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The Impact of Location of the Uptake of Telephone Based Healthcare: A UK Case Study

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***Abstract*— Telephone healthcare systems have been put forward as a key strategy to overcome geographical disadvantage, however, evidence has suggested that usage decreases with increasing rurality. This research aimed to identify geographical high and low areas of usage of NHS Direct, a leading telephone healthcare provider worldwide to determine if usage is influenced by rurality. National call data was collected (January, 2011) from the NHS Direct Clinical Assessment System for all 0845 4647 calls in England, UK (N=360,137). Data extracted for analysis included; unit postcode of patient, type of call, date of call, time of call and final disposition. Calls were mapped using GIS mapping software using full postcode, aggregated by population estimate by local authority to determine confidence intervals across two thresholds by call rate. Uptake rate Output Area Classification (OAC) group profiles was performed using the chi-square goodness of fit. The majority of calls were 'symptomatic' (N=280,055; 74.8%) i.e. calls that were triaged by an expert nurse, with the remaining 25.2% of calls health/ medicine information only (N=94,430). NHS Direct were able to manage through self-care advice and health information 43.5 of all calls made (N=99,367) with no onward referral needed. Geographical pattern of calls were highest for more urbanised areas with significant higher call usage found in larger cities. Lower observed usage was found in areas that are more rural of which were characterised by above average older populations. This was supported by geo-segmentation, which highlighted that rural and older communities had the lowest expected uptake rate. There is a variation of usage of NHS Direct relating to rurality, which suggests that this type of service has not been successful in reducing accessible barriers. However, geographical variations are likely to be influenced by age. There is a need for exploratory to determine the underlying factors that contribute to variation in uptake of these services particularly older people who reside in rural communities. This will have worldwide implications as to how telephone based healthcare is introduced.**

***Index Terms*— Demography, Equity, NHS Direct, Rurality, Tele-nursing.**

I. Introduction

The delivery of health services to rural communities has become a challenge in both developed and developing countries worldwide [1].

It has become increasingly apparent that geographical inaccessibility remains a key problem in current society with continued evidence that suggests the further away a person lives from a health service the lower the access and uptake for both primary and secondary care [2, 3].

Whilst current government strategies relate to the centralisation of health services; it is argued that health service planning needs to be patient-centred and innovative to create the balance between costs-effectiveness and the provision of accessible and equitable services [4]. As the developed world continues to face demographic changes, alongside an increased prevalence of chronic illness and increased expenditure, the appropriate use of e-health, including Internet-based and other telemedicine systems becomes even more integral [1, 4].

Darkins and Cary[5] outline that telephone based healthcare presents itself as not only a cost effective way to increase healthcare accessibility but also a socially accepted integration delivery system that has become indispensable within healthcare practice. Telephone driven healthcare services have gained popularity internationally with countries now such as the United States [6], New Zealand [7], Australia [8, 9], Hong Kong [5], Canada [10, 11] and Europe [12, 13] taking an international lead. Thus, the view of telemedicine has also dramatically changed; from a supplementary means of medical practice when there was no other way of providing healthcare other than substituting care with telephone based health services to a complementary service located within international health policy [14, 15].

Introduced in 1997, NHS Direct became at the leading edge of remote healthcare systems, pushing healthcare into the 21st Century through the application of new technology solutions in primary care in England and Wales, UK [16]. Through the provision of a 24/7 nurse-led telephone-based health care service [13]. The distinctness of NHS Direct was the whole system approach, providing the whole population in England and Wales with a national service through one contactable number, which soon became the largest telephone health care service in the world [8].

However, whilst telephone healthcare systems have been proposed as a key strategy to overcome geographical disadvantage16 this has not been supported by research. For example, Turnball et al [17] found that increased rurality in England was linked to lower uptake of an out-of-hours primary care based telephone-based healthcare service.

