

ORIGINAL RESEARCH

Simulated GP clinic closure: effects on patient access in the Irish Mid-West

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ABSTRACT:

Introduction: Rural communities can experience more barriers to accessing health care than their urban counterparts, largely due to fewer healthcare staff and services, and geographical isolation. The purpose of this study is to examine the availability of GP practices

in rural communities across the Mid-West of Ireland and the potential impact of practice closure on patient access.

Methods: GP clinic locations were identified in Ireland's Mid-West, specifically counties Limerick and Clare. Administrative

subdivisions of both counties, Small Areas (SAs), were identified and their XY geographic centre coordinates recorded. SAs were indexed into six levels of rurality according to Irish Central Statistics Office urban/rural classifications (1, cities; 2, satellite urban towns; 3, independent urban towns; 4, rural areas with high urban influence; 5, rural areas with moderate urban influence; 6, highly rural/remote areas). The direct linear distance from the centre of each SA to its respective closest GP clinic was calculated. Simulated closure of each GP clinic was assessed programmatically by removing practices from the overall dataset and calculating the new direct linear distance from each SA to the next closest GP clinic.

Results: The majority of the SAs in County Clare (63%) and County Limerick (66%) are classified as rural (rurality index ≥ 4), with the exception of Limerick City, where all SAs were defined as urban.

Keywords:

general practice, healthcare access, health equity, healthcare informatics, Ireland, primary care.

Rural SAs have longer travel distances to GP clinics than their urban counterparts, and these distances are greater with increasing rurality of a population. Simulated closure of GP clinics revealed increasing travel distances to the next closest clinic with increasing level of rurality in a stepwise fashion ($r^2=0.31$).

Conclusion: Rural community dwellers across the Mid-West of Ireland face longer travel distances to GP clinics than their urban counterparts. Thus rural communities will be, on average, more adversely affected should their local GP clinic close. While these findings are unsurprising, our methodology calculates a discrete number that can be used to rank vulnerability of local communities. Rural areas are particularly vulnerable to GP clinic closure, and maintaining a solid foundation of primary care in these areas will require careful service and workforce planning.

FULL ARTICLE:

Introduction

Nearly half of the world's population live in rural areas, and an estimated two billion people living in these areas do not have adequate access to essential health services¹. Geographical barriers, lack of transport, increased distances and consequent increased cost of accessing healthcare services leads to poorer health outcomes for rural dwellers as compared to people living in urban areas¹. A further critical factor underlying this inequality is a global lack of trained healthcare workers, which affects rural areas disproportionately^{1,2}. Geographic and economic barriers, coupled with low healthcare worker density, lead to missed opportunities to provide timely patient care, in addition to inefficiencies and delays in care, with rural healthcare workers and patients wasting considerable time in transit³.

Approximately one in three people living in Ireland live in rural areas⁴. Rural communities in Ireland tend to have a higher proportion of elderly members, who have more healthcare needs. Thus, older rural dwellers face more transport challenges than their urban counterparts, which may hinder their access to healthcare settings⁵. Rural populations are also dwindling in many areas, with younger people moving to cities and towns for further education and employment opportunities. Thus, rural populations are both contracting and getting older, which gives rise to unique challenges that may not be apparent from simple calculations around supply of healthcare worker per head of population in a region.

In Ireland, mortality rates and hospital admissions are higher in rural areas⁶, and mortality rates are higher among children living in rural Northern Ireland⁷.

General practice plays a vital role in delivering improved community health outcomes, particularly in rural communities⁸. From a study from the US, adding primary care physicians to a region was more effective in reducing disease and death than adding equivalent numbers of secondary care clinicians⁹. Long-term continuity with primary healthcare services is associated with reduced all-cause mortality rates¹⁰⁻¹² and it is widely recognised that money spent in primary care leads to considerable savings downstream for a population¹³.

