Equity of access to revascularisation in Wales by socioeconomic deprivation

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Public Health Wales Observatory

This publication consists of:

- A detailed report of the findings including tables and charts

- A summary report of the findings

These are available on www.publichealthwalesobservatory.wales.nhs.uk/revasc

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Key Messages

- This study provides evidence that access to revascularisation is currently provided equitably by socioeconomic deprivation for Welsh residents admitted to hospital with a first time acute myocardial infarction (AMI).

- A change in revascularisation provision in south Wales was associated with the elimination of the previously observed inequity between deprivation quintiles.

- Following the change in revascularisation provision in south Wales, rates of revascularisation have increased significantly for all deprivation quintiles, with the greatest increase seen in the most deprived, from 4.32 to 6.89 revascularisations per 1,000 person-days post-AMI. Also revascularisation is being provided in a much timelier manner for all, with almost half of patients receiving revascularisation within a month of admission post-change, a greater proportion than received revascularisation six months post admission leading up to the change.

- Analysis on the residents of north Wales provides evidence of no significant difference in the time to revascularisation between deprivation quintiles.

- The results suggest that measures to reduce previous inequity of access to revascularisation are working, alleviating previous concerns that increased access to revascularisation, in particular percutaneous coronary intervention, would only serve to widen the gap between deprivation quintiles.

- Throughout the study period differences in patient access to revascularisation six months after AMI were seen relating to a number of characteristics, after adjustment for other variables. In the south Wales analysis these include:
    - females were 23% less likely to undergo revascularisation than males
    - patients aged 75 and over were 60% less likely to receive revascularisation than younger patients
    - however, the size of the inequity decreased between the two periods studied

1. Introduction

1.1 Overview

This study investigated whether there is equitable access to revascularisation by socioeconomic deprivation across Wales for patients admitted to hospital with a first time acute myocardial infarction (AMI).

Long-standing evidence of inequity has been shown to exist in the treatment of patients with heart disease, with previous studies concluding that those living in the most socioeconomically deprived areas were disadvantaged in terms of access to revascularisation, despite having a greater need (Lester 2004; Cosh 2008; NPHS 2009; King 2014).

Recent years have seen the development of systematic approaches aimed at achieving greater health equity (Welsh Government 2011a) along with a Cardiac Disease National Service Framework (Welsh Government 2001). These have contributed to substantial changes to the way revascularisation, an effective treatment of heart disease (Keeley et al. 2003; Fox et al. 2010), is provided, with the aim of providing access to the best possible treatment in timely fashion for all with heart disease. This study builds on recommendations to reinvestigate the situation following substantial changes in the provision of revascularisation which have led to an increase in the capacity of revascularisation procedures across Wales.

1.2 Aim

The aim of this study was to investigate whether the historical socioeconomic inequity of access to revascularisation remained following changes in the provision of revascularisation for patients with heart disease in Wales.

1.3 Objectives

1) Establish a cohort of patients admitted to hospital for a first acute myocardial infarction (AMI) using the Secure Anonymised Information Linkage (SAIL) databank and describe the cohort's demographics by socioeconomic deprivation.
2) Investigate the relationship between socioeconomic deprivation and time to revascularisation using Kaplan-Meier, log rank test and Cox Proportional Hazards modelling.

2 Methods

2.1 Study design

The study used a retrospective observational cohort design, which linked the Patient Episode Database for Wales (PEDW) and the Welsh Demographic Service (WDS) datasets held in the SAIL databank. This allowed a cohort of patients to be followed over a period of time, while also allowing for the enumeration of patients lost to follow-up.

2.2 Study population

The study population were residents of Wales aged 35 and over admitted (PEDW emergency admission method 21-28) to a NHS hospital with a first-time primary diagnosis of AMI (ICD-10 code: I21-I22) in any episode of the admitting spell. The first defined admission in the period between 1st January 2010 and 30th June 2013 was chosen as the index admission. Patients with a previous hospitalisation for AMI recorded since the data was available from the 1999/2000 financial year were excluded.

The study population was further restricted to Welsh residents admitted to hospitals in Wales along with Welsh residents admitted to Liverpool Heart and Chest Hospital, Hereford County Hospital, Countess of Chester Hospital and Royal Shrewsbury Hospital since they are commissioned to serve residents of north and mid-Wales.

2.3 Socioeconomic deprivation

The Welsh Index of Multiple Deprivation (WIMD) 2011 (Welsh Government 2011b) was used to assign a measure of deprivation, in the form of deprivation quintiles, to each individual based on their lower super output area (LSOA) of residence.

Seventeen patients (0.1%) were excluded from the study population since they did not have an LSOA code and therefore could not be assigned to a deprivation quintile.

2.4 Non-socioeconomic deprivation variables

Other variables included since they may confound the relationship between socioeconomic deprivation and the receipt of revascularisation were:

- Gender;
- Age (35-54; 55-74; 75+);
- Rural-urban classification of residence (Urban; Town: small town/fringe; Rural: village/hamlet/isolated dwellings);
- Number of comorbidities (none; one; two; three or more). Comorbidities from any diagnosis field, up to five years prior to date of the index admission of AMI, were collected based on the Charlson comorbidity index (Charlson et al. 1987). This index was modified, in that HIV/AIDS is excluded from PEDW for information governance reasons, while AMI was not included since entry into the cohort was based on this diagnosis;
- Admitting hospital catheterisation facilities (no catheterisation facilities; angiography only; revascularisation facilities (PCI and/or CABG)).

2.5 Follow-up & Outcomes

Fifteen patients could not be linked to the WDS using their personal identification number and were excluded from the study. This left a final cohort of 12,525 patients admitted with AMI, with no missing data for any variables.

Patients were followed for up to six months following their index admission for AMI to determine whether they received the study outcome of a revascularisation procedure – coronary artery bypass graft (CABG) or percutaneous coronary intervention (PCI). These were defined according to OPCS-4 as:

Procedure	OPCS-4 code
CABG	K40-K46
PCI	K49-K50, K75

For patients that had a procedure, the episode start date and operation date were used to calculate the number of days to revascularisation.

Data were right-censored for patients not revascularised at the earliest date of a subsequent AMI, death, no longer resident in Wales, or the end of the study period at six months following the index admission for AMI.

