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Public Facility Closure and its Impact on Population Mobility in New Brunswick

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PROJECT TITLE

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Executive Summary

In popular culture, one phrase is often used to manifest success: "If you build it, they will come."

While this idea exudes positivity and the power of hard work, we have to question its accuracy in terms of population research. In a province like New Brunswick, which is heavily invested in population growth and recruitment, does building public facilities and increasing public services actually prompt people to come and stay? And, conversely, does closing public facilities or reducing services prompt them to leave? Answering these questions could be key to population recruitment and retention strategies, which are crucial to the future success of our economy, labour market, and social culture.

Across NB, public facilities like schools and hospitals provide valuable services to the population, taking on the role of "public assets." In this report, we investigate the link between these public assets and population mobility in the province, asking whether opening and closing facilities, and changing service offerings, has any effect on New Brunswickers' mobility decisions. More specifically, we look at the population mobility patterns in the neighbourhoods (i.e., "dissemination areas"[1]) near these facilities before and after such changes.

To do so, this study uses the Citizen Database (Medicare Registry) as the primary dataset to track population movement and annual population counts in a dissemination area (DA) over the period 2002-2018. Data identifying active and closed schools in the province (2000-2018) is provided by the Department of Education and Early Childhood Development (EECD), and data on the status of hospitals in NB is obtained from the province's *Annual Reports of Hospital Services* (2003-2015). Distance to the nearest school (active/closed) and hospital (active/closed) is measured for each of the province's DAs in the Citizen Database to estimate the impact of public facility closure on population change.

Highlights of Findings

School Facilities

The findings of this report suggest there is no evidence that closing a school negatively impacts local population change.

- For the DAs where the nearest school closed, the average 5-year rates for annual population change leading up to the school closure are usually negative or declining.

- On other hand, neighbourhoods with a continuously open school in the same period generally exhibit a positive population trajectory.

[1] Dissemination areas refer to small areas composed of one or more neighbouring dissemination blocks, with a population of 400 to 700 persons. All of Canada is divided into dissemination areas.

- Post- school closure, the nearest DAs do not generally exhibit a consistent accelerated population decline; the rates might decline slightly more, remain unchanged, or increase slightly (compared to pre-closure rates). In comparison, DAs with a continuously open school do not experience any noticeable population change over the same period.

- In some DAs, a new school opening is usually preceded by a notable upward population trend five years before the event, although this trend diminishes in the years after the event.

Hospital Facilities

Findings show that a DA experiences population decline over the five years following a nearby hospital closure. However, this decline is quantitatively small, and therefore we cannot conclude that closing a hospital results in marked population decline in the surrounding neighbourhoods.

- In DAs where the nearest hospital has either been closed or converted into a community health centre, the population trends prior to closure are rather mixed (unlike schools). However, post-closure, the average 5-year rates generally exhibit more negative population change compared to pre-closure rates.

- Even though findings show negative population change post-hospital closure, the magnitude of the change is an estimated decline of only nine additional individuals per year, on average, and 45 over five years for an area with a population of 4500 people. Thus, there is no evidence of substantial population decline in the surrounding area following a hospital closure or conversion to a community health centre.

- Opening a new hospital does not result in a net positive effect on the population change in the nearest DAs.

Key Takeaway

Since the evidence presented indicates there are population changes prior to the opening or closure of a school or hospital, it appears that changes in public facilities are more consistent with the interpretation that facility changes are in response to population changes, rather than the interpretation that population changes result from facility changes.

Introduction

Research Objective

This study focuses on the relationship between public assets and population retention in different communities of New Brunswick (NB). The objective is to determine whether public assets, specifically hospitals and schools, have any effect on population change in NB communities.

Although is it expected that the closure or opening of facilities in certain areas arises at least partly in response to changing populations in those areas, the key question in this report is whether the closing or opening of a school or hospital results in greater population change in communities closer to the public assets after the event.

Background

The Government of New Brunswick (GNB) has been investing resources and efforts to address the issue of population growth and a shrinking labour force in NB through recruitment (such as through policies to attract immigrants to the province). However, keeping the local population, and particularly the working-age population, in the province and within their communities can also play a pivotal role in addressing these issues.

