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Exploring inequalities in service use: the case of cervical cancer screening in Ireland, the United Kingdom and United States

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Abstract

This study examined inequalities in uptake of cervical cancer screening in the Republic of Ireland, Britain and Northern Ireland, and the United States using data from nationally representative surveys in 2007/2008. Regression analyses and a comparison of concentration indices measuring income related inequalities were used to explore between group differences across all countries. Uptake of cervical cancer screening in the past 12 months is significantly higher in the US (59.90%) than in the UK (28.43%) and Ireland (17.98%). Concentration indices for screening in the past 3 years demonstrated a pro-rich inequality in uptake in England (0.076***), no inequality in Wales (-0.027) and Scotland (-0.013) and increasing pro-poor inequalities amongst Northern Ireland Catholics (-0.155**). Whites had the largest inequalities in the US (0.261***), compared to Blacks (0.092**) and Hispanics (0.115***). Results from the marginal effects showed no inequalities in the UK as a whole, but significant disparities for Ireland and the US across both income and education levels in the US. There are a variety of potential explanations for the observed differences between countries in the pattern of uptake among demographic groups, including divergence in health systems across country and differences in perception of risk. Racial and cultural differences also appear to play a role. That such differences may exist but be masked by estimates of inequality at a national level indicates the importance of a more nuanced approach to the examination of inequality and policy makers should be cognisant of such potential heterogeneity when developing policy instruments to address inequalities. A policy which decreases inequality at a national level may exacerbate existing inequities between groups if such heterogeneity is ignored when formulating policy.
Introduction

Cervical cancer screening is an invaluable tool in combating cervical cancer. Pap smear testing, the predominant screening tool for cervical cancer screening has been estimated by Peto et al, (2003) to have prevented cervical cancer deaths in as many as 1 in 65 women born since 1965 in the UK. A similar reduction, in large part due to screening, has been seen in the United States, with mortality rates having fallen by 80% from 1950 to 2007 (Howlander et al., 2011). While the reduction in mortality from cervical cancer is to be welcomed, the importance of cancer screening has not abated. Pap testing, and more recently Liquid Based Cytology (LBC) or Human Papillomavirus (HPV) screening, all remain key elements in cervical cancer prevention, to reduce mortality rates even further. The utilisation of cervical cancer screening is underpinned by many determinants including socioeconomic variables. Socioeconomic inequalities, which may ensue due to differences in utilisation across socioeconomic groups, are particularly pertinent for the effectiveness of cervical cancer screening, more so than for most other cancers. Women from lower socioeconomic groups have significantly higher incidence and mortality rates from cervical cancer in comparison to women from more affluent groups (Kahn et al, 2007). Women in the most deprived groups have a relative risk of cervical cancer incidence over twice that of those in the least deprived group in the Republic of Ireland and Northern Ireland (Donnelly at al, 2009), and England (Shack et al, 2008). Mortality rates from cervical cancer in England also show statistically significant differences with mortality rates of 3.2 per 100,000 in the 30 most deprived areas in comparison to 1.7 in the most affluent areas (Trent Cancer Registry 2012). In the United States incidence rates for women from African American (Black) and from Latin American (Hispanic) groups are 10.2 per 100,000 & 11.5 per 100,000 respectively, compared to 7.5 per 100,000 for women of a Caucasian, or non-Hispanic White ethnicity (See Figure 4). While differences in incidence rates may be due, at least in part, to the aetiology of cervical cancer,
higher screening utilisation, especially amongst the lower socioeconomic groups where incidence is highest, may play a role in this. However determinants of disparities in incidence and mortality rates are not identical across races (Downs et al, 2008). Differences with regards uptake of screening and socioeconomic variables account for a large part of the disparities across White, Blacks, Hispanics and other ethnic groups. For example those in non-White groups were less likely to have screened and less likely to come from more affluent circumstances (McDougall et al, 2007). Those in non-White groups may on average be in lower socioeconomic groups. In the US mortality is also higher amongst Hispanic and especially Black women (4.3 per 100,000, Whites = 2.3 per 100,000) (CDC 2012, See Figure 5). Higher uptake of screening should help lead to a convergence in mortality rates between races if screening rates remain high for these groups. Access to rapid treatment, due to insurance coverage, quality of treatment and other factors will also determine mortality rate disparities across races from cervical cancer. The benefits of screening among women with higher incidence rates may take a long time to manifest themselves, but overtime benefits of higher screening rates, particularly amongst high risk groups should be observed. Differences with regards to health insurance may also be more likely to be replicated in Ireland and the US than the UK.