A flow diagram of the study population selection process can be seen in appendix 1.

2.6 Analysis

Analysis was performed separately for residents of north Wales and south Wales cardiac networks. North Wales cardiac network is inclusive of those resident in Betsi Cadwaladr University Health Board, with south Wales cardiac network covering the six other health boards in Wales. Analysis on north Wales covered the whole study period of 2010-13 with no major changes over this time to the provision of revascularisation. Analysis on south Wales was split into two cohorts of those admitted in the 24 months between 01/01/2010 to 31/12/2011 (2010-11 cohort) and those admitted in the 18 months between 01/01/2012 to 31/06/2013 (2012-13 cohort), with the 2012-13 cohort relating to the time period post change in the provision of revascularisation.

2.6.1 Descriptive Analysis

The chi-squared test was used to assess the distribution of the cohorts according to socioeconomic deprivation by the other explanatory variables, with a p-value <0.05 used to determine a statistically significant association. The incidence rate of revascularisation per 1,000 person-days post-AMI admission was calculated for each deprivation quintile, while also accounting for censoring, meaning that each person only contributed the number of days that they were followed up within the cohort.

2.6.2 Univariable Analysis

Kaplan-Meier estimates along with the log rank test for the equality of time to six month revascularisation were calculated to provide a univariable summary of the data for both periods, under the null hypothesis:

H_0: no difference in the time to revascularisation of individuals by deprivation quintiles

2.6.3 Multivariable Analysis

Cox proportional hazards models were used to estimate hazard ratios to determine whether time to revascularisation differed between deprivation quintiles for each cohort studied, while allowing for the simultaneous adjustment for other explanatory variables in the cohorts.

Hazard ratios were calculated for each deprivation quintile, with the least deprived quintile as the reference group.

The study followed Hosmer and Lemeshow's (1999) 'purposeful selection of covariates' for model selection, which included testing for interactions. The proportional hazards assumption, a required assumption of the model, was tested using both a formal significance test based on Schoenfeld residuals, along with plots of both the Schoenfeld residuals and cumulative hazards. In all models, the admitting hospital catheterisation facilities variable violated the proportional hazards assumption, with the cumulative hazard plots converging as time increased. This showed that patients admitted to a cardiac hospital received revascularisation more quickly than a non-cardiac hospital in approximately the first three weeks following admission. Over the rest of the study period the likelihoods were proportional. All models were therefore stratified on the non-adhering variable of admitting hospital catheterisation facilities. This meant that the variable could be adjusted for in the modelling process without estimating its effect, due to its violation of the proportional hazards assumption. The proportional hazards assumption was satisfied in all stratified models.

A sensitivity analysis was run with the most deprived quintile compared to all other quintiles combined, rather than only the least deprived quintile. This analysis produced similar results to the primary analysis.

Analysis was performed using STATA13 (StataCorp 2013) in the SAIL gateway.

3 Results – North Wales

3.1 Baseline Characteristics

Of the 12,525 patients in the study, 3,397 patients were in the north Wales cohort.

Patients in the most deprived quintile were more likely than those in the least deprived to be younger, in particular aged under 55 years, resident in urban areas and admitted to hospitals with revascularisation facilities (Appendix 2: Table 1).

Patients in the most deprived quintile had the highest incidence rate of 6.10 revascularisations per 1,000 person-days post-AMI, with the lowest rate in the least deprived with 5.18 revascularisations per 1,000 person-days post-AMI. However there was no significant difference in the incidence rates between quintiles (Appendix 2: Table 2). Overall in north Wales there were 5-times as many PCI procedures as CABG procedures.

3.2 Univariable Analysis

Kaplan-Meier estimates showed that at any time during the six months follow-up those in the most deprived quintile were more likely to receive revascularisation than those in any other quintile. Only in the most deprived quintile did over one-half of patients receive revascularisation at the end of the six months follow-up. However, the log rank test (p=0.31) indicated no significant difference in the time to revascularisation in the six months follow-up between quintiles (Appendix 2: Figure 1).

3.3 Multivariable Analysis

There was no significant difference in the likelihood of revascularisation at any time during the six months follow-up between quintiles, having adjusted for the effects of gender, age and comorbidities, and stratified on the admitting hospital catheterisation facilities variable (Table 3.1, Figure 3.1). The rural-urban classification was removed from the model, due to being non-significant in the multivariable model.

However, females were 33% less likely to receive revascularisation at any time in the six months follow-up compared to males (HR=0.67; 95% CI: 0.60 to 0.75, p<0.001), while those aged 75+ were 65% less likely to receive revascularisation compared to those aged 35-54 years (HR=0.35; 95% CI: 0.30 to 0.41, p<0.001). Increasing number of comorbidities was associated with a significant decreased likelihood of revascularisation, with those with 3 or more comorbidities 70% less likely to receive revascularisation compared to those with no comorbidities (HR=0.30; 95% CI:0.24 to 0.38, p<0.001).

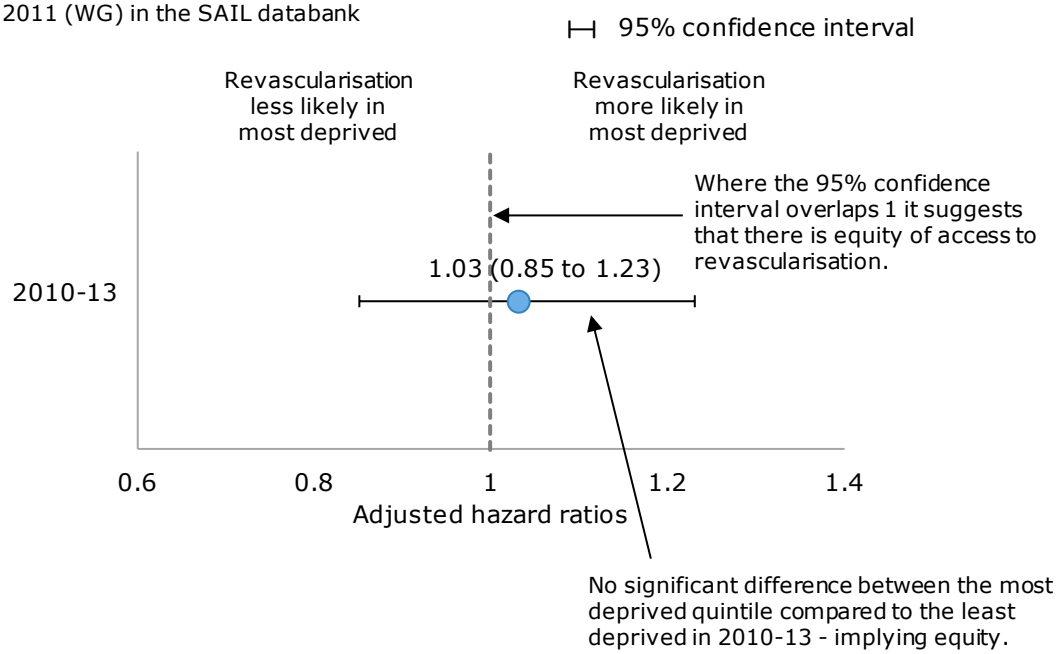
Table 3.1: Adjusted hazard ratios with 95% confidence intervals for six month revascularisation following hospital admission with first-time AMI for north Wales residents, 2010-13