According to data from the last four Censuses (2001, 2006, 2011, 2016), the population in NB's urban regions, including the three largest Census Areas[2] of Fredericton, Moncton, and Saint John, has steadily grown – increasing by 1.7% in 2016 compared to the previous (2011) Census (Statistics Canada, 2017). On the other hand, the population outside the three largest Census Areas continued to decline over the same period, with a 2.6% drop in 2016 compared to 2011.[3]

Due to higher population density in urban areas, public assets like hospitals are usually better equipped and more centralized in urban areas compared to rural ones. In general, there are more schools in urban communities compared rural ones, and NB is not an exception.

It is sometimes argued that closing public facilities will result in or exacerbate population decline in those areas. The key question behind this assumption relates to the nature of the link between a community's public assets and its population patterns. If the above argument is correct, would keeping public assets open help retain population in a region?

[2] The Census Areas are made up of Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs). A CMA must have a total population of at least 100,000, of which 50,000 or more must live in the core. A CA must have a core population of at least 10,000.

[3] According to the 2011 Census, the population outside the three largest Census Areas (Fredericton, Moncton, and Saint John) declined by 2.6% compared to the previous (2006) Census.

Reasons Behind Public Facility Closure

Schools

The closure of a public facility such as a school can be a sensitive and contested public policy issue, particularly in a rural community. Some of the main reasons behind closing a school in an area could include declining enrolments due to a declining population, compromised educational program viability, fiscal constraints, escalating costs associated with maintenance of an aging facility, and the need to redeploy limited services in response to increasing demands for schools where populations are increasing.

In NB, criteria and factors leading to a school closure decision are outlined under Policy 409.[4] The District Education Councils and the Department of Education and Early Childhood Development (EECD) consider factors such as low and declining enrolments in a school, along with enrolment trends and projections. The structural integrity of a school building and indoor air and water quality are health and safety aspects that are taken into consideration. Quality of educational programs and services are also considered. Likewise, cost of transportation (transit time and travel cost) and operating costs (staffing and utilities) are important factors for the long-term sustainability of a school.

There are other considerations to be made before closing a school, including impact on the local community, impact on other schools (feeder and receiving schools), and economic development in the community. Thus, the department may consider other issues specific to a community and not listed under Policy 409 while studying a school's sustainability.

Hospitals

Several factors can contribute to a hospital closure, including a declining population in the serviced communities, increasing health care operating costs (especially staffing), and the need to relocate resources to a location with increasing demands.

In the mid 2000s, the NB provincial government adopted strategies to reform and restructure health care services. These reforms included centralizing acute care services (hospitals) in larger population centres and closing or repurposing rural hospitals into community health centres (CHCs). One of the goals of converting rural hospitals into community health centres is to provide better primary care in those communities and reduce inappropriate hospital service usage for issues that can be managed in the CHCs, such as ambulatory care sensitive conditions (ACSC) (New Brunswick Ministry of Health and Wellness, 2004).

From 2003 to 2015, most effected acute care facilities in the province were repurposed instead of completely closed. Typically, transformation from a hospital to a CHC would entail loss of acute care services, emergency services, and surgical services. One such example is Tobique Valley Hospital, which was converted to a CHC offering no ambulance service or in-patient beds. On the other hand, Hotel-Dieu of St. Joseph in Perth-Andover was transformed from an

[4] https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/policies-politiques/e/409A.pdf

acute care facility into a small community health facility with 24-hour emergency and ambulance service and about 15 family practice beds.

Literature Review

Assessing the relationship between public facility closure and population mobility is complicated by the fact that an apparent decline in population after the closure of a facility might simply be the continuation of a trend that led to the closure. The few studies that have focused on the link between public asset closure and population change patterns do not provide conclusive evidence that closing a hospital or school in a region changes the underlying population trends.

For example, Barakat (2014) found no evidence of outmigration linked with school closure in his longitudinal study in Saxony, Germany. Similarly, several qualitative studies echoed the argument that rural outmigration is unlikely to be caused by the closure of a local school or hospital. Egelund and Laustse (2007) argue that school closures do not lead to population decline in the local community, and perhaps closures are the outcome of population decline. Findings from Liu et al. (2001) indicate that population loss occurred across all communities in Saskatchewan regardless of whether there was a hospital closure, and outmigration was prevalent among younger age groups.

In contrast, a small number of studies have found evidence of an effect. Chau et al. (2014) found that public work schemes in rural China encouraged outmigration, as public projects enabled households to afford the cost of migration. Using structured telephone interviews with a sample size of 1,000, Sørensen (2008) found that one-third of the inhabitants in a Danish island reported being likely to leave if the local hospital closed. Although, it is to be noted that this is a hypothetical situation, as the hospital has not closed and there is no actual scale of outmigration.