Primary care clinic closures bring negative impacts on the populations they serve. Studies have shown that patients affected by a practice closure show a 12% decrease in annual GP visits and an 11% increase in specialist care usage¹⁴. Other research from the US noted that rural hospital closures have been shown to increase mortality rates from myocardial infarction, chronic obstructive pulmonary disease and stroke; whereas urban hospital closures had no measurable impact¹⁵.

Research by the Irish Department of Health estimates that by 2031 there will be a 46% expected increase in demand for primary care services across Ireland¹⁶, largely due to the ageing of our relatively young population (average age 38.8 years¹⁷ as compared to the EU average of 44.4 years¹⁸). While the total number of Irish GPs per 100 000 has been steadily increasing over the past 30 years, the number of rural Irish GPs has decreased over the past two decades⁴. Additionally, there is considerable geographic variation in the number of GPs and their workloads in rural Ireland¹⁹. Previous research in Ireland has shown that 89% of urban populations live within walking distance to the nearest GP clinic, compared to only 7% of rural populations^{20,21}.

The purpose of this study is to explore the distribution of GP clinics among rural and urban populations in the Mid-West of Ireland. In addition, we investigate the impact on new travel distances if GP clinics were individually closed across the region.

Methods

Geography and rurality

Two counties in the Republic of Ireland were included in the study: County Clare and County Limerick. Both counties map onto the Community Healthcare Organisation 3 and are largely representative of the Republic of Ireland, with a mixture of urban and rural centres²². These two neighbouring counties have a combined population of 313 000 within an area of 6200 km², although the density varies greatly across urban and rural subpopulations. The study area contains the third largest urban area in the country: Limerick City (population 94 000). Given Limerick City represents close to a third of the overall population in this area, it is from here on discussed separately to County Limerick. The analysis here presented is carried out at the Small

Areas (SAs) level. SAs are the lowest level of official geography in Ireland and typically contain 80 to 120 dwellings. SAs were indexed into six categories of rurality per county based on the Irish Central Statistics Office classification for urban and rural areas⁴ (Table 1).

GP clinic identification

GP clinic locations in the area under study were identified using the Health Service Executive service finder website²³. Individuals can access this database to determine the availability and location of health services in Ireland. While only County Clare and County Limerick SAs were investigated, GP clinics close to the border of this region were also located and analysed as it is not unlikely for a patient to cross a county boundary for GP care.

Distance calculations and clinic closure analyses

The open source statistical software R v4.2 in R studio (2022.07) (R Project; <https://www.r-project.org> [<https://www.r-project.org>]) was used to map shapefiles that define SA boundaries in the Republic of Ireland and for subsequent analyses^{24,25}. First, the XY centroid coordinates (latitude and longitude) of each SA was calculated using R's SF package. Next, we calculated the distance from the centroid of each SA to its nearest clinic, in addition to the distance

to the second nearest clinic. Finally, we calculated the difference between the first and second closest clinics (Table 2). This served as a simulation for the additional travel burden that would be imposed on SA residents should the closest clinic be closed.

The analysis was iterated over each SA, allowing us to evaluate not only individual SA but also regional impacts across the study area.

Statistical analysis

Data analysis and statistics were carried out using R software²⁵. Linear regression was used to assess the predictive power of rurality on additional travel.

Results

Geographic and GP clinic data

A total of 1287 SAs exist in the study area: 511 in County Clare, 517 SAs in Limerick and 259 in Limerick City (Table 1, Fig1).

A total of 122 GP practice clinics were identified within the study area: 40 in County Clare, 48 in County Limerick and 34 in Limerick City (Table 1, Fig2). Additionally, 26 GP clinics outside but close to the border of the study area were identified.