The roll-out of the new Department of Health '111' service, introduced to provide a more integrated non-emergency NHS healthcare telephone-based service18 has subsequently marked the end of NHS Direct, which ceased to operate in April, 2014 [18]. Nonetheless, this highlights the continued government commitment to providing technology driven healthcare in England, United Kingdom (UK). As telephone-based healthcare has become an increasingly popular way of delivering healthcare triage and advice to the wider populations both nationally and internationally it becomes increasingly important to understand how national population groups engage in such remote models of healthcare.

Previous studies have shown that higher rates of calls for or on behalf of older patients (65+) have been found in the most deprived areas [19]. There has been a dearth of literature, which has focused on geographic location uptake of NHS Direct. The limited evidence available has highlighted that uptake varies by geographic location with lower use found in rural areas [17]. This suggests that rural populations could be further disadvantaged when health services are delivered via the telephone. Nonetheless, research has failed to provide a clear prospective of the geographical variation of a national population in England telephone-based healthcare [20] to identify levels of geographical high and low usage.

Therefore, it remains clear that there is a need for more primary research to explore how remote health services such as NHS Direct have engaged the whole population to identify if they have increased access with the more remote communities within England, with the ability to shape future policy strategy [21]. As such this research presents the first national study that has explored geographical distribution of all calls made to NHS Direct to determine significant high and low uptake to determine if call usage is influenced by rurality.

II. Method

One month of anonymised call data (January 2011) was collected from the Clinical Assessment System (CAS) for all 0845 4647 NHS Direct calls made in England. Data extracted for analysis included; unit postcode of patient, type of call, date of call, time of call and final disposition.

The NHS Essex 1 Research Ethics Committee provided ethical approval (REF: 10/H0301/29).

Individual written and verbal consent could not be obtained, however, a fair processing message is provided to all callers who phone NHS Direct which clearly states that anonymised call records may be used for research purposes. This message provided the caller detailed instructions on how they can withdraw their data. In the case of children, it is the parents/guardians responsibility to remove call records if required.

To investigate geographic variations in relation to use, geographic information system (GIS) mapping software (ARC GIS Desktop, Release 10, Redlands, CA: USA) was used. This method provides a novel approach to visualise and analyse data in the context of location and community within healthcare surveillance planning [22-24]. Heat maps provide a two-dimensional visualization tool that displays values of data matrices, which provides an invaluable insight into patterns of data, which are typically not achieved through traditional visualization techniques [25].

Call usage (postcode of patient) is compared to the percentage of the population providing a call rate density, which is uploaded to the software. The software then outputs heat maps, which allow for exploratory analysis. Heat maps were completed for national level at the Primary Care Trust (PCT) and Middle Super Output Area (MSOA) level [26, 27].

To estimate confidence intervals of call rate for geographic areas, unit postcodes for all NHS Direct calls were matched to local authority using GeoConvert software (online geographical matching and conversion tool for the UK). Data was then aggregated by Local Authorities (LA), which allowed individual data to be transformed to provide actual counts of calls by LA. Using LA's as a proxy for rurality and urbanisation meets the definition of population 'sparsity' adopted by national statistics [28] as small census based geography. Urban areas are classified as an output area with a populations of over 10,000, while the remaining are defined as three rural types; town and fringe, village or hamlet and dispersed [28].

Matched data was then linked to mid-2006 population estimates [29]. Using a public health analytical tool (http://www.apho.org.uk/default.aspx?RID=39403), a set of Excel template files, was supplied by the Association of Public Health Observatories (currently Public Health England) to study the variation in health outcomes, performance, or service use over time or between areas for needs assessment and epidemiological studies [30, 31]. The analysis was carried out using this tool under Microsoft Excel. The following variables were entered: events (number of calls per LA), and rate (call rate per 100 population) for the month period of data, and by average call rate which was 6.7 for all months calculated as number of calls/population.

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Funnel plots were used to analyse the data, which has become a popular approach to healthcare evaluation [32], and provide the opportunity to statistically control limits (e.g. 2SD/3SD equivalent 95% CI/ 99.8% CI,) around measurable outcomes highlighting outliers in performance ratings. Funnel plots were conducted to identify areas with variation, in particular, areas with unexpected (special-cause) variation, i.e., unusual pattern of service use. They were also completed to show confidence intervals (95%/99.8%) across two thresholds (2SD/3SD) for call rates across all local authority areas. This highlighted areas of significantly higher and lower expected usage of NHS Direct.