United Kingdom

A population-based cervical cancer screening programme was introduced by the NHS in 1988 that by 1993 had expanded to include all women in a targeted asymptomatic population across the UK. In this programme women receive an invitation for a cervical cancer screen every 3-5 years (depending on country and age), with subsequent diagnostic testing and screening intervals informed by the result of this screen. Since the introduction of population-
based cervical cancer screening, age standardised mortality rates have reduced from over 6 deaths per 100,000 women before the programme was initiated to just over 2 per 100,000 in 2008 (CancerResearchUK Cancer Mortality Statistics 2012). Within the health services research literature for the UK, England is used intermittently as a proxy for the UK as a whole in evaluations with results extrapolated to the overall population of the UK. Yet evaluations of the programme at administrative levels are more appropriately undertaken by each respective cancer screening programme in England, Northern Ireland, Scotland and Wales separately, where an appreciation of the differences between respective programmes are more likely to exist. Analysing the cervical cancer screening programme in the UK as a whole may be problematic for a number of reasons, specifically when trying to quantify socio-economic inequalities or differences in utilisation rates across demographic groups. But the majority of studies have predominantly taken place in England (Bradley & Freidman, 1993; Luke, 1996; Sabates & Feldstein, 2005; Sutton et al, 2005; Moser et al, 2009).

While the NHS operates across all four countries, it is possible that the impact of screening programmes may differ across England, Scotland, Wales and Northern Ireland. Devolved administrations are now in place in Northern Ireland, Scotland and Wales and have been granted significant independence regarding health and public services, operating with varying degrees of autonomy from centralised Government. A divergence in health policy has taken place in recent years as a consequence of greater devolution of political and government policy across the UK (O’Neill et al, 2012; Steel and Cylus 2012; Langley et al, 2012). The majority of allocated health funds may still originate from London yet health authorities in the Scottish Parliament, and Northern Ireland and Welsh Assemblies distribute their budget according to their own priorities (Jervis 2010). Outside of England, health care also tends to account for the largest part of the budget allocation and public health spending per head of
population tends to be significantly higher (O’Neill et al, 2012; Steel and Cylus 2012; Langley et al, 2012).

While respective health systems bear the hallmarks of similarity there has been divergence with regards to health policy, health interventions and evaluations occurring at the decentralised level. This autonomy and divergence has been seen in cervical cancer screening with heterogeneity with regards to programme rollout also evidenced across the NHS. Cervical cancer screening, while initiated universally by the NHS as a population-based programme, is organised in a diverse manner across the UK, both in terms of asymptomatic age-group targeted, the interval period operated by programmes between screens, and the diagnostic screening test used. Prior to 2011, Wales and Northern Ireland invited women between the ages 20-65 (Northern Ireland have invited women 25-64 subsequent to 2011) with women in Wales invited every 3 years, while in Northern Ireland those aged 20-49 were invited every 3 years, and those aged 50-64 every 5 years. Scotland invited women aged 20-60 every 3 years, and the English programme invited women aged 25-49 every 3 years and those aged 50-64 every 5 years. While Papanicolaou testing (Pap smear) was the predominant diagnostic test in the past, Liquid Based Cytology (LBC), (due to lower inadequate samples compared to Pap smears) was introduced as the predominant diagnostic test in research laboratories in recent years. But as with age range targeted and interval procedure preferred, use of LBC was initiated at different times in each country. Differences along the cancer care pathway, such as age, screening interval and diagnostic testing in the screening programme, and access to treatment, may give rise to diverse interactions across countries between cervical cancer screening and socio-demographic groups discordantly. As Palmer (2013) has expressed the cancer policies for England are different than that seen in other UK countries. In Northern Ireland, two large population groups exist, from Protestant and Catholic backgrounds. As community background holds particular significance and has
been shown to matter in cervical cancer screening utilisation (Murray and McMillen 1993a) we treat these as two distinct groups in Northern Ireland.