Table 1: Mean area, mean population per Small Area, and Small Area count for County Clare, County Limerick and Limerick City classified by rurality index

County/city	Rurality index	Rurality index description	Urban/rural	Mean area (km ²)	Mean population per Small Area	Small Area count	Number of GP clinics
Clare	1	City	Urban	0.4	317	14	1
	2	Satellite urban town		0.6	303	9	2
	3	Independent urban town		0.3	241	163	20
	4	Rural area with high urban influence	Rural	8.4	299	97	0
	5	Rural area with moderate urban influence		13.9	244	79	7
	6	Highly rural/remote area		9.8	162	149	10
Limerick	1	City	Urban	0.3	277	114	11
	2	Satellite urban town		0.3	271	18	5
	3	Independent urban town		0.5	223	46	11
	4	Rural area with high urban influence	Rural	8.0	297	191	7
	5	Rural area with moderate urban influence		8.9	236	110	8
	6	Highly rural/remote area		4.0	188	38	6
Limerick City	1	City	Urban	0.1	225	259	34

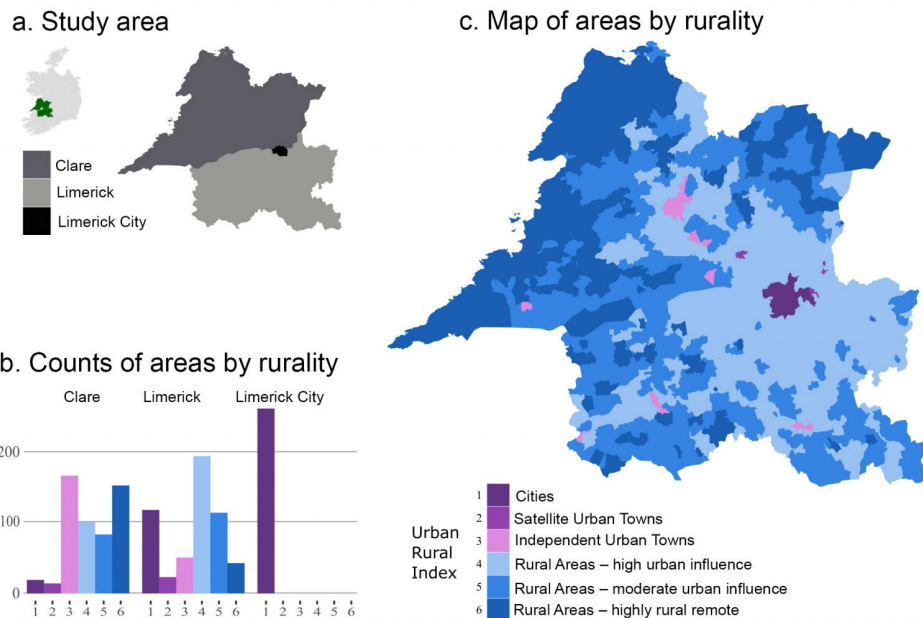


Figure 1: (a) Map showing location of study area within Republic of Ireland (green) and divisions of County Clare, County Limerick and Limerick City. (b) Bar chart showing number of Small Areas per study area. (c) Heat map of Small Areas classified on level of rurality.