	2010-13	
Explanatory variable	**Hazard ratio (95% CI)**	**p-value**
Deprivation Quintiles		
1 (Least deprived)	1	
2	1.05 (0.90 to 1.23)	0.520
3	1.04 (0.89 to 1.22)	0.614
4	0.98 (0.83 to 1.16)	0.819
5 (Most deprived)	1.03 (0.85 to 1.23)	0.786
Gender		
Males	1	
Females	0.67 (0.60 to 0.75)	<0.001
Age		
35-54	1	
55-74	0.87 (0.73 to 1.02)	0.073
75+	0.35 (0.30 to 0.41)	<0.001
Comorbidities		
0	1	
1	0.73 (0.65 to 0.82)	<0.001
2	0.47 (0.39 to 0.57)	<0.001
3 or more	0.30 (0.24 to 0.38)	<0.001

Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS) and WIMD 2011 (WG) in the SAIL databank

All explanatory variables are adjusted for each other and stratified by the admitting hospital catheterisation facilities variable since this variable did not meet the proportional hazards assumption

Figure 3.1: Equity of access to revascularisation* for the most deprived quintile (reference: least deprived quintile), north Wales, 2010-13
Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) in the SAIL databank



*for Welsh residents admitted to hospital with a first time acute myocardial infarction

4 Results – South Wales

4.1 Baseline Characteristics

5,431 patients were in the south Wales 2010-11 cohort (01/1/2010 to 31/12/2011) and 3,697 patients in the south Wales 2012-13 cohort (01/01/2012 to 30/06/2013).

In both cohorts, patients in the most deprived quintile were more likely than those in the least deprived to be younger, in particular aged under 55 years, resident in urban areas, have more comorbidities and admitted to hospitals with no revascularisation facilities (Appendix 3: Table 1; Table 2).

In both cohorts, patients in the most deprived quintile had the lowest incidence rate of revascularisation. However, the incidence rate in each quintile in the 2012-13 cohort was statistically significantly higher than the rate in each quintile in the 2010-11 cohort (Appendix 3: Table 3). There were 4-times as many PCI procedures as CABG procedures in the 2010-11 cohort, this rose to 6-fold in the 2012-13 cohort.

4.2 Univariable Analysis

Kaplan-Meier estimates confirmed that the most deprived quintile received the least revascularisation in the six months following admission for a first AMI in both cohorts (2010-11=41.5%; 2012-13=52.1%). The time to revascularisation was statistically significantly longer for the most deprived quintile in 2010-11 compared to the other quintiles (p=0.02). However, no significant difference was seen in the equality of time to revascularisation between quintiles in 2012-13 (p=0.78).

Kaplan-Meier estimates showed that the proportion of patients receiving revascularisation on the first day following admission doubled between the two cohorts to between 17%-20% for all quintiles in the 2012-13 cohort. In addition, a greater proportion of patients in all quintiles received revascularisation in the first month post-AMI admission in the 2012-13 cohort compared to six-months post-AMI admission in the 2010-11 cohort (Appendix 3: Figure 1; Figure 2).

4.3 Multivariable analysis

In the 2010-11 cohort, there was a significant difference in the time to revascularisation between quintiles, with those in the most deprived quintile 20% (HR=0.80; 95% CI: 0.69 to 0.92, p=0.002) less likely to receive revascularisation at any time during the six months follow-up compared to those in the least deprived. However in the 2012-13 cohort, there was no significant difference in the likelihood of revascularisation at any time during the six months follow-up for patients in the most deprived quintile compared to the least deprived (HR=1.04; 95% CI: 0.89 to 1.20, p<0.649), having adjusted for the effects of gender, age, rural-urban classification, comorbidities and stratified on the admitting hospital catheterisation facilities variable (Table 4.1, Figure 4.1).

In both cohorts, females were significantly less likely to receive revascularisation at any time during the six months follow-up; however while females were 33% (HR=0.67; 95% CI: 0.61 to 0.75, p<0.001) less likely in the 2010-11 cohort, this had decreased to 23% (HR=0.77; 95% CI: 0.70 to 0.85, p<0.001) in the 2012-13 cohort. Compared to those aged 35-54, those aged 55-74 were significantly less likely to receive revascularisation in 2010-11 (HR=0.73; 95% CI: 0.66 to 0.81, p<0.001), but not in 2012-13 (HR=0.95; 95% CI: 0.84 to 1.07, p=0.372). Those aged 75 years and over were significantly less likely to receive revascularisation in both cohorts,

although the hazard ratios moved closer towards no significant difference between the two periods (2012-13: HR=0.40; 95% CI: 0.35 to 0.46, p<0.001). Compared to patients resident in urban areas, patients resident in rural areas were significantly more likely to receive revascularisation in both cohorts, with little change between cohorts. Increasing number of comorbidities showed a very strong association with decreasing likelihood of revascularisation in both cohorts, with those with 3 or more comorbidities having a 65% decreased likelihood of revascularisation compared to those with no comorbidities in 2012-13 (HR=0.35; 95% CI: 0.29 to 0.43, p<0.001).