Some studies focused instead on the economic impact of the public asset closures, which can help us understand if such an event can lead to outmigration (i.e., the indirect effect of closure events on migration). The outcomes are rather mixed in terms of economic impact, especially in the longer term. A cross-country study by Manlove and Whitacre (2017) found adverse and significant short-term effects from rural hospital closure in the region, particularly on income, employment, home values, and jobs in various sectors including hospitals. In contrast, other literature on the subject shows that closing rural hospitals has an insignificant effect on the regional economy (Ona et al., 2007; Probst et al., 1999). However, Holmes et al. (2006), using a panel data study on US counties, conclude that closing the only hospital in a rural community would have significant impacts on income per capita and unemployment compared to communities with alternative sources of hospital care.

It is possible that the economic impacts of hospital or school closure are important factors in migration decisions and would be an interesting topic to study; however, investigating indirect effects on migration is beyond the scope of this study.

From the discussion above, it appears the literature on the relationship between population change and public asset closure is inconclusive, but it is also very limited in terms of number of studies. The issue of keeping public assets open or closed is multifaceted and could impact a range of outcomes, including cost efficiency, quality of services, and the health, social, and economic impacts on the local population.

The question is particularly important in NB, as our province faces an aging population and substantial outmigration from rural areas. It is imperative to understand if public expenditure should be directed towards keeping these facilities open or allocated elsewhere. Therefore, this study provides a good opportunity to add further evidence on the topic, with a focus on NB. As such, this study addresses one particular dimension of the potential effects of a change in public asset provision – namely, its effect on population retention and mobility.

Data/Methodology

Data

Citizen Database

The primary dataset for this study is the longitudinal Citizen Database covering the years 2002-2018, which contains demographic and location information on all NB residents based on information provided through enrolment in the provincial public health insurance system (NB Medicare). Since our objective is to assess citizen movement in areas where hospital or school closure and opening events have taken place, it is necessary to observe any address changes updated or recorded in the current or new Medicare record of an individual.

Based on the Citizen Database, the indicator for Dissemination Area (DA)[5] can be used in identifying any change in movement of individuals in and out of a DA, and thus, mobility patterns at an area level. To estimate the date of said change, indicators such as "address effective date" and "termination date" are used. Moreover, to validate whether an address is correct or current, these data are cross checked with other variables in the dataset, such as the Medicare "eligibility status" of an individual. After identifying the address change event and its associated timeline, we link instances of moving to events of hospital or school closures and openings in the region.

School and Hospital Datasets

EECD has provided a list of active and closed schools for the years 2000-2018. This dataset contains information on the active years of 376 public schools (active and closed as of 2018) in

[5] As mentioned in the Executive Summary, dissemination areas refer to small areas composed of one or more neighbouring dissemination blocks, with a population of 400 to 700 persons. All of Canada is divided into dissemination areas.

the province. For active schools, postal codes are also available in the dataset. However, in the case of closed schools, addresses have been imputed from web searches, and out of 81 schools that closed over the sample period, postal codes/addresses for only 67 could be found. The other 14 have been omitted from the study. The school postal codes are used to measure distance from the center of each DA in the province.

Out of the 67 closed schools with location identifiers available, 16 were closed between 2008 and 2013, enabling us to conduct a full 5-year pre- and post-closure event analysis. During the study period 2000-2018, 25 new schools opened in the province. Thus, the number of schools that remained continuously open throughout 2000-2018 is 270. The school postal codes are then used to measure distance from the center of each DA in the province.

Table 1: Number of NB Public Schools and Their Statuses, 2000-2018

School Status	Count
Open (Active)	270
New	25
Closed	67
Closed with missing address (omitted from study)	14
Total	**376**

Changes in hospital status (including the closure of a hospital and the conversion of a hospital to a community health centre) are derived using the province's *Annual Reports of Hospital Services* (2003-2015).[6] Specifically, Table I-3 in each report is used to denote if a hospital has been repurposed into a CHC (e.g., if a facility was listed as an acute care facility in the 03/04 Annual Report and then listed as a CHC in the 04/05 report, this would indicate "hospital loss or repurposing."[7]) In general, the transformation of a hospital to a CHC would constitute (but is not limited to) loss of acute care services, emergency services, and surgical services.