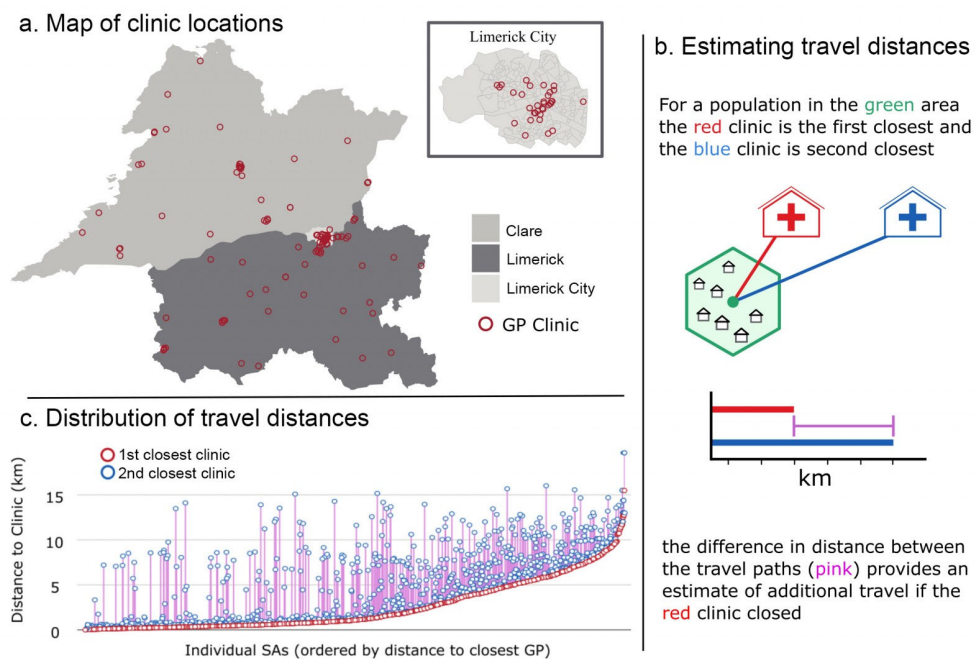


Figure 2: (a) Map showing location of GP clinics across County Clare, County Limerick and Limerick City. (b) Schematic representation of calculations for nearest clinic travel distance and new additional travel distances after clinic closure. (c) Overview of all estimated additional distances for Small Areas in the study.

Rurality indexing

SAs in County Clare and Limerick were indexed into six levels of rurality. Of the SAs in County Clare, 325/511 (63%) SAs were classified as rural (rurality index 4–6) and, in Limerick, 339/517

(66%) were indexed as rural. Within Limerick City, 259/259 (100%) of the SAs were defined as being urban cities, with a rurality index of 1 (Table 2). Highly rural/remote SAs represented 187/1287 (15%) of all SAs across the study area, with 149/511 (29%) and 38/517 (7%) in County Clare and Limerick respectively.

Table 2: Travel distances to the nearest GP clinic and new additional distances after nearest clinic closure for SAs in County Clare, Limerick and Limerick City

County/city	Rurality index	Rurality index description	Distance (95%CI) to closest clinic (m)	New additional distance (95%CI) after nearest GP clinic closure (m)
Clare	1	City	656(±240)	1892(±308)
	2	Satellite urban town	729(±202)	759(±201)
	3	Independent urban town	766(±101)	1225(±187)
	4	Rural area with high urban influence	4755(±496)	5962(±648)
	5	Rural area with moderate urban influence	5402(±713)	8737(±844)
	6	Highly rural/remote area	4388(±535)	7991(±629)
Limerick	1	City	654(±95)	864(±91)
	2	Satellite urban town	425(±135)	691(±131)
	3	Independent urban town	646(±177)	1985(±811)
	4	Rural area with high urban influence	3811(±286)	5967(±310)
	5	Rural area with moderate urban influence	4531(±472)	7218(±494)
	6	Highly rural/remote area	3089(±1051)	7444(±843)
Limerick City	1	City	472(±41)	666(±49)

CI, confidence interval.

Travel distances to GP clinics

The average distance for all SAs to their closest GP clinic was 2530 m (95%CI ±150 m). In County Clare, the average travel distance for all SAs to their closest clinic was 3290±270 m; 2820±220 m in Limerick and 470±40 m for SAs in Limerick City. Rurally defined areas (rurality index 4–6) had higher travel distances than areas classified as being urban (rurality index 1–3). For all rurally defined SAs in the analysis, the average distance to the closest GP clinic was 4350±210 m, and for urban-defined SAs the average travel distance was 600±40 m (Table 2).

Travel distances to GP clinics after simulated closure: To model closure of each GP clinic closest to an SA (Table 2, Fig3), the difference between the original travel distance and the new distance to the second closest clinic was measured for all SAs. The average new additional travel distance across all SAs in the analysis was 1570±140 m (Table 2). The average new additional travel distances across County Clare were 1980±270 m, 1803±200 m in County Limerick and 200±30 m in Limerick City (Table 2).