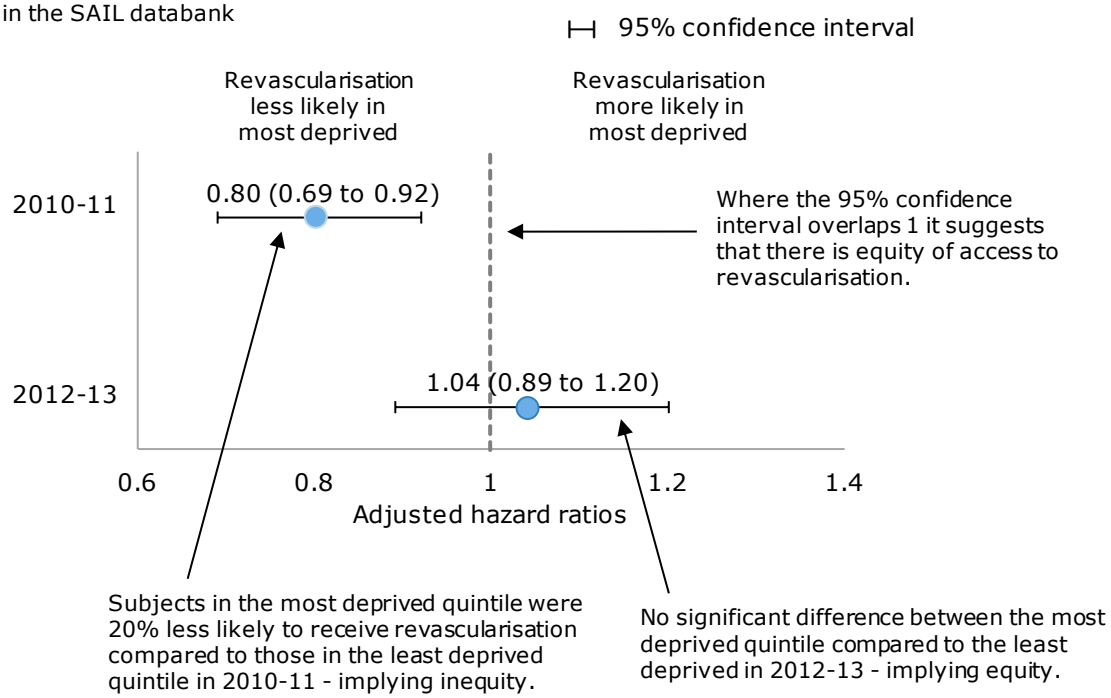
Table 4.1: Adjusted hazard ratios with 95% confidence intervals for six month revascularisation following hospital admission with first-time AMI for south Wales residents, 2010-13

	2010-11 cohort		2012-13 cohort	
Explanatory variable	**Hazard ratio (95% CI)**	**p-value**	**Hazard ratio (95% CI)**	**p-value**
Deprivation Quintiles				
1 (Least deprived)	1		1	
2	1.05 (0.91 to 1.23)	0.445	1.07 (0.91 to 1.25)	0.396
3	1.00 (0.87 to 1.15)	0.987	1.03 (0.88 to 1.19)	0.739
4	0.93 (0.81 to 1.07)	0.312	1.08 (0.94 to 1.26)	0.285
5 (Most deprived)	0.80 (0.69 to 0.92)	0.002	1.04 (0.89 to 1.20)	0.645
Gender				
Males	1		1	
Females	0.67 (0.61 to 0.75)	<0.001	0.77 (0.70 to 0.85)	<0.001
Age				
35-54	1		1	
55-74	0.73 (0.66 to 0.81)	<0.001	0.95 (0.84 to 1.07)	0.372
75+	0.22 (0.20 to 0.25)	<0.001	0.40 (0.35 to 0.46)	<0.001
Rural-Urban Classification				
Urban	1		1	
Town	1.14 (1.02 to 1.29)	0.024	1.12 (0.99 to 1.28)	0.081
Rural	1.21 (1.07 to 1.37)	0.002	1.25 (1.08 to 1.43)	0.002
Comorbidities				
0	1		1	
1	0.78 (0.71 to 0.86)	<0.001	0.83 (0.75 to 0.93)	0.001
2	0.50 (0.43 to 0.58)	<0.001	0.55 (0.47 to 0.64)	<0.001
3 or more	0.30 (0.25 to 0.36)	<0.001	0.35 (0.29 to 0.43)	<0.001

Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) and rural/urban classification 2004 (ONS) in the SAIL databank

All explanatory variables are adjusted for each other and stratified by the admitting hospital catheterisation facilities variable since this variable did not meet the proportional hazards assumption.

Figure 4.1: Equity of access to revascularisation* for the most deprived quintile (reference: least deprived quintile), south Wales, 2012-13 compared to 2010-11
Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) in the SAIL databank



*for Welsh residents admitted to hospital with a first time acute myocardial infarction

5 Discussion

The results of this study suggest that measures to improve access to services are working, with previous signs of socioeconomic inequity of access to revascularisation not apparent, but rather increased access for all and in a timelier manner regardless of socioeconomic deprivation for patients admitted to hospital with a first time AMI.

5.1 Summary of results

The results are summarised in relation to the study objectives.

5.1.1 Objective 1

1. Welsh residents from the most deprived quintile admitted with AMI were more likely to be younger and living in urban areas than those from the least deprived quintile.

2. Residents from the most deprived quintile in north Wales were more likely to be admitted to hospitals with revascularisation facilities, while in south Wales they were more likely to have comorbidities and be admitted to hospitals without revascularisation facilities, compared to those from the least deprived quintile.

5.1.2 Objective 2

1. Both univariable and multivariable analysis showed there was no difference in the time to revascularisation between quintiles for north Wales residents.

2. While there was evidence of inequity by socioeconomic deprivation in south Wales in 2010-11, with those in the most deprived quintile 20% less likely to receive revascularisation compared to patients in the least deprived quintile, there was not a significant difference in the time to revascularisation between quintiles in 2012-13.

3. Increased incidence rates of revascularisation have benefitted all, with rates statistically significantly higher in each quintile in the 2012-13 cohort compared to the rates in all quintiles in 2010-11 in south Wales.