**United States**

In the European Union population-based screening programmes, similar to the one explained above are commonplace. The EU Commission Action Plan on Cancer (Advisory Committee on Cancer Screening, 2000) has emphasised the value of organised population-based screening, aimed at 100% of the targeted high risk asymptomatic population. Opportunistic programmes on the other hand rely to a greater extent on the subjective assessment of risk by the individual and their physician. The willingness and ability of the individual to take responsibility to initiate and subsequently undertaking the screen, plays a central role. Differences between the two types of screening programmes may contribute to differences in participation rates, while subjective risk, willingness and ability of individuals to initiate a screen may also vary across socioeconomic groups. In the United States rather than centralised organised programmes, organisations such as the American Cancer Society and American Medical Association along with physicians groups recommend screening for all women over the age of 21, at regular intervals. The main recommendation body, the US Preventative Services Task Force (USPSTF) recommends cervical cancer screening for all women aged 21 to 65 years of age every 3 years using Pap testing or every 5 years for HPV testing (Moyer 2012). While these recommendations provide the impetus to screen for women, physicians and gynaecologists, the implementation of these recommendations are less systematic compared to population-based programmes. As such individuals, who screen, tend to screen more regularly than those in organised programmes, even when recommendations urge for 3 yearly intervals, while those who do not screen regularly often
do not screen at all. High utilisation rates for screening evidenced in the US is multi-faceted, but may be due in large part to supply-side factors, such as monetary reimbursement for physicians, and an environment where regular screening has become the norm (especially when used as part of an annual check-up for example). Since many insurance companies cover annual screening costs for women of a certain age, it may be seen as foolhardy amongst women to not take advantage of this.\footnote{Private Insurance companies, HMOs and publicly financed Medicaid (Medicare for the older population 65+ covers 12 months to 24 months depending on selected criteria) offer annual screening coverage.} Private Insurance companies, HMOs and publicly financed Medicaid (Medicare for the older population 65+ covers 12 months to 24 months depending on selected criteria) offer annual screening coverage.

Inequalities associated with racial background in the United States have been well documented, with Blacks and Hispanics experiencing poorer health and lower health care utilisation (Bloom et al., 2011). This is also seen with regards to cervical cancer screening with incidence and mortality rates far higher among Black and Hispanic women compared to their White counterparts (CDC 2012, Figure 4 & Figure 5). While a large literature exists on this we focus on screening utilisation and inequalities here. Attitudes, community knowledge and behaviour, access and acculturation differences across individuals of different races and ethnicities in the US may all play important roles in disparities. These differences may subsequently determine why those from different socioeconomic groups interact differently with health care and manifest themselves in divergent behaviour across racial or ethnic groups. Shi et al, (2011) have shown that while disparities across racial or ethnic groups have reduced over time, disparities between insurance states have actually widened.

Ireland

A population-based cervical cancer screening programme has now been fully implemented in Ireland, however when the Survey of Lifestyle, Attitudes and Nutrition (SLÁN) data was
being collected in 2007, the programme was not yet fully developed. As such in terms of the programme at this time, it may be seen to a certain extent to be a transition between the fully rolled out, and mature UK organised screening programme and the fully opportunistic US screening programme. Ireland also has a health care system which combines features of both the US and UK variants. A mixed public/private health care system is in place in Ireland with those from the lowest socioeconomic groups or those with long term illness having public insurance through the Medical Card System. Individuals may also purchase supplementary private health insurance from private institutions. As such approximately 50% of the population have a Medical Card, 40% have private health insurance (10% have both) with the remaining 20%, termed ‘uninsured’ here, having neither. Previous work using concentration indices has demonstrated a pro-rich pattern of utilisation (Walsh et al, 2012) with respect to cancer screening, including for cervical cancer, in Ireland. The unfinished screening programme may explain some of the inequality of cervical cancer screening, though the authors note than pro-rich inequalities remained for breast cancer screening, even after the introduction of population-based screening (Walsh et al, 2012). This result was largely underpinned by those who had private health insurance compared to those who did not.

While heterogeneity in screening programmes across countries noticeably exists, differences across groups are seldom highlighted, and most studies of cervical cancer screening fail to account for nuances in screening programme, health service and population groups. As well as contrasting screening between the US, the UK and Ireland, we also explore inequalities between racial groups in the US and community background in Northern Ireland. This study uses concentration indices and probit regressions, to investigate inequalities in cervical cancer screening and emphasises how these inequalities occur discordantly across countries and also across various groups within the countries.
Methods

*Data*

**Britain and Northern Ireland**

Data were collected from wave 18 of the British Household Panel Survey (BHPS) covering 2008. The BHPS dataset allows for a detailed socio-demographic characterisation of the respondent (including details of education, income and community background) which would not be possible using administrative data held by a screening programme (Moser et al, 2009). The BHPS asks details of cervical cancer screening uptake in the previous 12 months. This variable allowed us to compute variables for cervical cancer screening in the previous 12 months and 3 years for 4,171 women. To allow women in our sample equal opportunity to have been called to screening regardless of age, interval and country in the last 5 years, women aged 25 to 65 were included in our 5 year interval analyses in Northern Ireland and Wales, 25 to 60 in Scotland and 30-65 in England. This was done in accordance to the age groups targeted by the respective programmes and to ensure to the best of our ability that women had had at least 1 invite in the last 5 years to screen.\(^2\) Data was thus partitioned across the 4 countries and by community background in Northern Ireland, giving us 5 distinctive groups to analyse and compare results between them.