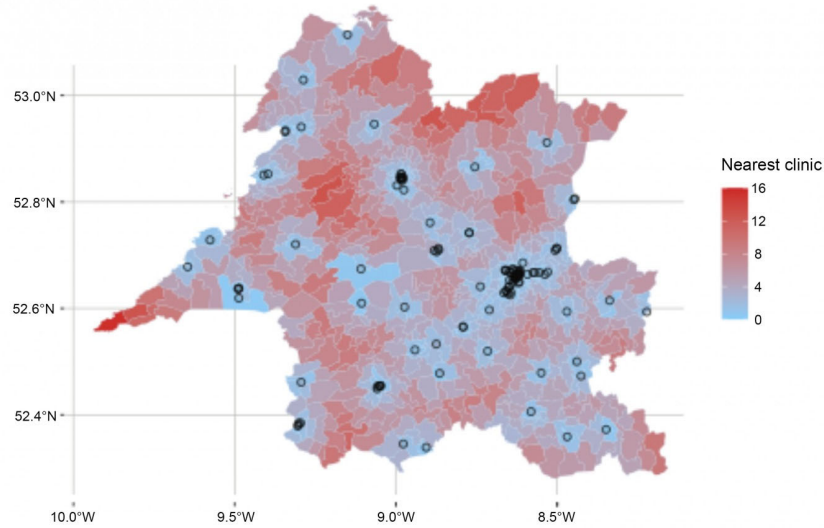
For rurally defined SAs the average distances to the second closest clinic were 7040±250 m, whereas urban areas had new average

distances of 980±90 m. As such, after simulated GP clinic closure additional distance also showed an urban rural split: average added distance for rural SAs was 2700±230 m compared to 370±70 m for urban SAs. The added distance was most prominent for highly rural and remote areas (rurality index 6), where average new estimated distance across both counties for these areas was 3760±500 m.

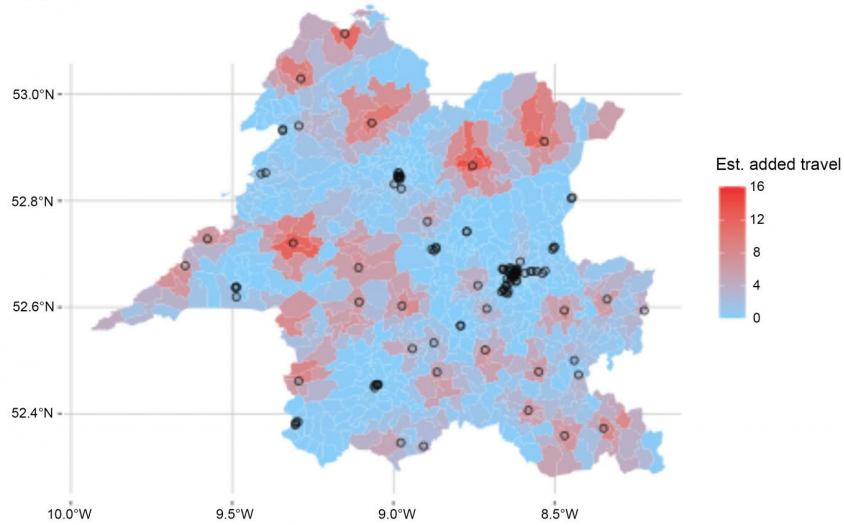
We carried out regression analysis using rurality to predict additional distance to a GP should the closest clinic close. The model also controlled for the current distance to the nearest GP. The model predicted that, for each additional step up in rurality, one additional kilometre of travel could be expected (982 m (95%CI 902–1063 m), $p < 0.0001$). Overall, the model predicted about 30% of the variability in additional travel time (adjusted $r^2 = 0.31$).