Geo-segmentation was used to determine the geo-demographic characteristics of NHS Direct usage. Foster (2007) [33] defines geo-segmentation as 'the classification of a population into different groups…. for providing services based on an understanding of local populations and neighbourhood' (p. 4). Essentially segmentation utilises both generalising and summarising data to characterise different segments of the population, which aims to define a small number of groups that are able to maximise between group variance, alongside minimise within group variance. In simple terms, individuals in one segment should be as similar to one another and as different to another segment as possible.

Geo-demographic segmentation offers a more sophisticated approach to determining the impact of deprivation. Geo-demographic classifications groups together areas, which are similar in terms of their demographic, socio-economic and housing composition. Using this type of analysis enabled the researchers to gain a better understanding of geographic variations focusing on lifestyle characteristics and consumer behaviour [34]. Segmentation also enables identification of communities that are not entirely homogenous in terms of population structure. For example, communities nor often differ by income, age distribution, levels of deprivation, ethnicity and education, but also differ in terms of attitudes, lifestyles and expectations within their local community [33].

Output Area Classification (OAC) [35] was used as the geo-segmentation model. This census based segmentation tool has been purposefully built on a small output area spatial unit and deals with a wide range of variables including demographic, household composition, housing, socio-economic and employment. There are three levels of clusters, which include OA Supergroups (N=7), OA Groups (N=21) and OA Subgroups (N=76) (see Tab. 1).

TABLE 1
OAC 'SUPERGROUPS'

OA Super group		Description
1	Blue Collar communities	Communities predominantly characterised by those working in manufacturing, retail or construction, hold fewer educational qualifications compared to national average. There are three OA Groups; terraced, those who reside in terraced social housing and younger & older blue-collar workers.
2	City Living	Urban built up areas where single and live alone in rented properties. Residents are either students/recent graduates or young professionals. This group are more likely to hold educational qualifications and are often students/first generation immigrants. There are two OA Groups transient communities and settled in the City.
3	Countryside	Rural and semi-rural residents. Higher than the national average of employment in agriculture and fishing, most likely to live in detached households with more than one car. There are 3 OA groups; village life, agriculture and accessible countryside.
4	Prospering suburbs	Prosperous people who are well established in the workplace. Most live in detached privately owned houses often with older children who have left home. There are three OA Groups within this category; prospering younger and older families and prospering semis.
5	Constrained by circumstances	Residents in this OA Supergroup are likely to be on welfare benefits and typically reside in social housing. They are likely to hold few qualifications and many will be older workers, pensioners, or those on benefits.
6	Typical traits	This relates to the 'average person' and includes three OA Groups; settled households, least divergent and young families in terraced housing. Most likely to own their own home and are commonly characterised as young families and aspiring households.
7	Multicultural	Residents are often non-white first time immigrants and mainly reside in Asian and Afro-Caribbean communities. Housing is mixed (social and private) but mostly rented.

III. RESULTS

A Chi-Square goodness of fit test compared NHS Direct observed (O) usage compared to expected (E) frequencies. Expected frequencies were based on the known percentages of each of the OA Groups based on the Office for National Statistics (ONS) data estimates of population distribution [36].

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A total of 374,485 calls were made to the NHS Direct core 0845 4647 service during January 2011. The majority of calls were 'symptomatic' (N=280,055; 74.8%) i.e. calls that were triaged by an expert nurse, with the remaining 25.2% of calls health/medicine information only (N=94,430) which can be delivered by either the nurse or call handler. Disposition was collected for 307,817 calls with the remaining cases classified as missing (N=66,668; 17.8%). However, the main reason for missing calls was because these were classified as 'quick calls' i.e. calls which calls handled by the health advisor with no onward referred needed, contributing to 59,375 of all missing cases (89%). The character of quick calls are different to calls transferred to the expert nurses therefore excluding this are not expected to impact on analysis. The remaining missing calls were due to either the patient not being assessed (N=363) or system errors (N=6,930).