**United States**

The Medical Expenditure Panel Survey (2008) is a nationally representative survey in the United States containing information on cancer screening behaviour. Within MEPS, individuals answer questions in five periods over an approximate 2 year period, with screening behaviour elicited in the 3\(^{rd}\) and 5\(^{th}\) periods used to compute our independent

\(^2\) Separate analyses was conducted on a homogenous age group (30-60) but little differences were observed
variable. From this we computed cervical cancer screening in the previous 12 months and previous 3 years separately, in the same way as the BHPS data. Women between the ages of 25 and 65 were included in our analysis to again allow for those ages 21 and over to have had at least 1 opportunity to adhere to 3 year recommended screening interval. This gave us 8,134 observations to use in our analyses.\(^3\) The data was further divided by race/ethnicity allowing us to compare utilisation and inequalities across individuals that characterise themselves as White (non-Hispanic), Black, Hispanic or other (including Asian, Native American). Screens for the uninsured, are theoretically not covered and require out-of-pocket payments, though charities and organisations such as the American Cancer Society and Planned Parenthood do offer free screening for the uninsured and/or poorer individuals.

Ireland

Data from SLÁN 2007—a large representative, cross-sectional survey of health and wellbeing conducted using face-to-face interviews was used for our Irish analyses. Individual-based data were collected on a range of issues, including, uptake of cervical cancer screening. Uptake in the preceding 12 months only was measured in the survey and as such, 3 year utilisation could not be computed. A range of socioeconomic variables that allow for a detailed socio-demographic characterisation of the respondent are included in SLÁN. Data on 3,937 women aged 25–64 (the age range targeted by the national cervical programme) were extracted. This age range specified reflect those used in other programmes or recommended by the EU Council (Advisory Committee on Cancer Prevention, 2000; Schroder et al, 2009) and allow us to compare utilisation with the UK and US.

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\(^3\) Note: BRFSS 2008 was also used which had ~170,000 observations. Results were very similar and are presented in the Appendix
Empirical Analysis

Concentration indices were computed across countries, community background and race to give a quantifiable index which can be compared easily across populations since the same dependent and ranking variables are utilised. Concentration indices are gaining prominence in health economics and have been used previously in the measurement of cancer screening utilisation and socioeconomic inequalities (Devaux & de Looper 2012; Walsh et al, 2012). The standard concentration index compares the cumulative proportion of screening uptake and the cumulative fractional ranking of a continuous socioeconomic variable, in this case net equivalised household income to obtain a measure of inequality. This translates into determining the proportion of resources (cancer screening) used across different points of the income distribution. A state of perfect equality would be observed where $k\%$ of screening resources (as measured by uptake) is used by the lowed $k\%$ of the population when ranked by socioeconomic status. This would yield a concentration index of 0. A situation in which all of the screening resources are utilised by the poorest individual yields a CI of -1, while a situation where all of the resources are used by the richest individual yields a CI of +1.

While interpreted differently than regression analyses, Koolman and Van Doorslaer (2004) have stated that if a pro-rich index of 0.10 is observed for instance, this would require a lump sum redistribution of 10% of the total amount of health care resource from the richest half of the distribution to the poorest half to equalise the resource use along the income distribution. This is a simplified interpretation and assumes those along the distribution will behave similar if given the opportunity, which need not be the case.

Thus equivalised household income was used as the ranking variable in the construction of the concentration indices. The equivalence scale used here was total household income
divided by the square root of the number of individuals in the household.\(^4\) By using the same dependent and ranking variable throughout our analyses, differences in inequality are easily compared across countries and groups in our analyses. Following Kakwani et al. (1997) and Van Doorslaer et al. (1997) the concentration index is presented as equation 1.

\[
CI = \frac{2}{N\mu} \sum_{i=1}^{n} y_i R_i - 1 \tag{1}
\]

Here N represents the number of individuals in the sample, \(\mu\) is the mean of our dependent cancer screening variable \(y_i\) (i=0,1, whether the individuals had a cancer screen in preceding 5 years or not). \(R_i\) represents the ranking variable with the fractional rank of the i-th individual within the socioeconomic distribution according to their income. Thus the CI measures relative inequality across the socioeconomic distribution with a positive result reflecting a pro-rich inequality.