One hospital (Upper River Valley) opened in 2009 and is used to examine the effect of opening a new hospital on population change. As with the schools, the hospital postal codes are used to measure distance to the center of DAs in the province.

Table 2: New, Converted, and Closed Hospitals in NB, 2003-2015

Hospital	Status
Upper River Valley	New (2009)
Hotel-Dieu of St. Joseph	Converted into CHC (2008)
Tobique Valley Hospital	Converted into CHC (2008)
Northern Carleton Hospital	Closed (2008)
Carleton Memorial	Closed (2008)

[6] https://www2.gnb.ca/content/gnb/en/departments/health/Publications.html
[7] Crouse et al. (2019) applied a similar methodology for determining hospital status change to examine the impact of changes to hospital service provision in NB on ambulatory care sensitive conditions (ACSC).

Methodology

To capture the impact of a public facility closure or opening on population mobility, the number of residents in a DA with an "Active" Medicare status and valid NB address as of December 31 of each year is aggregated. Then, distance to the nearest school (open or active) from the center of a DA is measured.

There are 226 DAs whose nearest schools were closed over the study period; due to the large number, these DAs are disaggregated into the different categories described below. We similarly disaggregated the population in 74 DAs whose nearest schools were newly opened between 2000-2018 to account for the effect of school openings on mobility. There are 1,153 DAs whose nearest schools are active/open – meaning these facilities did not close between 2000 and 2018.

DAs are disaggregated according to varying proximity to the nearest closed school to see whether DAs closest to the examined schools are affected more than those farther away. They are presented in four categories of distance from the facility:

- Under 2 km
- 2 km to under 10 km
- 10 km to under 20 km
- Over 20 km

Comparison with Open (Never Closed) and New Public Facilities

To compare the impact of school closures and openings, we use three categories to analyze population trends for the DAs with closed, open, and new schools:

- DAs with nearest school closed
- DAs with nearest school open (never closed)
- DAs with nearest new school open

These three categories are also used to measure any impact of hospital closure/repurposing on nearby DAs and are presented as follows:

- DAs with nearest hospital closed or repurposed
- DAs with nearest hospital open (never closed)
- DAs with nearest new hospital open

Estimating Impact on Population Change

If the assumption is that the decision to close (or open) a public facility is an exogenous event (i.e., affected by external factors like population change), then measuring population change in nearby DAs post-closure (or post-opening) would indicate an impact – though, it is possible that population change could occur with significant delay after the event took place.

An acceleration in population decline would indicate that public asset closure had a significant impact on retaining the local population. Meanwhile, a declining population trajectory pre-closure could raise the issue of reverse causality, such as population decline leading to the closure of a public facility like a school, rather than resulting from it. Similarly, an increasing population trend could lead to the opening of a new school or hospital as a response to increasing demands for these facilities.

Similar trends between pre- and post-closure/opening events could imply insignificant effects of closing or opening a public facility on population retention. Hence, to address this issue of reverse causality, we first measure population change in DAs five year pre- and post-event (closure or opening) affecting the nearest public facility (school or hospital). We then compare these DAs with other areas where there were no facility closures for the period 2000-2018 to examine if an event comparatively caused a significant change in mobility.

For example, if a school closed in 2008, the 5-year pre- and post-event population changes are estimated using the method below:

i) $\text{Population change in } 2003 = \frac{(Population\ 2003 - Population\ 2002)}{Population\ 2002}$

ii) The step is repeated for five years pre- and post-event, followed by estimating the average of these rates: i.e.,

$$\text{Pre closure average } 5-\text{year rates } = \frac{(Population\ Change\ 2003 - 2007)}{5}$$

$$\text{Post closure average } 5-\text{year rates } = \frac{(Population\ Change\ 2009 - 2013)}{5}$$

Looking into population trends and population change pre- and post-closure events enables an estimation of population movement caused by the closure (or opening) event over the study period.

Among 67 closed schools, 16 with location identifiers have been closed for the period 2008-2013, allowing us to conduct a full 5-year pre- and post-closure event analysis. As a robustness check, we also estimate population change using a 2-year timeframe to check for accuracy of the results and to capture any shorter-term effects.