The largest percentage of calls made to NHS Direct were during the day 07.00 -14.00 (N=166,166; 44.3%) and afternoon/early evening 15.00 - 22.00 (N=159.357; 42.6%), with the least calls made at night and early morning 23.00 - 06.00 (N=48,962; 13.1%). There were also more calls during the week (N=217,061; 58.0%) compared to calls made during weekends and bank holidays (N=157,424; 42.0%).

Figure 1 presents the disposition of all calls made to NHS Direct during the month of January 2011. The majority of calls were managed with no onward referral needed with 43.5% (N=99,367) managed by self-care and 11.2% (N=39,270) provided health information. Urgent calls contributed to 22.9% of all calls made, with 4.3% (N=13,193) of calls transferred to 999, 9.4% were advised to attend A&E (N=13,193) and a further 9.2% of calls were advised to attend primary care urgently (N=28,428). A combined 26.9% of calls were advised to seek advice from their primary care either the same day or routinely (N=82,717). The remaining 5.2% were signposted to dental (N=13166) and community pharmacists (N=2,717).

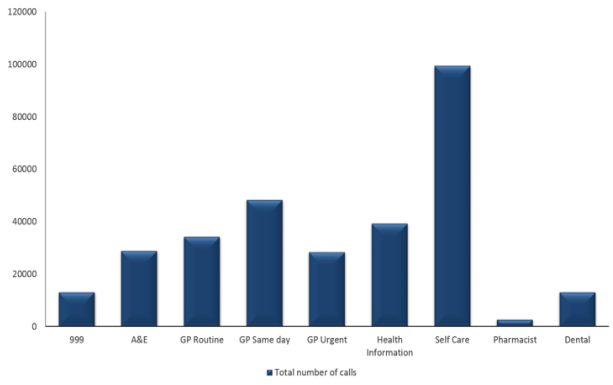

FIGURE I DISPOSITION OF NHS DIRECT CALLS IN ENGLAND DURING JANUARY 2011

A total of 14,348 of calls were excluded, as there was no postcode provided which left 360,137 cases included in the final analysis. Figure 2 illustrates the geographical dispersal of all the calls in England, UK. Calls made were geographically mapped per PCT as a percentage of the population. Lowest call rates were characterised as 0.3% - 0.55% of the population to the highest call rates ranging from 0.78% - 1.13%. Calls were seemingly higher in more urbanised cities (London, Leicester, Nottingham, Leeds and Liverpool) and in the South of England with lowest calls shown in more urbanised areas located towards the North of England especially areas such as Newcastle upon Tyne and Sunderland.

A more detailed analysis of the geographic distribution of patients who used NHS Direct was analysed by Middle Super Output Area (MSOA). What becomes more evident is that higher call dispersal is found within the larger, more urbanised areas. For example, when focusing on the North of England it appears that when focusing at the MSOA level there is higher density of callers in the more built up areas such as; Durham, Newcastle Upon Tyne and Darlington, with lower usage found towards the North East of England covering more rural areas such as Carlisle and Richmond with as low as 0.09% of the population using NHS Direct with Penrith being the only exception to this (0.05%).