One benefit of using the BHPS and MEPS is that it includes detailed information on household income that effectively allows for the construction of a continuous income variable and the ability to compare those with similar income, thereby aiding the quantification of a more precise concentration index (Chen & Roy 2009). Household income in both these surveys was equivalised by the square root of the number of people in the household. In SLÁN income is slightly different. Income was recorded as 25 categories in the survey, with class mid-point used as the income level for each group. Chen et al. (2009) have shown that grouped income data may lead to an underestimation of the concentration index. However, the extensive number of income categories used here together with the subsequent use of an

\(^4\) Other equivalence scales were also tried with little variation in the results.
equivalence scale allows for within-group variation, thus mitigating any underestimation in the resultant concentration indices.\textsuperscript{5}

Since the dependent variable in our analyses was a binary response, the standard CI is not bounded between -1 and +1, thus normalised concentration indices of screening utilisation and fractional rank of income were calculated using the binary variable method in Wagstaff (2005).\textsuperscript{6}

\[ C_{\text{II}} = \frac{C_{\text{I}}}{1 - \mu} \]  \hspace{1cm} (2)

Corrected standard errors are computed for these indices which control for heteroskedasticity and autocorrelation using the Rao Delta method (Kakwani et al, 1997) and are illustrated for the Wagstaff normalisation by Siegal and Mosler (2010).

Marginal effects following probit regressions with robust standard errors were also computed to explore the factors that influence individuals’ screening decisions. These regressions included variables viewed as pertinent to socioeconomic inequalities and cervical cancer screening utilisation. Datasets from the countries included here allowed us to run the marginal effects analyses using the same variables across all countries. Logarithmic equivalised household income (which was averaged over the period of the 3 year interval in BHPS as was the case for the Concentration Indices, though current year was used in MEPS), educational attainment and marital status their age, private/public health insurance status (uptake is still relatively low in the UK). Geographic region was also controlled for. As such,\textsuperscript{5}

\textsuperscript{5} BRFSS was set up in a similar was as SLAN
\textsuperscript{6} Normalisation of the concentration indices using methods put forth by Erreygers (2009) were also undertaken, with results similar to those produced using Wagstaff (2005) methods. Results available from the authors
since we used the same variables, the concentration indices and marginal effects were the most relevant techniques to use in our analyses.

**Results**

Table 1A presents descriptive statistics for the uptake of cervical cancer screening in the previous 12 months, partitioned across country, community background and race. Results illustrate that uptake of cervical cancer screening were broadly similar across the UK. Utilisation in Ireland, which may be due in part to its nascent, incomplete population-based programme, had only 17.98% uptake in the previous 12 months. The largest differences are observed when comparing the UK and Ireland to the US, where 59.90% had a cervical screen in the previous 12 months. Differences in uptake also emerge when comparing demographic groups within countries. Women who categorised themselves as Black had 63.57% uptake compared to 59.21% and 60.00% for Whites and Hispanics respectively. There are disparities with regards to education (except in Scotland and Ireland) and age (which may be expected due to invitation and recommendations being different across age groups) in all countries.

In the US, lower educated Whites (40.72%) are less likely to have a screen in comparison to lower educated Blacks (53.46%) and Hispanics (56.47%). Though there is little difference across races for women in the highest educated groups (women with at least a college Degree). The largest differences in the US though are observed between those with different insurance states. Women with private health insurance are more likely to screen compared to the uninsured, but also interestingly are more likely to screen than those with public insurance, even though public insurance also covers annual cervical cancer screening. Similarly to the pattern for education, the largest differences across insurance states are observed amongst White women (64.73% private health insurance versus 34.31% uninsured),
though differences exist amongst Blacks (68.75% versus 43.34%) and Hispanics (68.33 versus 47.81%), uninsured. White women are less likely to have been screened compared to these groups, similar to results in education. Again younger non-Whites have greater uptake that Whites. Interestingly for Blacks and Hispanics with public insurance, their utilisation is only slightly lower than those with private health insurance, yet a large difference between insurance type is seen for White women (64.73% versus 48.21%).

Table 1B, illustrates descriptive statistic for cervical cancer screening uptake in the previous 3 years (except for the Republic of Ireland where data is not available), results are very similar to Table 1A. The US (85.90%) still had far higher uptake than the UK (58.57%), which again is in large part due to the population-based screening programme in place in the UK. While non-Whites have higher uptake than Whites, this seems to be in large part due to higher uptake amongst lower educated groups, as similar utilisation rates are seen for those with a Degree, (90.98% for White; 92.62% for Black; 89.24% for Hispanic) while those with lowest education is far different (69.23% for Whites; 84.49% for Blacks; 85.46% for Hispanics.

