility as candidates for healthcare, then have their candidacy assessed and acted upon. The decision to seek help in the first place may be influenced by individual patients' knowledge, information, their evaluation of the seriousness of their problem, their judgement of the ability of the health service to respond, psychological factors such as embarrassment or fear, and practical issues such as the need to rely on public transport or arrange childcare/time off work.[4] Once patients have gained entry to the health system, the categorisation and disposal of their health needs depend to some extent on their ability to present in ways that health professionals find credible and legitimate.[4] In turn, the way in which health professionals categorise health needs may be affected by their perceptions of patient preferences, technical eligibility and moral or social 'deservingness'.[71] For example, we observed geographical variation in prescription of oral anticoagulation for AF, but individuals living in the most deprived areas (index of multiple deprivation [IMD] quintile 5) are 15% less likely to receive oral anticoagulation compared with those who live in the most affluent areas (IMD 1).[47] Furthermore prescription of oral anticoagulation for Black patients in the most deprived areas fell between 2017 and 2019.[47]

Third, we summarise evidence for 'delivery' of care – that is, medications prescribed or procedures performed

Search strategy and selection criteria

We searched Medline for original articles and reviews in English from inception to Dec 23, 2022 using the search terms for “inequity”, “equity” adjacent to “care” “service”, “provision”, “treatment”, or terms of difference including “access” or “barrier” or “challenge” or “disparity”, and “healthcare” and “age” or “sex” or “gender” or “race” or “ethnicity” or “rural” or “location” or “geography” or “primary or “secondary” or “tertiary” and “cardiology” or “cardiac” and a series of disease-specific and procedure-specific terms or terms of outcome such as “survival” or “death” or “prognosis”, then terms to apply a UK geographic search filter. We also searched the reference lists of articles identified by this search strategy and selected those we judged to be relevant. We gave priority to the publications that used nationwide data sources noted in Panel 2. We included the publications and other data sources that we judged to be important and timely contributions to the topic.

– but our data does not capture barriers to access or relevance to need, which have been reviewed elsewhere.[4] Fourth, we report whether the same care interventions are provided to individuals of different age, sex, ethnicity and geographical location (horizontal equity, that is, equal treatment of equals) but we accept that different groups (for example younger and older patients) may have different healthcare requirements outside of the care interventions we focus on. Fifth, we have only focussed on management of STEMI, NSTEMI, HF, AF, and AS after diagnosis but there may also be variation in diagnosis rate and management of conditions that predispose to these conditions, such as hypertension, hyperlipidaemia and diabetes mellitus.[72,73] Variation in the uptake of prevention and control to treatment targets across age, sex, ethnicity, and geography may contribute to observed variations in outcomes. Sixth, differences in care delivery may extend to CVDs beyond those reported here.

Conclusions

Our review of the literature suggests that the UK NHS does not currently provide equitable care to all for MI, HF, AF, and AS and that this is associated with differential outcomes amongst the population. The policy recommendations highlighted in this Series paper align with international trends and guidance, whilst also embracing the unique strengths of the UK health ecosystem. The UK NHS, as a universal healthcare system free at point of care in a data-enabled and high-income country, is well-positioned to explore efficient and effective innovations in care delivery that may curtail and reverse long-standing inequalities, and in doing so provide novel insights for other countries.

Contributors

RN and CPG conceived the topic. MF, KR, JW and RN contributed to the literature search and interpretation of the available evidence. RN drafted the Article. All authors critically revised the manuscript. All authors had full access to all the data in the study and accept responsibility to submit for publication.

Declaration of interests

CPG reports personal fees from AstraZeneca, Amgen, Bayer, Boehrinher-Ingelheim, Daiichi Sankyo, Vifor, Pharma, Menarini, Wondr Medical, Raisio Group and Oxford University Press. He has received educational and research grants from BMS, Abbott inc., the British Heart Foundation, National Institute for Health Research, Horizon 2020, and from the European Society of Cardiology, outside the submitted work. YMN reports a study grant from Bayer. All other authors declare no competing interests.

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