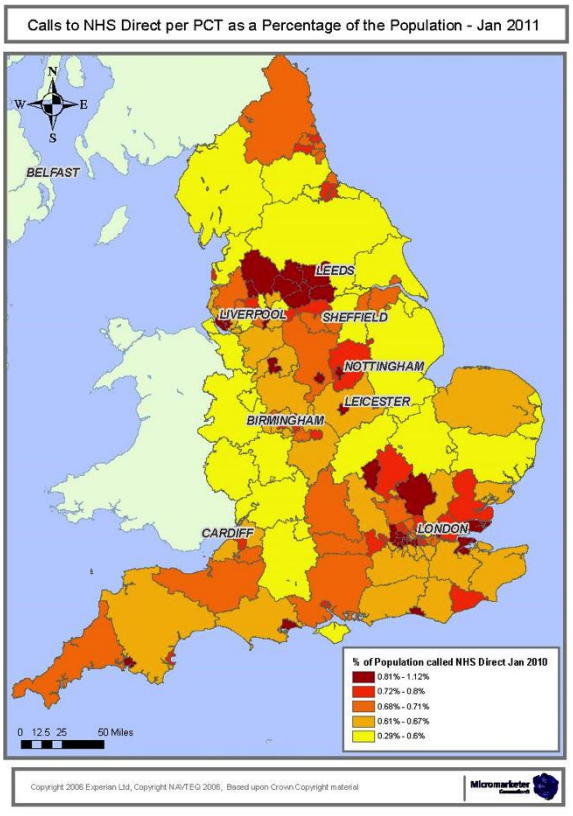

FIGURE II CALLS TO NHSD PER PCT AS A PERCENTAGE OF THE POPULATION

A similar pattern was found in the centre of England with high call rates shown around the cities of Leeds, Preston and Manchester, and lower usage shown in more rural areas such as Ludlow and Hereford to the west of Wales, presenting the lowest geographical utilisation. When focusing on the South East of England although there appears to be higher utilisation again predominantly in the main cities and Towns such as London and Luton with regions in the South West such as Newquay and Poole also highlighted as high usage areas. However, as seen in the North there are still pockets of areas with low utilisation distributed around the more urbanised areas such as Carlisle, York and Lancaster although high uptake is shown in the more populated areas in the North such as Newcastle upon Tyne.

To identify confidence intervals for usage in relation to population size a geographic funnel plot was completed across two thresholds (2SD/3SD). These were completed for call rates by LA area, highlighting key areas of significant higher than and lower than expected usage of NHS Direct.

The funnel plot (Figure 3) highlighted 20 local authorities identified as higher and lower than expected (Table 1). The results confirm the visual representation, highlighting that more urbanised areas are associated as higher use examples including City of London, with an observed rate of 23%, alongside other larger cities such as Milton Keynes, Bradford, and Nottingham. In contrast, more rural local authority areas were highlighted as lower usage including; Isle of Wright, Suffolk, Ryedale, and Melvern Hills.

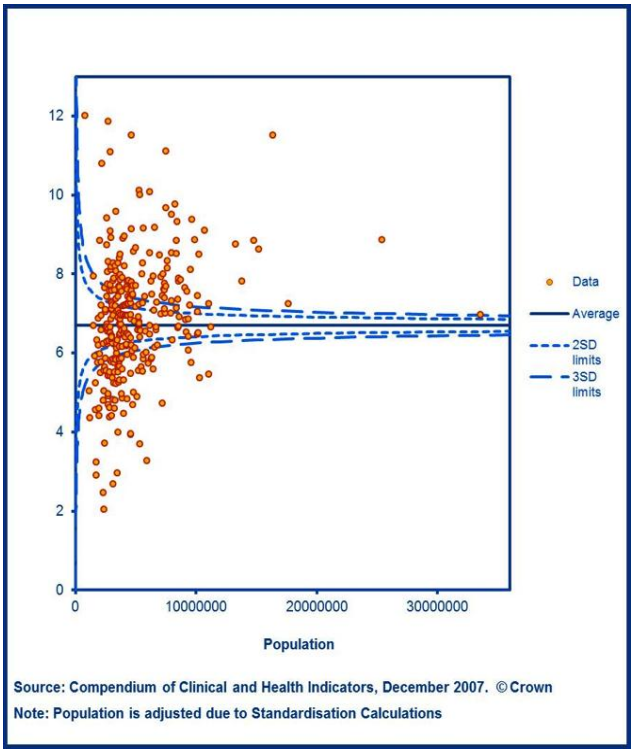

FIGURE III CALL RATES PER 100 STANDARD POPULATION IN ENGLAND FOR JAN 2011

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Table I
Uptake of NHS Direct by OA group during the month period of January 2010