Figure 3c represents level of rurality and new travel length. Stepwise increase in travel distance is observed for increasing urban-rural index scores. Visual analysis shows the highest amount of variance in added travel time for increasing level of rurality (Fig3).

a. Distance to nearest GP clinic



b. Estimated added travel after clinic closure



c. Estimated added travel by area rurality

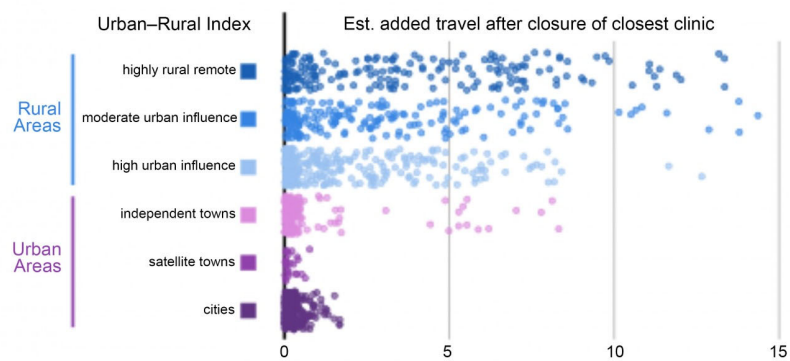


Figure 3: (a) Map showing location of GP clinics, with Small Areas coloured for distance (km) to nearest clinic. (b) Map showing location of GP clinics, with Small Areas added for estimated added distance (km) after nearest clinic closure. (c) Overview of the estimated new additional travel distances (km) for all Small Areas in the study population, indexed by level of rurality.

Discussion

Main findings

This study demonstrates and quantifies the increased distance that rural and remote populations have to travel to access GP clinics compared to those living in more urban areas. Travel distances

increase in a stepwise fashion with the rurality of a community.

In addition, our study demonstrates that, the more remote a community, the greater the distance people will have to travel to the next closest GP clinic should their current closest clinic close. This may be expected given the lack of GP clinics seen in rural areas (Table 1).

Limerick City has a relatively small footprint and far more GP clinics compared to more rural areas in the county, and thus travel distances in the city are much shorter. The GP clinic distribution in County Clare was not as expected for level of rurality, as the most rural areas in County Clare had more GP clinics than their urban County Clare counterparts (Table 1). However, in highly rural and remote communities in both counties, the increase after the nearest clinic closure was more than double the overall average and more than 10 times the average increase seen in urban areas. These distances also tend to increase in a stepwise fashion with increasing rurality.

Our findings highlight the current geographical barriers that rural communities in Ireland face in terms of having to travel further to access GP clinics and services, and in relation to increased vulnerability to clinic closures. These findings confirm that rural community geographical isolation and limited GP clinic options make these areas particularly prone to GP clinic closure.

Comparison to existing literature

Ireland has one of the highest rates of rural-dwelling communities in Europe⁴. Previous research in the US has shown rural communities have to travel two to three times further to seek primary and secondary health care compared to their urban counterparts. Worryingly, patients with cancer, heart disease, depression or those who required complex surgical treatment needed to travel the furthest²⁶. The same findings highlighted that rural communities often do not have any access to urban healthcare facilities²⁶.

Similarly, data in Peru suggest rural communities compared to urban cities had a 1.9-fold increase in travel times to primary healthcare facilities and a 2.3-fold increase for secondary healthcare facilities²⁷.

Our study focused solely on access and travel distances to primary care services rather than secondary health care. However, our data parallel previous research as the distance to GP clinics for rural-dwelling populations is seven times higher than for those who live in urban areas.

Our data indicate that Limerick City SAs are far more likely to contain a GP clinic than other SAs in this project. For rural and remote areas in our analysis, clinics are scarcer, and thus patient autonomy to choose a specific clinic is limited.