4. Revascularisation is being provided in a timelier manner. The proportion of patients that received revascularisation on the first day following admission doubled between 2010-11 and 2012-13 for all quintiles in south Wales. Also, a greater proportion received revascularisation in the first month post-admission in all quintiles in 2012-13 compared to six months post-admission in 2010-11.

5. Inequity persists for both females and those aged 75 years and over in the time to revascularisation in the six months following AMI admission in both north and south Wales.

5.2 Possible explanations for the patterns observed & implications for policy

These results not only differ between the two periods studied in south Wales but also previous studies (Lester 2004; Cosh 2008; NPHS 2009; King 2014) into inequity of access to revascularisation in Wales, which concluded that those living in the most socioeconomically deprived areas were disadvantaged in terms of access to revascularisation.

The most likely explanation for the apparent change from inequity to equity of access to revascularisation are that the *Cardiac Disease National Service Framework* (Welsh Government 2009a) along with other Welsh Government policies to reduce inequity in health such as *Fairer Health Outcomes for All* (Welsh Government 2011a) and *Our Healthy Future* (Welsh Government 2009b), are beginning to be effective. In addition, a *Cardiac Service Review* in 2011 by the Welsh Health Specialised Services Committee (WHSSC) also highlighted a number of changes in the provision of revascularisation. This included the benefit of revascularisation in more high risk patients and older patients, which would have diluted any previous socioeconomic inequity since patients from the more deprived areas are associated with worse clinical prognosis following AMI (Bergström et al. 2015), along with substantial capital investment in cardiac laboratories allowing more patients to be treated. The increased capacity of revascularisation saw PCI activity in Wales increase by almost 25% between 2010 and 2013 to 1,341 PCI per million population, with primary PCI trebling over the same period to 333 primary PCI per million population (BCIS 2014).

Since the NPHS report in 2009, which used data up to 2006, Glan Clwyd Hospital in north Wales has moved from only starting to provide angiography in March 2006 to providing PCI from mid-2009. A PCI service in Glan Clwyd Hospital would not only have taken the burden off Liverpool Heart and Chest Hospital but also increased capacity of revascularisation for those in the north and decreased waiting times. Increased access for all in north Wales should continue with the expansion of facilities in Glan Clwyd Hospital in August 2014 and a 24/7 primary PCI service for north Wales implemented in autumn 2015. Likewise in south Wales, Royal Gwent started providing PCI mid-2011, therefore providing a more local service for the Aneurin Bevan health board, which has areas of high deprivation.

2012 saw access to primary PCI expanded across the whole of south Wales, with "overwhelming evidence" of its effectiveness (WHSSC 2011). The expansion of the primary PCI service across the whole of south Wales has not only made the delivery of revascularisation quicker but has also seemingly reduced the socioeconomic deprivation impact of access to revascularisation for those with a first time AMI. The reduced impact of deprivation following the introduction of primary PCI has been noted elsewhere, with socioeconomic factors having a small impact on time to revascularisation after presenting to a healthcare facility (Agarwal et al. 2014). Previous inequity may have existed with physicians' perceptions of non-clinical factors, such as low socioeconomic status (SES), unhealthy lifestyle, and lack of social support, having more of a role, with the influence of non-clinical factors only diminishing once patients reached a cardiothoracic specialist (Barnhart et al. 2003).

However, the study concentrated only on patients with a first time hospital admission for AMI, with emergency admissions used on the basis that they seem to avoid the difficulty that other types of admissions have in differing threshold for referrals and waiting times. While we can conclude that there is currently no socioeconomic deprivation inequity in those that are admitted directly to hospitals with a first time AMI, inequity could reside in the community, with a greater degree of impact of SES on the duration between symptom onset and first medical contact (Agarwal et al. 2014). Patients with angina may also be suitable for revascularisation. Those with angina generally present to their primary care physician, however, the most deprived have different illness thresholds and lower expectations in consulting GPs and therefore are less likely to visit a GP (Hippisley-Cox and Pringle 2000; Richards et al. 2002); whilst socioeconomic differences could reside in GPs referrals to specialist care with the least deprived having a seemingly "louder voice" and greater expectations (McBride et al. 2010). Korda et al. (2009) suggested that socioeconomic inequity existed in patients with angina but not AMI due to more discretion being used since intervention guidelines for angina are not as well established as those for AMI.

In contrast, females and the older aged continued to be significantly less likely to receive revascularisation in the six months following AMI admission. The most likely explanation for

inequity in the older aged is, despite the falling thresholds in eligibility for revascularisation and adjusting for the number of comorbidities present in the models, that they are too ill-health to undergo a procedure. The reason for the apparent inequity in females is less obvious and requires further investigation. The lack of interaction between females and age means it cannot all be attributed to females being admitted at an older age than males. One possible explanation is that STEMI is more often diagnosed in males (Barlyski et al. 2011), and therefore the expanded access to primary PCI would have continued to benefit males more than females, with primary PCI provided to those with STEMI with a call-to-balloon time target of 120 minutes. However, part of the inequity is more than likely due to an inability of the study to fully adjust for all clinical conditions.

5.3 Limitations of the study

The study could not distinguish between ST Segment Elevation Myocardial Infarction (STEMI) and non-ST Segment Elevation Myocardial Infarction (NSTEMI), meaning they had to be analysed together, although clinically they are both managed differently. Future research could link the existing dataset to the Myocardial Ischaemia National Audit Project (MINAP) dataset, which distinguishes between STEMI and NSTEMI, and possibly the SAIL GP dataset, as it increases its coverage throughout Wales. This would allow other confounding variables such as smoking status, alcohol intake and BMI to be used, subject to an assessment of data quality and completeness.

The study could not include patients managed privately, with individuals in the least deprived quintile more likely to benefit from private healthcare. However, none of the five private hospitals in Wales offered revascularisation during the study period.

The assignment of SES to an individual based on the characteristics of area of residence and not on an individual's characteristics is prone to the ecological fallacy (Robinson 1950). However, this was the only reasonable option and the assignment of area-based deprivation measures to individuals is commonly used. In response to the ecological fallacy, Alker et al. (1969) made reference to the "individualistic fallacy", whereby one wrongly assumes that individuals are unaffected by the neighbourhood in which they live, which individual-level SES does not account for.