In the case of DAs with open schools (never closed) between 2000 and 2018, proxy event years similar to the distribution of the event years of the 16 closed schools (period 2008-2013) are assigned to enable comparison. Therefore, 25% of open schools are assigned 2013 as a proxy event year, 19% are assigned 2012, 25% are assigned 2011, 19% are assigned 2010, and the remaining 12% are assigned 2009.

For DAs with open hospitals (never closed/repurposed) between 2003-2015, the proxy event year is 2008, similar to the event years of two closed and two repurposed hospitals in the province.

Results

School Closures

This section estimates the potential effects of public school closures on population change in the dissemination areas (DAs) closest to the facilities. It also shows population trend comparisons for DAs with active (never closed between 2000-2018) and new schools in the following tables.

In general, the annual population counts for DAs with nearest closed schools ranges between 400-600 residents. When possible, we compare DAs with nearest schools open to DAs of similar population sizes with nearest schools closed.

Table 3 below shows the pooled population changes for DAs with nearest school closed (under 2 km) between 2008 and 2013 (i.e., 16 schools with full 5-year pre- and post-event observations).

The population of all DAs are added, and annual population changes are estimated. The average 5-year population post-school closure does not decline; in fact, it slightly increases.[8] On the other hand, DAs (500-700 residents) with nearest schools continuously open show positive annual population trends five years prior to and following the event years.[9]

Table 3 also exhibits pooled population estimates for DAs within 2 km of new schools which opened during the period 2008-2013.

The 5-year trend before the school openings shows notable positive population change with an average of 5%. However, even though this trend continues post-openings, the rates do not accelerate and gradually taper off.

[8] Population changes for all DAs (all distances) with nearest school closed between 2008 and 2013 show similar trends, with average pre-closure rates at 0.3% and post-closure rates at 0.6%.
[9] Proxy event years are similar to the distribution of event years for the 16 closed schools (period 2008-2013).

Table 3: Pooled Population Change (%) in DAs with Shortest Distance (Under 2 km) to the Nearest School

Year	DAs with closed schools	DAs with open (never closed) schools	DAs with new schools
Year 0	0.0%	0.3%	5.1%
Year 1	1.2%	-0.1%	5.4%
Year 2	0.7%	-0.3%	5.5%
Year 3	0.3%	0.8%	4.3%
Year 4	0.5%	0.0%	5.0%
5-year pre-event average	**0.5%**	**0.1%**	**5.0%**
Event	**-0.6%***	**-1.2%**	**3.2%****
Year 6	0.3%	0.3%	6.7%
Year 7	2.4%	-0.2%	4.5%
Year 8	1.2%	0.7%	1.9%
Year 9	-0.3%	0.1%	2.7%
Year 10	-0.4%	0.2%	2.7%
5-year post-event average	**0.7%**	**0.2%**	**3.7%**

* School Closure
**New School Open

Table 5 in the Appendix shows population change in the DAs close to Lower Coverdale School, which closed in 2013. The DAs closest to this school cover various categories of proximity to the nearest closed school – meaning these DAs have no other closed, new, or open (never closed) school in the distance categories under 2 km, 2 to under 10 km, and 10 to under 20 km.

For other DAs with closed schools, most of the closure events can be reported for smaller distances (under 2 km) without any new or open schools in the same radius, but not for wider areas; hence, Lower Coverdale School is shown in Table 3 above.

The previous five years leading to the school closure in 2013 indicate that annual population change had mostly stagnated with an average of 0.3% growth. After 2013, there was no acceleration in the rate of population decline. In fact, for the communities between 10 km and 20 km from the school, average population change increased post-school closure compared to the time prior to closure.

Tables 6 and 7 in the Appendix exhibit more population changes in the remaining DAs within 2 km of other closed schools in the province. The results show fluctuating population trajectories before and after school closures.

The average 5-year population change rates pre- and post-closure events are mixed. Rates after school closures are either higher than, lower than, or the same as pre-closure rates, with no notable change between the two time periods.[10]

The results overall indicate no consistent impact on population change in areas experiencing a school closure relative to what was the case when the school was open.

Comparison with New and Open (Never Closed) Public Facilities

In Table 8 in the Appendix, results are compared for DAs (700-800 residents) within 2 km of a closed school, a continuously open school, and a new school.

École Le Sommet opened in the same year Alexander Gibson Memorial School closed, enabling us to compare results over the same time period. In the DAs with the nearest school closed, no other school was active or had opened within 2 km.