One of the benefits of the Concentration Index is that is allows for comparisons of inequalities, even as the utilisation rate change across and within countries. Figure 1 illustrates the concentration indices for all countries with regards to inequalities observed in Table 2. While no inequality (index equal to 0) exists in Wales and Scotland using 1 year and 3 year periods, a pro-poor inequality is observed in Northern Ireland with this driven by

7 If we were to compare 5 yearly rates (not included here) utilisation is closer again, though the US still has higher uptake.
Northern Ireland Catholics (-0.155**) in the 3 year period. A statistically significant pro-rich inequality is observed in England across both time periods (0.096*** yearly and 0.076*** over 3 years). In the UK as a whole a pro-rich inequality is seen in the 12 monthly period, though it is insignificant in the 3 yearly period. Pro-rich inequalities in the US are far larger than those in the UK (0.145***, 12 months; 0.156***, 3 yearly) but as is seen in the UK, there are vast differences across racial groups. Mirroring the descriptive statistics, the largest inequalities are amongst Whites (0.202*** & 0.261***). While these inequalities are still large amongst Blacks (0.129*** & 0.092***) and Hispanics (0.132*** & 0.115***), these groups have higher uptake and lower inequalities than white women.

To complement the concentration indices, Table 3 provides marginal effects following probit regressions in the UK, Ireland and United States for cervical cancer screening utilisation in the previous 12 months. Again results are compared with the UK and US according to country and race respectively. 3 year period results were included for the sake of brevity though marginal effects were very similar. No inequalities are seen in the UK as a whole for income, education (those with secondary level education having the highest uptake) or private health insurance. But differences across countries and community background groups are observed, with Northern Ireland Protestants having greater uptake of screening compared to both Catholics and England (ME=0.057**). Following on with what was seen in recent literature, both Blacks (ME0.089*** and Hispanics (ME=0.084***) had higher uptake of cervical cancer screening compared to Whites, ceteris paribus. Though those categorised as other had lowest uptake rates (-0.083***). Differences between Whites and Blacks and Hispanics, may be in large part due to the relatively higher uptake (though inequalities do remain) in the lower socioeconomic groups (See Table 1A & Table 1B). In England (ME=0.040**), Ireland (ME=0.030**) and amongst White (ME=0.040***) and Black (ME=0.049**) women in the United States, equivalised household income (in its logarithmic
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form) is a significant contributor to cervical cancer screening uptake with similar marginal effects across each country. This result is complementary to our concentration index results, even after controlling for a range of other socioeconomic variables. A social gradient is observed with regards to educational attainment with those with secondary level (ME=-0.030** Ireland, and ME=-0.064***) education and lower level (ME=-0.064***) education when compared to women with Degrees or higher, even after controlling for age. In the United States, marriage (controlling for age) is a significant determinant amongst Hispanic women, but not so for White of Black women.

(Note: While we use MEPS here, one issue is that larger datasets in the US do exist (Behavioural Risk Factors Surveillance Survey, (BRFSS)) though the income variable for calculating the concentration indices may not be fully continuous as it is in MEPS. But Figure 2 and Figure 3 show that results remain very similar in terms of inequalities regardless of US data used.)

Discussion

This study highlights differences with regards to cervical cancer screening utilisation across the Republic of Ireland, the UK and the Unites States. These differences are illustrated both in terms of utilisation rates and socioeconomic inequalities across countries but also more importantly between distinct groups within countries. In addition, this study highlighted that even within countries; differences with regards to inequalities are also observed. Often inequalities are computed at the country levels, in lieu of more detailed results, and as such, nuanced differences observed within groups in health care systems, such as across devolved states in the UK or ethnic groups in the US are often lost. This will have implications for policymakers, since policies which achieve broad objectives may have differing impacts on
sub-groups in the population and this may be overlooked when analyses are not conducted at the appropriate scale. This has implications for initiating policy changes across the cancer care pathway, not just for screening.

Concentration indices are important tools in the statistical analyses of cancer screening inequalities. These indices are relatively nascent in their use, but have emerged in health services research and have the ability to inform policy via an easily interpretable number, which can be compared across countries, groups and time. In our analyses, we can compare these inequalities across specific groups as we importantly use the same dependent and ranking variables. These indices show a considerable difference across countries in the UK, Protestant and Catholic backgrounds in Northern Ireland and even across racial groups in the United States. This was the first time this approach has been applied at a disaggregated level, using concentration indices across many countries to understand nuances in inequalities.

