New Zealand Healthline call data used to measure the effect of travel time on the use of the emergency department

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ABSTRACT

Telephone triage is a health tool increasingly used to connect geographically distant populations. Such services are also utilised to address issues of Emergency Department (ED) overuse. New Zealand's tele-triage service, Healthline, has existed since 2001 but is yet to be the focus of analysis. This research sought to understand the role that travel time to ED had upon Healthline users' compliance with telephone advice. Additionally, the role of deprivation in Healthline (as a determinant of caller behaviour) was examined. Travel time to ED was found to influence the impact of Healthline advice upon callers but this was not confounded by deprivation. Those living closest to the ED were more likely to attend when advised to, and less likely to stay away if told to avoid the ED. Different time brackets showed stronger trends, suggesting that callers at varying distances from EDs may be more or less influenced by both travel time and Healthline advice.

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1. Background

Geographic access to healthcare services, or the relative ease by which healthcare services can be reached from a given location (Wang, 2012) is an important consideration for health planners. Healthcare accessibility has multiple definitions (Guagliardo, 2004) and incorporates both geographic and socioeconomic elements. For example, barriers such as distance, transportation, travel time and cost all affect a user's ability and motivation to utilise healthcare services (Cromley and McLafferty, 2011). Consequently, poor healthcare utilisation could lead to geographic inequalities in health (Pearce et al., 2007); which has implications for the location of health resources.

Recent advances in measuring and explaining spatial accessibility have somewhat untangled the dimensions of healthcare accessibility, however, less is known about and there is little consensus on the effect of distance to and the supply of healthcare on utilisation (Guagliardo, 2004). It has been widely reported that utilisation is strongly correlated with the geographical distance from the hospital (Seidel et al., 2006; Lee et al., 2007) i.e. the notion of distance decay. However, alternative research asserts that the

relationship between physical distance from healthcare services and utilisation is more complex than it first appears; those living further away from healthcare services are not always less likely to attend. Evidence suggests that the degree to which distance effects utilisation usually depends on the severity or need of an individual to attend healthcare services and the supply of reasonable alternatives for outpatient treatment (Cromley and McLafferty, 2011). For instance it was found that early stage breast cancer patients in the United States (US) were electing to travel long distances to seek the best (perceived) care, bypassing nearer services (Boscoe et al., 2011).

The lack of knowledge and consensus in this area can largely be accounted for by issues relating to measuring the distance to healthcare services and utilisation. Primarily, there is no single, decisive method to measure distance decay, which means comparisons across studies are hard to achieve. For instance, although it is relatively simple to calculate travel time or road distance from patient to healthcare services (the most accurate estimate of distance) many studies (e.g. see Lee et al., 2007) have opted to use less accurate measures such as Euclidean or Manhattan distance; both have major shortcomings and may lead to highly inaccurate distance estimations (Shahid et al., 2009). Next, due to lack of personalised data (Guagliardo, 2004) many studies are limited to studying a single clinic or hospital rather than a whole country (e.g. see Seidel et al., 2006; Lee et al., 2007) and are limited to analysing

aggregated data. Studying single locations can be problematic because they are not nationally representative (Zuckerman and Shen, 2004) but it also assumes those in the bounds of the study only use that facility, which may not always be the case. Next, analysis using aggregated data gives rise to the ecological fallacy or the modifiable area unit problem (MAUP) (Openshaw and Openshaw, 1984). Lastly, distinguishing between healthcare need and service utilisation is often a detail that is missed when investigating geography and healthcare service use. Healthcare service utilisation can be as much a product of health need (or demand) as it can be a product of accessibility (in this case geography). Distinguishing between the two is critical in untangling the dynamics of healthcare utilisation.

The aim of this study is to explore the relationship between distance by travel time from healthcare services and service utilisation, tackling some of the previous methodological issues in this area. This has been achieved by investigating individual callers to Healthline, New Zealand's telephone triage service, and their compliance with advice provided by a Healthline nurse as to whether the individual should visit an emergency healthcare service. The study is particularly poignant given the interest in appropriate ED use and the reasons for misuse (Jones and Thornton, 2013).

There is precedence using network travel time as a means to analyse health care service accessibility. In New Zealand, for example, studies have used network travel time to measure access to EDs (Brabyn and Beere, 2006), general practitioners (Brabyn and Barnett, 2004; Brabyn and Gower, 2004) and hospitals (Brabyn and Skelly, 2002). However, this research does not address all of the issues surrounding distance from healthcare services and service utilisation, as identified above.