Table 8 shows the annual population change in DAs within 2 km of Alexander Gibson Memorial School, which closed in 2013. The annual average population change before the school closure (2008-2012) was negative, indicating the DA had also been experiencing population decline. After the closure, the trend remained similar with few upward changes; however, the population decline did not increase or accelerate post-closure.

On the other hand, DAs near Birchmount School, which was continuously open, generally exhibit positive population dynamics year to year and on average during same time period as the closed school (2008-2018). Five years prior to the opening of École Le Sommet (opened in 2013), the population increased by 2.6% on average. Five years after opening (2014-2018), the trend remained positive, though it has not increased notably.

New Schools

In contrast, other DAs near École Le Sommet (800-1,200 residents) showed significant population increase prior to its opening in 2013. Between 2008 and 2012, the 5-year average population change in two DAs is about 10% and 15.1% (see Table 9 in the Appendix). There was also a jump in 2014, the year following its opening; however, the trend tapers off, and the 5-year average post-opening is comparatively less than pre-opening.

In Table 10 in the Appendix, the DAs near Northrop Frye School (800-1,500 residents) also appear to have higher 5-year average population changes pre-opening compared to five years after it

[10] Similar analysis is conducted over 2-year periods pre- and post-events, with results similar to 5-year average rates.

opened. Smaller communities (400-600 residents) near a new school usually do not show notable changes in resident counts pre- and post-opening, as in the case of Bliss Carman Middle School.

These findings indicate that opening a new school could be a response to growing number of residents in nearby DAs or at least maintaining the current population count.

Hospital Closures

This section looks at the impact of a hospital closure on population patterns in the nearest DAs and compares results for DAs with similar population sizes (400-600 residents) near an existing hospital.

Table 4 below illustrates pooled population changes for DAs with nearest hospital closed or repurposed (under 2 km) in 2008 (for example, two hospitals[11] closed and two converted to small health centres[12]). The annual population of all DAs within 2 kms of hospitals with closure events (closed/repurposed) are added together (total population of 4,500-4,600), and pooled population changes are estimated.

The average 5-year population change pre-event is -0.2%. The declining trend continues post-event, with an average 5-year population change is -0.3%.[13] In DAs within 2 km of open hospitals (never closed), pooled population change generally shows negative trends five years pre- and post-event (2008).[14]

The average 5-year population change rate in DAs within 2 km of open hospitals is -0.9%, while it is -0.8% post-event (proxy). The average 5-year population change in DAs with hospital events post-closure or repurposing is -0.2% compared to DAs with no hospital closure or repurposing.[15]

As a result, the additional decline over five years for a population of about 4,500 is approximately nine individuals per year (4,500 X 0.002) and 45 over five years.

Therefore, we find more negative population change in nearby DAs post-hospital closure event. However, the magnitude is not quantitatively substantial.

[11] Northern Carleton Hospital and Carleton Memorial closed in 2008.
[12] In 2008, Hotel-Dieu of St. Joseph and Tobique Valley were converted to a small health centre and community health centre, respectively.
[13] Pooled population change in DAs with closed (not repurposed) hospitals (Northern Carleton Hospital and Carleton Memorial) shows average 5-year rates pre- and post-events of -0.2% and 0%, respectively.
[14] The proxy event year is 2008, similar to the event years of the hospitals that have either been closed or repurposed.
[15] The difference in 5-year pre- and post-event population change rates for DAs with hospital events is -0.1 percentage points, and for DAs with no hospital events the difference is +0.1 percentage points.

Table 4: Pooled Population Change (%) in DAs with Shortest Distance (Under 2 km) to the Nearest Hospital

Year	DAs with closed/repurposed hospitals	DAs with open hospitals (never closed)
Year 0	-1.3%	-1.1%
Year 1	1.1%	-1.7%
Year 2	-0.1%	-1.3%
Year 3	-0.3%	-1.3%
Year 4	-0.4%	0.8%
5-year pre-event average	**-0.2%**	**-0.9%**
Event	**-1.7%***	**0.2%**
Year 6	0.7%	-0.2%
Year 7	-1.9%	-1.7%
Year 8	0.0%	-0.8%
Year 9	-0.3%	-0.4%
Year 10	0.2%	-0.9%
5-year post-event average	**-0.3%**	**-0.8%**

*Year in which the hospital closed or converted to a small health centre

Disaggregating the events by each hospital (closed/repurposed) and DAs under 2 kms produces mixed results.