OA Supergroup		OA Group	Observed (O)	Expected (E)	(O-E)	(O-E/√E)	Uptake Rate	Sig
Blue Collar Communities	1a	Terraced Blue Collar	11886	14836.2	-2950.2	-24.22	0.80	<.001
	1b	Younger Blue Collar	27387	24234.8	3152.2	20.25	1.13	<.001
	1c	Older Blue Collar	19717	21101.9	-1384.9	-9.53	0.93	<.001
City Living	2a	Transient Communities	11737	8102.3	3634.7	40.38	1.45	<.001
	2b	Settled in the City	18499	13971.9	4527.1	38.30	1.32	<.001
Countryside	3a	Village Life	14131	17861.0	-3730.0	-27.91	0.79	<.001
	3b	Agricultural	6246	12387.5	-6141.5	-55.18	0.50	<.001
	3c	Accessible Countryside	12187	14584.1	-2397.1	-19.85	0.84	<.001
Prospering suburbs	4a	Prospering Younger Families	13977	16060.5	-2083.5	-16.44	0.87	<.001
	4b	Prospering Older Families	17253	24270.8	-7017.8	-45.05	0.71	<.001
	4c	Prospering Semis	21420	25567.2	-4147.2	-25.94	0.84	<.001
	4d	Thriving Suburbs	14925	17140.8	-2215.8	-16.92	0.87	<.001
Constrained by circumstances	5a	Senior Communities	3521	4177.2	-656.2	-10.15	0.84	<.001
	5b	Older Workers	26558	24847.0	1711.0	10.85	1.07	<.001
	5c	Public Housing	8330	10262.9	-1932.9	-19.08	0.81	<.001
Typical Traits	6a	Settled Households	21206	20021.6	1184.4	8.37	1.06	<.001
	6b	Least Divergent	19701	18509.2	1191.8	8.76	1.06	<.001
	6c	Young Families in Terraced Houses	20035	15916.5	4118.5	32.64	1.26	<.001
	6d	Aspiring Households	17026	15016.2	2009.8	16.40	1.13	<.001
Multicultural	7a	Asian Communities	32295	25099.0	7196.0	45.42	1.29	<.001
	7b	Afro-Caribbean Communities	22100	16168.5	5931.5	46.65	1.37	<.001

**OA Groups that use more than expected are highlighted in yellow and groups that use less than expected are highlighted in red.*

A chi-square goodness of fit was performed and confirmed that uptake of NHS Direct was not representative (X^2=17966.82, df=20, p<0.001) of the OA Groups. Table 2 provides adjusted standardized residuals and uptake rate by each of the 21 OA Groups. Analysis revealed that lower representation was found in all OA groups in the OA.

Supergroup 'Countryside' with lower uptake rate found for village life at (0.79), agricultural (0.50) and accessible countryside (0.84) (p<0.001). Other lower usage groups was found in OA Groups characterized as having older residents i.e. 'Prospering Older Families' (0.71), 'Older Blue Collar' (0.93), 'Senior Communities' (0.84) and 'Public Housing' (0.81) (p<0.001). Lower usage was also found in all prospering suburbs, which is characterized as a more affluent well educated/ well established individuals.

Usage to NHS Direct was over represented in younger individuals who live in built up urban areas characterized as 'Transient Communities' and 'Settled in the City' OA Groups. Higher uptake rate was also found in family based sub-groups i.e. 'Settled Households' (1.06), 'Least Divergent' (1.06), 'Young Families in Terraced Houses' (1.26) 'Typical Traits' and 'Aspiring Households' (1.13).

Furthermore, over representation was found for the 'Multicultural' OA Supergroup. In particular, higher uptake rates were found for both Asian (1.29) and Afro-Caribbean (1.37) communities.

IV. Discussion

Main findings

NHS Direct dealt with 374,485 calls during the month of January 2011 in England. Calls were most likely to be symptomatic and were triaged by an expert nurse. Calls to NHS Direct were higher during the day and in the evening and calls were more likely to be during the week rather than at weekends and bank holidays. A key aim of NHS Direct is to support the public to take more responsibility for their health and symptoms. This is supported by disposition whereby NHS Direct successfully supported 43.5% of calls through self-care and health information alone.