6 Conclusions

This study investigated access to revascularisation for patients with first time AMI by socioeconomic deprivation in Wales. Recent years have seen increased resources in the provision of revascularisation, prior to this previous studies concluded that patients living in the most deprived areas of Wales were disadvantaged in terms of access to revascularisation.

The key findings were:

- Access to revascularisation following first time AMI is being provided equitably by socioeconomic deprivation for Welsh residents.
- A change in revascularisation provision in south Wales was associated with the elimination of the previously observed inequity between deprivation quintiles, along with statistically significantly increased rates of revascularisation for all deprivation quintiles and much timelier access to revascularisation.
- Analysis on the residents of north Wales provides evidence of no significant difference in the time to revascularisation between deprivation quintiles.
- Results suggest inequity of access to revascularisation persist for both females and those aged 75 years and over across Wales.

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Appendix 1

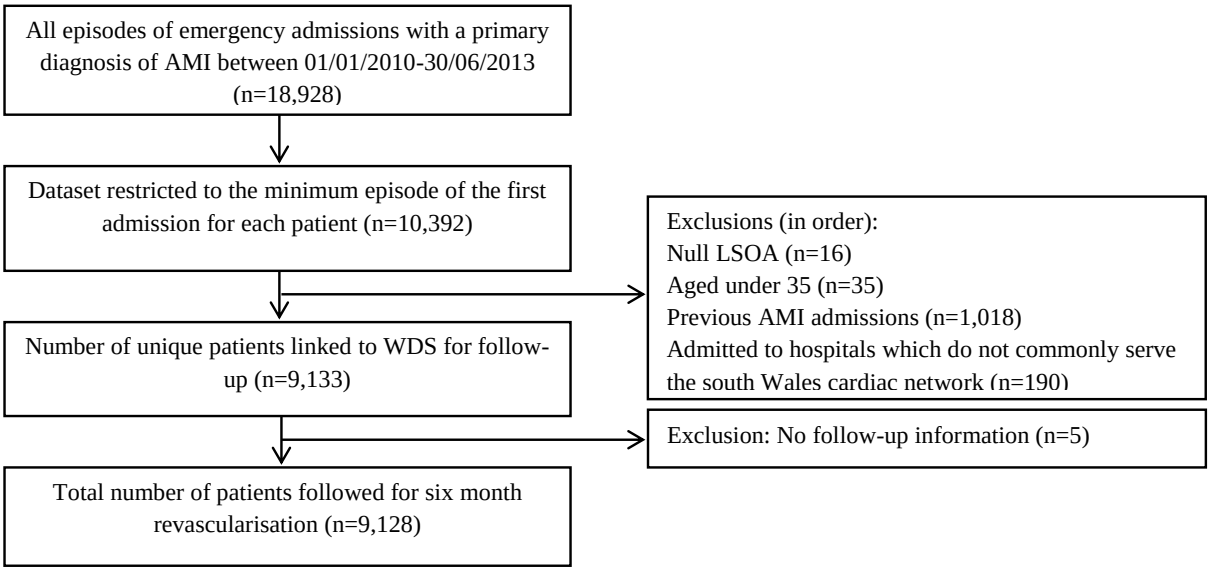

Figure 1: Flow diagram of study population selection

Appendix 2

Table 1: Distribution of characteristics and outcomes by deprivation quintile of patients resident in north Wales admitted to hospital with acute myocardial infarction, 2010-13

	1 (Least deprived)		2		3		4		5 (Most deprived)		
	n	%	n	%	n	%	n	%	n	%	p-value
Gender											
Males	418	67.1	527	62.6	515	60.8	416	62.7	258	61.1	
Females	205	32.9	315	37.4	332	39.2	247	37.3	164	38.9	0.420
Age											
35-44	16	2.6	32	3.8	23	2.7	22	3.3	15	3.6	
45-54	53	8.5	92	10.9	93	11.0	93	14.0	73	17.3	
55-64	114	18.3	125	14.8	145	17.1	130	19.6	88	20.9	
65-74	159	25.5	185	22.0	199	23.5	169	25.5	102	24.2	
75-84	166	26.6	244	29.0	236	27.9	153	23.1	99	23.5	
85+	115	18.5	164	19.5	151	17.8	96	14.5	45	10.7	<0.001
Comorbidities											
0	299	48.0	361	42.9	365	43.1	272	41.0	187	44.3	
1	161	25.8	235	27.9	228	26.9	191	28.8	106	25.1	
2	83	13.3	136	16.2	136	16.1	112	16.9	72	17.1	
3 or more	80	12.8	110	13.1	118	13.9	88	13.3	57	13.5	0.664
Rural-Urban Classification											
Urban	293	47.0	293	34.8	302	35.7	406	61.2	385	91.2	
Town	233	37.4	204	24.2	271	32.0	145	21.9	37	8.8	
Rural	97	15.6	345	41.0	274	32.3	112	16.9	0	0.0	<0.001
Admitting Hospital											
No catheterisation facilities	378	60.7	518	61.5	602	71.1	350	52.8	174	41.2	
Angiography only	60	9.6	83	9.9	25	3.0	51	7.7	43	10.2	
Revascularisation	185	29.7	241	28.6	220	26.0	262	39.5	205	48.6	<0.001

Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) and rural/urban classification 2004 (ONS) in the SAIL databank

Table 2: Incidence rate per 1,000 person days at risk for six month revascularisation following first-time AMI for north Wales residents, 2010-13

	Person-time at risk	Total	Incidence rate (95% CI)
Socioeconomic deprivation			
1 (Least deprived)	53485	277	5.18 (4.60 - 5.83)
2	67304	374	5.56 (5.02 - 6.15)
3	70681	363	5.14 (4.63 - 5.69)
4	54922	301	5.48 (4.90 - 6.14)
5 (Most deprived)	33610	205	6.10 (5.32 - 6.99)

Produced by Public Health Wales Observatory, using PEDW and WDS (NWIS) in the SAIL databank