Table 11 in the Appendix shows the impact of converting Hotel-Dieu of St. Joseph into a small health centre in 2008 on the DAs under 2 km. For one of the DAs, the trend appears to fluctuate between positive and negative population change five years pre- and post-closure. The average population change between 2003 and 2007 is 0.4%, and after closure the average 5-year rate (2009-2013) is 0%. However, for other DAs, the average 5-year rates pre- and post-closure are -1.5% and -2.4%, indicating negative population change.

For the same time period, population trends near a continuously open hospital such as Edmundston show similar fluctuating patterns, although the average 5-year population change rate is negative between 2003 and 2007 and 0% for the 2009-2013 time period (see Table 11 in the Appendix).

Other hospitals were also closed or repurposed over our study period. Tobique Valley Hospital was repurposed into a CHC in 2008. The effects of such a change on a nearby DA (500-550 residents) appear negative in terms of population growth (see Table 12 in the Appendix). For a DA within 2 km of the hospital, the average 5-year population change pre-closure is 0.2% and -0.7% afterwards.

The results are similar for the DAs near two permanently closed hospitals that were not replaced by CHCs. These are Northern Carleton Hospital and Carleton Memorial, both of which were permanently closed in 2008.

In the case of the Northern Carleton Hospital, the closest DA (under 2 km) had an average 5-year population change rate of -2.2% before the closure and -3.6% afterwards, which indicates a moderate impact on population trajectory. However, for the DAs within 2 km of the Carleton Memorial Hospital, population change is quite mixed, with some DAs showing positive population trends after the closure (see Table 12 in the Appendix).

For our investigation of DAs near newly opened hospitals, we examined Upper River Valley Hospital, which opened in 2009. The Citizen Database could not capture any DAs under 2 km, possibly due to the absence of any residential area within this distance. However, there are several neighbourhoods within 2 km to 10 km of this hospital. In Table 13 in the Appendix, all the DAs within this distance show an increasing population trend and positive average 5-year rate before the hospital opened (2004-2009). However, five years following the opening (2010-2015), the general population trajectory declined, and on average the 5-year population growth rates are negative.

The analysis of pre- and post-event population trends in DAs closest to closed hospitals shows a general more negative population decline post-closure. However, in terms of the quantitative aspect, the change is estimated to be small. On the other hand, population trends across the DAs close to the newly opened hospital give no indication that opening a hospital has a positive impact on local population growth.

Limitations

Prior to 2002, any address change/update in the Citizen Database was overwritten in the underlying database, rather than adding another record/observation to an individual's file. Because the longitudinal address history for an individual is only available from 2002 onwards, address changes can only be recorded starting from this period.

Population mobility is measured in DAs five years pre- and post-event (closure or opening), and therefore our analysis excludes facility changes towards the beginning and end of the study period. That is, if a school closed or opened in 2008, the data is available for five years on either side of the event. However, this is not the case for schools that closed in 2004 or 2017, and any changes due to these public facilities are not considered in this analysis.

Conclusion

The aim of this study is to investigate whether closing public facilities has any impact on population change. We consider changes in two types of public facilities – schools and hospitals – and estimate 5-year population trends before and after closure events in the communities closest to these facilities.

For communities closest to schools that closed, population trends five years prior to closure show a decline, but following the closure that rate of decline does not appreciably increase in magnitude. As well, communities near new schools exhibit increasing population trends on average five years before the opening, but the school opening event similarly has no marked positive impact on that population trend.

While school openings and closures appear to reflect underlying population changes, the closure and/or opening of a school does not substantially change the pre-closure trajectory. In other words, these events do not appear to cause a decline or influx of people in those communities.

In the case of hospitals, our findings are inconclusive, as there is no clear indication whether closing a public hospital or converting it into a community health centre results in the outward mobility of residents.

Even though the population trends for surrounding areas near a closed hospital are negative for five years after closure, quantitatively speaking these numbers are not large. On the other hand, neighbourhoods near a new hospital do not experience an influx of residents.

The results from the neighbourhoods closest to public facilities, especially schools, indicate that the impact of closing these facilities on local population trends is not substantial (quantitatively). In this case, it appears that closure of a school is a function of population decline in surrounding communities and not vice versa.

Therefore, as a policy tool to maintain or grow the population in various communities, it appears that it is not the closure of a public facility *per se* that would likely exacerbate population outflow.