The findings have also illustrated that there appears to be geographical variation of calls influenced by rurality. Essentially, NHS Direct was set up to increase accessibility to healthcare in England, it, therefore, appears surprising that more remote and rural geographical areas highlight lower uptake of this service.

This finding cannot be compared to previous NHS Direct utilisation studies as no studies have analysed geographical usage at a national level, however, this does support suggestions of previous research, which indicates that rural areas could well be the lowest users [37].

This supports previous analysis suggesting that rural communities are less likely to use NHS Direct. However, when we review international literature it appears that this pattern is not uncommon. For example, Australia set up 'Health Direct' a government initiative that provides 24/7 telephone-based healthcare related information and advice Australian Capital Tertiary, New South Wales, Northern Tertiary, South Australia, Tasmania alongside West Australia. Whilst a key aim of this service was to support remote areas with healthcare, findings have suggested that from evaluations only 6% of calls were from rural areas [38].

Geographical areas identified as lowest usage could be related to the higher distribution of older residents. For example, both Mid Suffolk and Suffolk Costal were outlined as low usage areas, however, the 2011 census has revealed a striking increase in Suffolk's ageing population outlining a growth of 25% of those aged 60 and above from 2001 [39]. Further, the Isle of Wight, another low usage area, with a largest group of residents are aged 60 to 64 (8.1% of the total population), and almost a quarter of residents (24.1%) aged 65 and over older residents remains particularly high when compared with the England average (16.6%) [40]. This finding is supported by the analysis of geo-demographic profiles, with rural communities and communities with older residents were shown to have the lowest observed uptake rate of NHS Direct.

A wealth of previous research has highlighted that older people are the lowest users of NHS Direct [41] with deprivation suggested to increase call rate [20, 42], however, this research suggests that older people in more urbanised areas could more likely to use the service. Previous research highlights a wide range of factors that could impact on uptake of telephone-based healthcare. For example Werner and Karnieli [43] proposed that attitudes and patient-physician relationship, mediated by technology anxiety and past behavior can significantly impact on the willingness to use telemedicine. Further, research has highlighted a direct relationship between satisfaction of current healthcare on willingness to use technology based healthcare [43, 44]. Whilst this theoretical approach has not been applied to telephone-based healthcare, this does provide a clearer understanding of uptake behavior, which may be related to attitudes and perceptions towards telephone-based healthcare but also mediated by demographic and geographic location.

As telephone, health care is put forward as a cost-effective solution to reduce healthcare inequalities as well as improve self-care [45, 46] it becomes increasingly paramount that research explores the reasons why people do and do not engage with such services in low usage population groups residing in rural communities. This will not only advance the theoretical understanding in the field but will provide an evidence-based approach which can be applied to other areas of telehealth to help increase access to the wider population.

Strengths and limitations of the study

This research is the first national analysis that has explored geographical variation of all NHS Direct users, overcoming bias of previous research, which has only focused on older individuals (65+). Furthermore, through the adoption of a novel methodological approach to determining geographical dispersal through the application of funnel plot analysis, this has become the first study that can determine high and low uptake in relation to geographic location.

However, there have been some limitations that should be acknowledged. Firstly, the data has been collected via NHS Direct clinical database where there were some missing postcodes, however, the number excluded (N=14, 348; 3.8%) was not felt to impact on the statistical interpretation of analysis. This research only focused on one month period of data and may not have captured seasonal differences, nonetheless, as a national study this sample was viewed substantial to answer the set research question.

V. Conclusion

NHS Direct has become a popular service by the public in England taking over 350,000 calls in January 2011 alone. This service is used primarily outside of weekends and bank holidays both in and out of hours. The presented research has demonstrated that NHS Direct has successfully supported over 40% of the national public to self-manage their symptoms. Whilst it is unknown what these patients would have done if they had not used NHS Direct, improving access could have effectively reduced pressure on overstretched health services both in and out of hours.

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