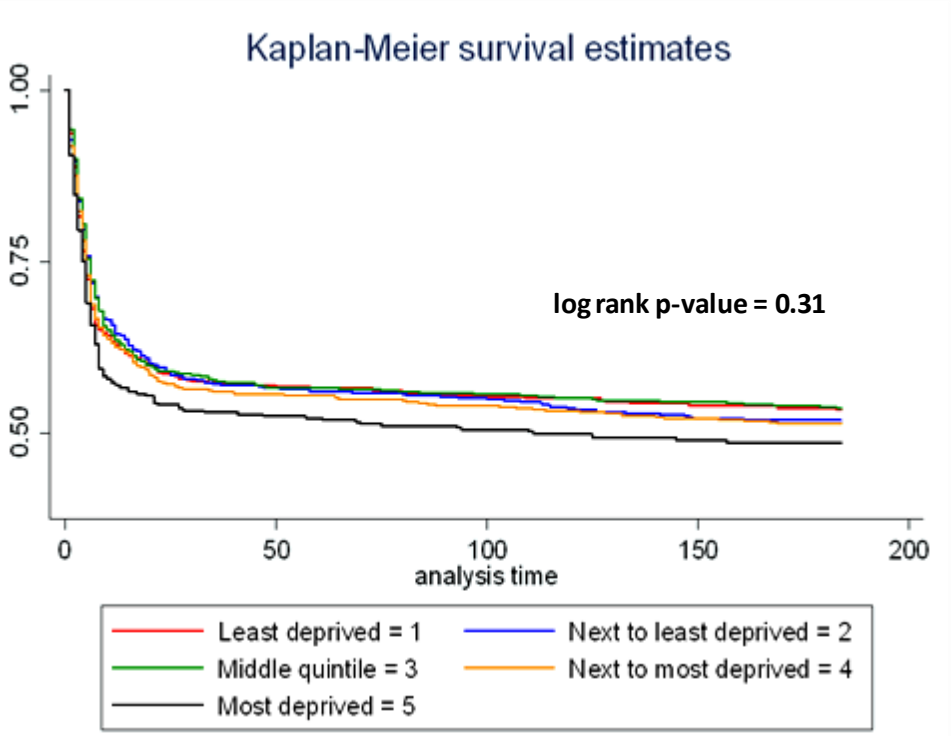

Figure 1: Kaplan-Meier estimator of time to six month revascularisation by deprivation quintiles following first-time AMI for residents of north Wales, 2010-13

Appendix 3

Table 1: Distribution of characteristics by deprivation quintile of patients resident in south Wales admitted to hospital with acute myocardial infarction, 2010-11

	1 (Least deprived)		2		3		4		5 (Most deprived)		
	n	%	n	%	n	%	n	%	n	%	p-value
Gender											
Males	534	65.9	594	62.1	751	61.7	737	59.9	734	60.3	
Females	276	34.1	362	37.9	466	38.3	493	40.1	484	39.7	0.063
Age											
35-44	15	1.9	22	2.3	34	2.8	52	4.2	52	4.3	
45-54	65	8.0	87	9.1	124	10.2	147	12.0	160	13.1	
55-64	137	16.9	170	17.8	236	19.4	228	18.5	243	20.0	
65-74	165	20.4	227	23.7	297	24.4	301	24.5	279	22.9	
75-84	247	30.5	255	26.7	326	26.8	287	23.3	283	23.2	
85+	181	22.3	195	20.4	200	16.4	215	17.5	201	16.5	<0.001
Comorbidities											
0	318	39.3	386	40.4	469	38.5	461	37.5	412	33.8	
1	235	29.0	298	31.2	361	29.7	339	27.6	368	30.2	
2	128	15.8	137	14.3	215	17.7	208	16.9	205	16.8	
3 or more	129	15.9	135	14.1	172	14.1	222	18.0	233	19.1	<0.001
Rural-Urban Classification											
Urban	602	74.3	443	46.3	715	58.8	945	76.8	1036	85.1	
Town	106	13.1	167	17.5	181	14.9	217	17.6	175	14.4	
Rural	102	12.6	346	36.2	321	26.4	68	5.5	7	0.6	<0.001
Admitting Hospital											
No catheterisation facilities	214	26.4	374	39.1	582	47.8	380	30.9	418	34.3	
Angiography only	332	41.0	404	42.3	404	33.2	593	48.2	521	42.8	
Revascularisation	264	32.6	178	18.6	231	19.0	257	20.9	279	22.9	<0.001

Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) and rural/urban classification 2004 (ONS) in the SAIL databank

Table 2: Distribution of characteristics and outcomes by deprivation quintile of patients resident in south Wales admitted to hospital with acute myocardial infarction, 2012-13

	1 (Least deprived)		2		3		4		5 (Most deprived)		
	n	%	n	%	n	%	n	%	n	%	p-value
Gender											
Males	382	62.5	384	60.0	455	61.2	520	64.3	517	57.9	
Females	229	37.5	256	40.0	289	38.8	289	35.7	376	42.1	0.087
Age											
35-44	18	2.9	9	1.4	29	3.9	28	3.5	46	5.2	
45-54	48	7.9	74	11.6	80	10.8	99	12.2	123	13.8	
55-64	103	16.9	108	16.9	141	19.0	155	19.2	169	18.9	
65-74	143	23.4	155	24.2	172	23.1	186	23.0	206	23.1	
75-84	161	26.4	170	26.6	177	23.8	223	27.6	209	23.4	
85+	138	22.6	124	19.4	145	19.5	118	14.6	140	15.7	<0.001
Comorbidities											
0	259	42.4	263	41.1	291	39.1	304	37.6	309	34.6	
1	178	29.1	189	29.5	227	30.5	237	29.3	271	30.3	
2	107	17.5	92	14.4	121	16.3	144	17.8	143	16.0	
3 or more	67	11.0	96	15.0	105	14.1	124	15.3	170	19.0	0.007
Rural-Urban Classification											
Urban	439	71.8	323	50.5	453	60.9	592	73.2	753	84.3	
Town	88	14.4	122	19.1	111	14.9	158	19.5	130	14.6	
Rural	84	13.7	195	30.5	180	24.2	59	7.3	10	1.1	<0.001
Admitting Hospital											
No catheterisation facilities	110	18.0	168	26.3	242	32.5	217	26.8	254	28.4	
Angiography only	148	24.2	191	29.8	156	21.0	233	28.8	209	23.4	
Revascularisation	353	57.8	281	43.9	346	46.5	359	44.4	430	48.2	<0.001