In the UK while the overall rate of uptake of cervical cancer screening remains relatively stable across England, Wales, Scotland and Northern Ireland, heterogeneity of screening programmes and health services does exist - particularly regarding the impact of socio-demographic variables. A more nuanced approach allows us to gain greater understanding of the heterogeneity in the distribution of inequalities across the UK. Pro-poor patterns of utilisation are evident in the Catholic community while it is not in the Protestant community which has no statistically significant inequalities. There is no significant inequality in Wales or Scotland. The largest pro-rich inequalities are observed in England, 0.096*** for 12 months and 0.076*** for 3 Years. This suggests using prior indications (Koolman and van Doorslaer 2004) that approximately 7-10% of screening resources would need to be moved from the top half of the income distribution to the poorest half.
In Ireland screening utilisation is lower than is seen in the UK, and far below that evidenced in the United States. While at the time, Ireland may almost be viewed as being in transition between an opportunistic system and a fully developed population-based system, this format, in variance with the US system, had the lowest uptake, while also had very high pro-rich inequalities. The results regarding the US must also be interpreted carefully. Utilisation rates for cervical cancer screening are far higher in the United States, but inequalities as measured by concentration indices and marginal effects are also higher particularly when compared to the UK. Utilisation rates were highest among Blacks and Hispanics, following a similar trend in recent literature. But this is the first study, in these authors knowledge, that inequalities were also seen to be lower in Blacks and Hispanic compared to Whites. While the higher uptake among minorities especially when incidence and mortality rates are highest in these groups is to be welcomed, some caution must be noted as the impact of screening will not be seen for many years. For instance, the group with the largest incidence rates of cervical cancer in the US occurred in Black women aged 70-79, while overall the largest incidence is seen in women older than 50 (Henley et al, 2010). The low uptake amongst poorer, uneducated Whites, observed here in the broader scheme of things may be worrisome in the future. While uptake in these groups may be higher than symmetric groups in the UK, this is still a worry that may need to be addressed in the US. Again these poorer, lower educated and uninsured individuals may also be less likely to interact with the health care system as whole, receive later detection of any cancer present, and lower, slower standards of treatment. 54% of all cervical cancers in the United States occurred in women with ‘inadequate’ screening histories, while as many of 41% of women with cervical cancer were never screened (Spence et al, 2007). The Health People 2010 report (National Center for Health Statistics, 2012) has aimed to have 90% cervical cancer screening uptake by appropriate age groups. This is
important as 41% of cervical cancer occurred in women who had not screened (Spence et al, 2007) while half of all cervical cancers are diagnosed at a late stage (Henely et al, 2010). While this is a possibility, these authors suggest that particular attention should be placed upon those from lower socioeconomic groups, across all racial groups, including Whites.

Cervical cancer screening has been shown to have had a significant impact on reducing mortality, to a far greater degree than other cancer screens. This is especially true for those in the lower socio-economic groups which have a far greater propensity for cervical cancer incidence (Shack et al, 2008). As such, having high utilisation rates in lower socio-economic groups is extremely important for an effective population-based cervical cancer screening programme particularly within a national health system. Walsh et al. (2011), in a cross-country comparison, found that population-based cervical cancer screening programmes in Europe demonstrate far less inequality than opportunistic programmes. We observe in this study that analysing individual countries is important when evaluating the impact of the screening programme in specific regions. The US, within an opportunistic setting, has far higher uptake compared to the UK, but inequalities may also be higher, especially amongst White women. From a UK stand point this study clearly shows that treating the UK or the NHS system as a homogenous context in which to evaluate health inequities, particularly in regards to cancer screening is erroneous. Firstly, undue importance is often afforded to England compared to the relatively smaller states which becomes an issue when there is heterogeneity across countries as evidenced here. Secondly, this is especially important in the context of devolution of powers relating to elements of the public health to the smaller jurisdictions through their Assembly’s and Parliament for Northern Ireland Wales, and Scotland respectively, even if London remains the dominant driver to the health decisions. Beyond the particular lessons for the UK and the US, the study clearly demonstrates the danger of assuming that a pro-rich or pro-poor pattern of service uptake at a population level
describes accurately the experience of all groups and all countries. Indeed where there exists sizeable minority populations, population-level analyses may mask very different patterns of uptake among particular groups (Selvin & Brett 2003). But the high susceptibility amongst lower socioeconomic groups, not just certain races must be viewed as important when targeting cervical cancer screening towards specific groups. While inequalities are higher for Whites, the inequalities for the other groups are still very large, larger than seen in the UK. The higher uptake may be hiding inequalities to a greater degree than the population-based system in the UK, thus socioeconomic inequalities may originate differently across different groups, even if the socioeconomic conditions are relatively similar between them. While the concentration index, which uses the same outcome variable and a similar ranking (socio-economic/income) variable presents an intuitive result in which to compare inequalities across countries (Devaux & de Looper, 2012) a degree of caution is warranted. Our results show that it is important to correctly measure utilisation, and inequalities in utilisation, between countries or community groups rather than extrapolating results across heterogeneous populations. It is also an imperative that screening utilisation rates and disparities across specific demographic groups are constantly measured, understood and relayed to policymakers.