This study is unique for several reasons. First, digital road networks are used to measure time travel from patient to the ED, and complications with the ecological fallacy are avoided by measuring time from patient to nearest ED using geocoded address points, in contrast to other studies which use boundary centroids (for example Lee et al. (2007)). Second, data encompasses the whole of New Zealand, largely a closed system. Third, our data reveal a clear definition of need. Healthline collects information on the original inclination of the caller i.e. what action would have been taken if calling Healthline was not an option and also the recommendation given by the Healthline nurse i.e. whether to attend hospital, see a doctor or administer self-care. Lastly, callers who present themselves at the ED are tracked using administrative data and deterministic data linkage, which provides a clear outcome from the initial call, i.e. attendance or non-attendance at an ED.

New Zealand's telephone triage, Healthline, was initially introduced as a pilot scheme in 2001 and subsequently launched nationwide in 2005 (St George et al., 2008). Healthline is a government-funded service which aims to provide an alternative to visiting a health provider in person as the first port of call for health advice. This seeks to reduce pressure upon both primary health providers and emergency departments (ED) (Ministry of Health (MOH, 2012). Healthline is available 24 h a day and provides the contact of a registered nurse for all callers. Computer-based decision making software is used within the system to ensure consistency across calls and precautions are taken to ensure that the service provides a safe alternative to a face to face visit to a medical practitioner (MOH, 2012). The ultimate goal of Healthline is to increase appropriate access to health advice and services for populations which may otherwise be unable to reach them, whilst also reducing unnecessary visits to unsuitable healthcare providers where possible (MOH, 2012). Services such as Healthline are seen as innovative ways of addressing the problem of ED overcrowding within modern healthcare systems (Bunn et al., 2005). Additionally,

they act as a means by which to provide a health service for social groups with lower utilisation rates of General Practitioner (GP) services (Scott et al., 2003).

For context, it is necessary to consider how healthcare in New Zealand is paid for, and consider the potential contribution of socioeconomic deprivation to ED utilisation.

Publicly funded (subsidised) healthcare is available to all New Zealand citizens, residents (or holders of a work visa valid for 2 years or more) and their children (aged 17 years or under), and most physical injuries are covered by the Accident Compensation Corporation (ACC) scheme (Immigration NZ, 2016). The ACC scheme provides no-fault insurance for the entire New Zealand population (including visitors), regardless of residency or occupational status (Accident Compensation Corporation, 2016).

In addition, initiatives such as the Very Low Cost Access (VCLA) present the opportunity of reduced fees for subpopulations with greater need and lower financial resources. The VCLA scheme provides a number of Public Health Organisations (PHOs) and GPs with extra funding in return for fees being placed within agreed thresholds, such as an $18.00 maximum for adults aged 18 years and over (Ministry of Health (2015)). It is unclear as to whether the VCLAs are suitably located across the country, though it has been reported that GPs which serve areas with the highest levels of need face unsustainable business practices, and that neighbouring practices serving similar populations may receive different levels of funding and subsequently offer inequitable access to patients in those areas (General Practice New Zealand, 2015).

Despite the healthcare system in New Zealand being part-subsidised, certain injuries being comprehensively insured, and schemes offering reduced fees for medical services such as GP appointments or prescriptions, financial cost remains a barrier for some wishing to access healthcare services. Information collected in the New Zealand Health Survey reveals that for people requiring medical care in the form of a GP visit or a prescription, an estimated 14% of adults (and 6% of children) were unable to visit a GP when they had a medical problem (Ministry of Health (2016)). An estimated 6% of the total adult population experienced unmet need for after-hours services due to cost.

The NZHS also reports that unmet need is higher for the Māori (indigenous New Zealander) and Pacific ethnic groups (both groups have higher rates of poor health than other ethnic groups), for younger people, and for people who live in the more socioeconomically deprived areas. For example, 11% of Māori adults experienced unmet after-hours service need due to financial cost, and the rate of unmet need for after-hours services in the most socioeconomically deprived areas is three times that of the rate in the least deprived areas.

2. Methods

2.1. Data

Healthline call data between July 2010 and June 2012 were obtained from the Healthline service information provider. These data include the following information about each call and caller: date and time of call, gender, date of birth, ethnicity, address of residence, the intention of the caller had they been unable to call Healthline, and the recommended course of action provided by Healthline (i.e. attend an ED immediately, call the emergency services, visit a GP, or administer self-care). The address of each caller was geocoded to produce geographic coordinates. An analysis (not reported here) of geocoded and unsuccessfully ungeocoded records indicated that the unsuccessfully geocoded records were representative of all Healthline records. Records without recommendation (due to an incomplete/unfinished call) were excluded, as were