Produced by Public Health Wales Observatory, using PEDW (NWIS), WDS (NWIS), WIMD 2011 (WG) and rural/urban classification 2004 (ONS) in the SAIL databank

Table 3: Incidence rate per 1,000 person-days post-AMI for six month revascularisation following first-time acute myocardial infarction for south Wales residents, 2010-13

	2010-11 cohort			2012-13 cohort		
	Person-days post-AMI	Total	Incidence rate (95% CI)	Person-days post-AMI	Total	Incidence rate (95% CI)
Deprivation Quintiles						
1 (Least deprived)	65589	328	5.00 (4.49 to 5.57)	41481	318	7.67 (6.87 to 8.56)
2	77583	427	5.50 (5.01 to 6.05)	42792	327	7.64 (6.86 to 8.52)
3	96486	533	5.52 (5.07 to 6.01)	51975	373	7.18 (6.48 to 7.94)
4	103008	514	4.99 (4.58 to 5.44)	54798	418	7.63 (6.93 to 8.40)
5 (Most deprived)	105624	456	4.32 (3.94 to 4.73)	63533	438	6.89 (6.28 to 7.57)

Produced by Public Health Wales Observatory, using PEDW and WDS (NWIS) in the SAIL databank

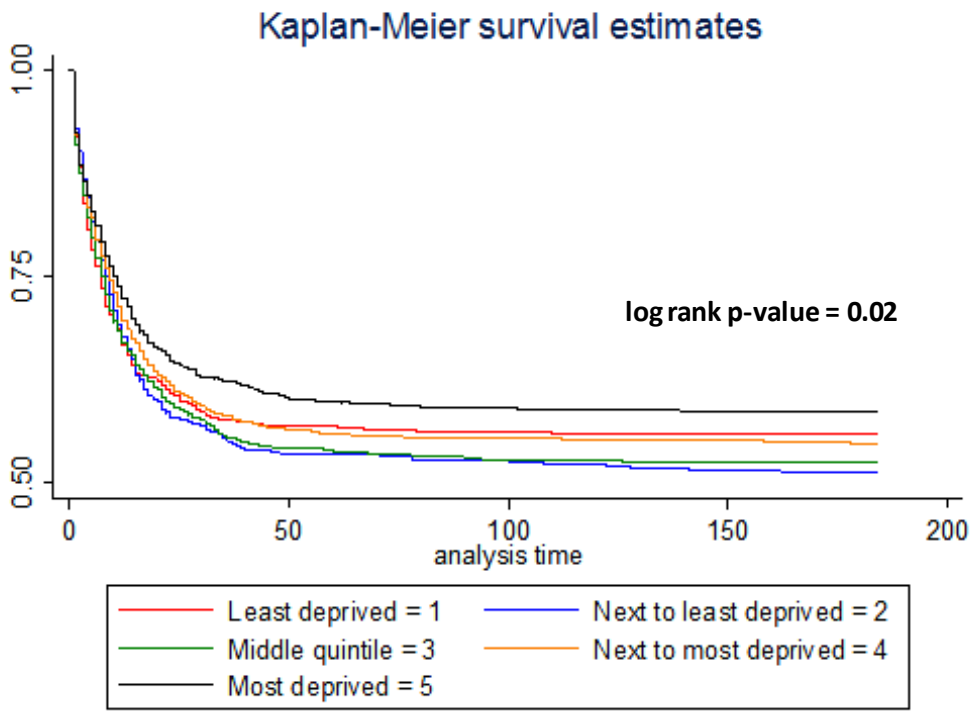

Figure 1: Kaplan-Meier estimator of time to six month revascularisation by deprivation quintiles following first-time AMI for residents of south Wales, 2010-11

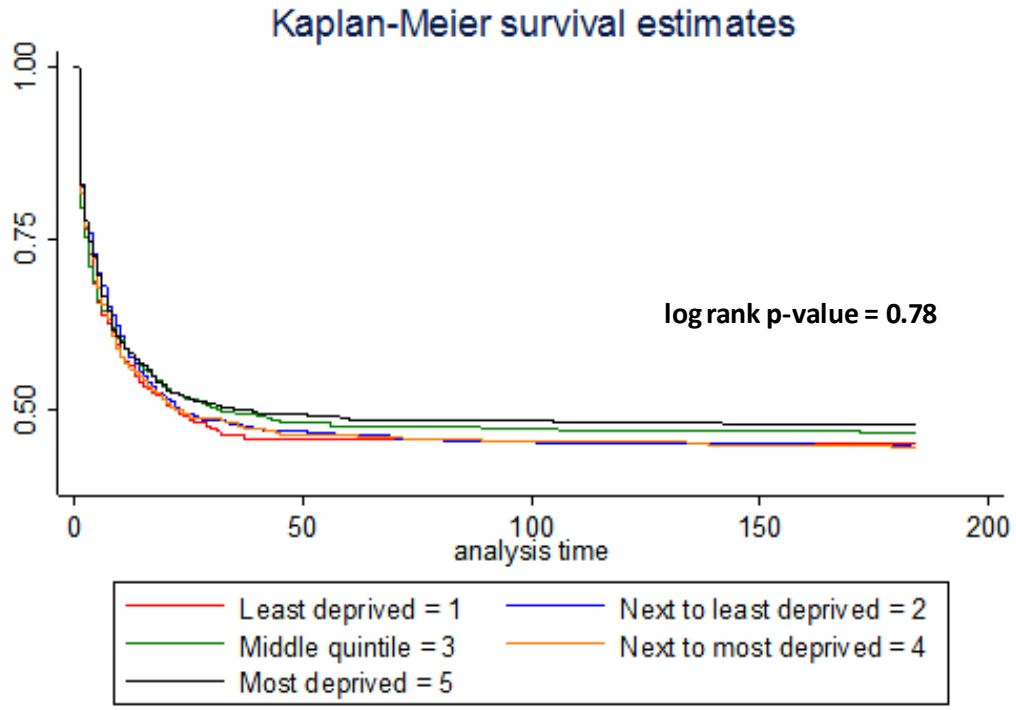

Figure 2: Kaplan-Meier estimator of time to 6-month revascularisation by deprivation quintiles following first-time AMI for residents of south Wales, 2012-13