Limitations:

While concentration indices allow us to look at the inequalities across these groups, due in part to smaller numbers in the data, we were unable to compute accurate decompositions following the computation of the indices. We were also unable to test for geographic area and community due to data restriction which may help given credence to the suggestion of social support and conformity within communities. We were also not able to reduce our sample to
women who had not had a hysterectomy which may in particular affect the descriptive statistics in the UK or Ireland, as such we also did not control for this in the US to allow for more comparable results.

References:


### Table 1A: Descriptive Statistics of Cervical Cancer Screening Uptake in the previous 12 months (2007/2008)

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>England</th>
<th>Scotland</th>
<th>Wales</th>
<th>N Ireland</th>
<th>Ireland</th>
<th>US</th>
<th>White</th>
<th>Black</th>
<th>His</th>
<th>Other</th>
</tr>
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<tbody>
<tr>
<td>Overall</td>
<td>28.43 (4,171)</td>
<td>28.70 (1,958)</td>
<td>28.53 (743)</td>
<td>27.27 (715)</td>
<td>28.74 (755)</td>
<td>17.98 (3,937)</td>
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<td>59.21</td>
<td>63.57</td>
<td>60.00</td>
<td>54.51</td>
</tr>
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<td>32.75</td>
<td>29.72</td>
<td>31.13</td>
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<td>69.29</td>
<td>70.65</td>
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<td>54.31</td>
<td>64.13</td>
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### Table 1B: Descriptive Statistics of Cervical Cancer Screening Uptake in the previous 3 Years (2007/2008)

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<th>N Ireland</th>
<th>Ireland</th>
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<th>Black</th>
<th>His</th>
<th>Other</th>
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<td>84.23</td>
<td>89.89</td>
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</tr>
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<td>-</td>
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<td>-</td>
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<td>Age 25-29</td>
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<td>82.25</td>
<td>77.47</td>
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<td>90.06</td>
<td>84.06</td>
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<tr>
<td>Age 60-65</td>
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<td>77.07</td>
<td>74.42</td>
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</table>

Table 2: Concentration indices of Cervical Cancer Screening Uptake in the previous 12 months and 3 Years.

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</tr>
</thead>
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<tr>
<td></td>
<td>1 Year</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
</tr>
<tr>
<td>UK</td>
<td>0.035*</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
</tr>
<tr>
<td>Region</td>
<td>Estimate 1</td>
</tr>
<tr>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>England</td>
<td>0.096***</td>
</tr>
<tr>
<td>Scotland</td>
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</tr>
<tr>
<td>Wales</td>
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</tr>
<tr>
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<td>NI Catholic</td>
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<td>NI Protestant</td>
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<td>US</td>
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<tr>
<td>White</td>
<td>0.202***</td>
</tr>
<tr>
<td>Black</td>
<td>0.129***</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.132***</td>
</tr>
<tr>
<td>Other</td>
<td>0.135***</td>
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</table>
Figure 1: Concentration indices of Cervical Cancer Screening Uptake in the previous 12 months (BLUE) and 3 Years (RED).

Table 3: Marginal Effects following Probit regression Cervical Cancer Screening Uptake in the previous 12 months.
Figure 2: Concentration indices of Cervical Cancer Screening Uptake in the US previous 12 months. Comparisons between BRFSS and MEPS.
Figure 3: Concentration indices of Cervical Cancer Screening Uptake in the US previous 3 Years. Comparisons between BRFSS and MEPS.

![Chart showing concentration indices for cervical cancer screening](chart)

Figure 4: Percentage of U.S. Women Aged 18 Years and Older Who Have Had a Pap Test in the Last 3 Years by Race* and Ethnicity†
Figure 5: Cervical Cancer Death Rates* by Race and Ethnicity, U.S, 1999–2009

Source CDC (http://www.cdc.gov/cancer/cervical/statistics/race.htm)