In the UK, data showed the highest travel distances and travel times to hospital and primary care clinics were in rural areas²⁸. Our findings on clinic closure are congruent with previous research exploring the effects of healthcare clinic closure in rural areas.

For example, rural hospital closures in the US have resulted in increased mean transport and total emergency medical services activation times²⁹. Single rural hospital closures in rural counties in the US have been shown to reduce community per-capita income and increase the unemployment rate³⁰. There are several factors that may lead to the closure of a GP clinic. These include doctors retiring, practices with two or more doctors compared to a single doctor, high medical costs among patients and practices low in women and younger populations³¹.

GP clinic closures may also impact house-call visits. Data show house calls are more common in elderly patient populations and also more common in rural areas³². Recent research shows that

house call rates are more common among older GPs compared to recent graduates, and house-call rates are more common among rural GPs compared to their urban counterparts³³. House-call rates are declining in the Republic of Ireland, and visits may be essential for patient wellbeing and health outcomes³⁴.

The closure of GP clinics has a considerable impact on the practice population, particularly on older patients. When a practice shuts, older patients may be content to move to a new clinic that is relatively close by, but dislike changing GPs. On the other hand, if they move clinic in order to retain the services of the same doctor, they value retaining the doctor–patient relationship but are unhappy with the increased travel³⁵. In summary, clinic closure discommodates served populations. Nearby alternatives might not be suitable due to existing workload and workforce issues in general practice, distance and transportation issues. Hence, maintaining access to existing rural GP clinics is vital to meet health needs and provide accessible GP care locally.

Policy considerations

More must be done to address the gap in health equity for rural communities in the Republic of Ireland. Over the past 20 years in Ireland, the total number of GPs is increasing; however, the number of rural GPs is decreasing³⁶. This is not a local phenomenon, and it is well documented that primary care providers tend to gravitate towards working in urban areas. Indeed, rural Irish GPs tend to be older than the GP national average: recent census data shows that 24% are over the age of 60 years and 14% are older than 65 years³⁷. Difficulties in GP recruitment, short- and long-term cover and replacements, and poorer rural infrastructure contribute to a complex and worsening situation for rural GPs³⁸.

There exist several opportunities in government policy and healthcare management plans to enhance equity for healthcare access for rural and remote communities across Ireland.

Financial incentives are one of the few health policy interventions intended to improve the distribution of GPs in rural areas³⁹. Extensive postgraduate healthcare training in rural and remote areas as well as loan repayment options have been shown to retain rural healthcare workers⁴⁰. Loan repayment options have been shown to be superior for retaining rural physicians compared to visa waivers; however, the issue appears to be complex, and should involve measures integrating health workers' families into rural communities to enhance retention⁴¹. While there is a rural practice allowance scheme in Ireland, its strict criteria, modest budget and limited application have done little to stem the flow of younger GPs to urban centres.

Travel in Ireland is predominantly by car, averaging at 69% nationally⁴². In rural Ireland, 80% of trips are taken by car compared to 58% of those living in cities⁴². Approximately 32% of city dwellers walk for transportation compared to 8% of those in rural areas⁴². Public transport, including bus and train, accounts for approximately 4% and 1% respectively for a travel purposes⁴². A total of 68% of rural citizens report having no public transport tickets, 13% lower than the national average⁴². For comparison, 14% of a rural dwellers report they are within a 15-minute walk to their nearest doctor's surgery, whereas 78% of those living in Dublin and the surrounding suburbs report living within walking distance⁴². The recent census data highlight that those living in rural areas are much more heavily dependent on cars for transport

than any other region in the Republic of Ireland, rely less on public transport and walking, and are more likely to travel longer distances to all destinations including shops, restaurants, healthcare services and bus stops compared to the national average. The Republic of Ireland has implemented the Rural Transport Programme to combat the issue surrounding rural access and exclusion. The program includes door-to-door bus services and subsidised group travel to transport rural dwellers to cities and access other essential services. Expanding this program to include community car schemes is planned.

Mobility rates of GPs are generally low in urban areas but tend to increase with rurality⁴³. Data from the US suggest that the majority of GP mobility begins early in GP careers, becoming more stable during the mid-late career years⁴⁴. Thus, financial incentives should be directed at medical students and early-career GPs to incentivise rural practice. Data in Australia suggest higher financial pay increases incentives for newly trained GPs to work in rural areas; however, the effects on waiting times for patients are mixed, and financial incentives alone are not sufficient to increase access to rural primary care⁴⁵. Currently, there are no additional government incentives in Ireland to increase the prevalence of rural GP practitioners. Specific rural medical curriculums and pathways should exist to enhance exposure of medical students and newly trained physicians to rural areas. Therefore, GP training schemes should include rural exposure to give new doctors experience of the complexities that rural patients present with. These training practices should expand to nursing students, pharmacists and all other medical care workers in primary care to close the gap on health access inequities³⁸.

Study limitations

Importantly, there was an assumption that individuals used the clinic closest to them. There are limited data on this subject in the Irish context; however, recent data out of New Zealand shows that bypass rates may be as high as 60%⁴⁶. There appeared to be a sigmoidal curve in the bypass rates: they were lowest when an individual lived closest to a clinic and highest when their clinic was further away. However, as Irish GP care provision is traditionally provided via the General Medical Services contract, which limits patient choice by their geography, bypass rates in the Irish context are not expected to be this high. Nonetheless, this requires further investigation to achieve a more accurate analysis of who uses certain GP facilities in the Republic of Ireland.

Another limitation to the study is that we are assuming that, should a GP clinic close, the next practice is able to recruit new patients. At present, approximately 79% of practices in the Republic of Ireland have their patient list closed³⁷. We feel that highlighting areas where pressure to take on new patients will be felt most keenly is still possible and worthwhile using our

methodology. We also understand that bypass rates can be significant in other jurisdictions, and a better understanding of these rates in the Irish context would add further richness to our analyses⁴⁶. However, this requires further study as no central accessible list of patient addresses/locations (and indeed their chosen GP) is currently available to researchers in Ireland. However, we think that bypass rates are unlikely to be extremely high because the Irish system traditionally followed geographic lines: until 2011 GP lists included distance codes, which gave healthcare planners an incentive to place patients with GPs that worked relatively close by. The Health Service Executive can assign patients to new practices without the expressed agreement of the treating GP; however, these tend to be few in number (<10 000)⁴⁷.

Another important limitation is that we did not account for single-handed or multi-GP clinics in our analyses. Thus the assumption that patients could just receive care in the next-nearest GP clinic is a gross over-simplification. Nevertheless, despite these limitations related to bypass rates and capacity issues in GP clinics in the Republic of Ireland, it is fair to say that if a clinic closes no patients will be able to receive care there, and thus the methodology here is a valid means to assess regional vulnerability to practice closure.

All travel distances from SA centroids to GP clinics were calculated as a minimum direct linear distance. We did not have access to a spatial interaction model to determine average travel distances and times within an SA to the nearest GP clinic using road networks or public transport. Thus we were unable to include travel time in our analyses. Further research should include data on travel time and not just linear distance to healthcare facilities, which is likely to be relevant to our rural areas with poorer road infrastructure and limited public transport links.

Conclusion

People in rural and remote communities in Ireland may have to travel more than 10 times further than their urban counterparts to access their GPs. GP clinics are most densely located in urban cities and towns, and travel distance to GP clinics increases with increasing level of rurality in a stepwise fashion. Moreover, rural populations will be most adversely affected by GP clinic closure in terms of increasing new additional travel distance, with the most remote populations being affected to the greatest degree. Rural communities, GPs, academia and policymakers will need to actively collaborate to ensure high-quality accessible and equitable health care remains possible in rural and remote areas.

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Conflicts of interest

The authors declare no conflicts of interest.

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