Efforts to maintain or grow population in previously declining areas should focus more on economic development.

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Appendix

Table 5: Population Change (%) in DAs (8-digit codes) with Nearest Closed School

Year	DAs with closed school (Lower Coverdale School)		
	Under 2 km	**2 km to under 10 km**	**10 km to under 20 km**
	13060054	**13060053**	**13060074**
2008	-1.2%	-3.3%	-6.4%
2009	3.8%	0.0%	-2.7%
2010	-1.2%	5.9%	0.0%
2011	1.2%	-2.4%	0.0%
2012	-1.2%	-2.4%	4.2%
5-year pre-event average	**0.3%**	**-0.4%**	**-1.0%**
2013*	**2.4%***	**3.3%***	**0.0%***
2014	-1.2%	0.8%	-1.4%
2015	1.2%	-2.4%	0.0%
2016	0.0%	0.0%	4.1%
2017	1.2%	-0.8%	1.3%
2018	1.2%	-0.8%	-5.2%
5-year post-event average	**0.5%**	**-0.6%**	**-0.2%**

*School Closure Date

Table 6: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest Closed School in 2013

Year	Gunningsville School			South Devon School	
	13060001	**13060003**	**13060006**	**13100175**	**13100172**
2008	1.0%	0.0%	-4.2%	-1.0%	-2.6%
2009	1.0%	1.1%	1.1%	-1.0%	-1.3%
2010	-1.0%	0.0%	1.1%	12.5%	1.3%
2011	-1.0%	-3.3%	4.3%	1.9%	2.6%
2012	7.2%	0.0%	-1.0%	4.5%	1.3%
5-year pre-event average	**1.4%**	**-0.4%**	**0.2%**	**3.4%**	**0.3%**
2013*	**2.9%***	**0.0%***	**-3.1%***	**-4.3%***	**-3.8%***
2014	-3.7%	2.2%	0.0%	-1.8%	-5.3%
2015	3.9%	8.8%	0.0%	1.9%	0.0%
2016	0.9%	-2.0%	-1.1%	-0.9%	2.8%
2017	-1.9%	-1.0%	-3.3%	2.8%	4.1%
2018	0.0%	3.1%	2.2%	-0.9%	3.9%
5-year post-event average	**-0.2%**	**2.2%**	**-0.4%**	**0.2%**	**1.1%**

*School Closure

Table 7: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest Closed School in 2011

Year	École Arthur-Pinet	École Le Domaine des Copains	École Marie Immaculée	
	13140099	**13140104**	**13120045**	**13120051**
2006	1.7%	-1.2%	1.0%	-1.8%
2007	0.0%	0.0%	-1.9%	2.7%
2008	-4.9%	0.0%	-1.9%	1.8%
2009	-3.4%	-1.9%	0.0%	1.7%
2010	3.6%	-1.3%	-2.0%	-3.4%
5-year pre-event average	**-0.6%**	**-0.9%**	**-1.0%**	**0.2%**
2011*	**-1.7%***	**-1.3%***	**3.0%***	**-2.7%***
2012	0.0%	0.0%	-3.9%	0.0%
2013	7.0%	-2.6%	-5.1%	-0.9%
2014	-1.6%	-2.0%	-2.1%	0.9%
2015	-6.7%	-0.7%	2.2%	0.0%
2016	-3.6%	-2.1%	-8.5%	-3.6%
5-year post-event average	**-1.0%**	**-1.5%**	**-3.5%**	**-0.7%**

*School Closure

Table 8: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest School

Year	DA with closed school Alexander Gibson Memorial School	DA with open (never closed) school Birchmount School	DA with new school École Le Sommet
	13100169	**13070225**	**13070329**
2008	-1.2%	2%	2.5%
2009	1.9%	-2%	7.4%
2010	-1.2%	2%	-0.6%
2011	-1.8%	-1%	-1.1%
2012	-2.5%	1%	4.7%
5-year pre-event average	**-1.0%**	**-1.1%**	**2.6%**
2013	**0.0%***	**-1.3%**	**-1.1%****
2014	-0.6%	7.4%	-1.1%
2015	0.6%	3.8%	2.8%
2016	0.6%	-1.8%	1.1%
2017	-0.6%	-3.1%	1.6%
2018	0.6%	-1.3%	-1.1%
5-year post-event average	**0.1%**	**1.0%**	**0.7%**

*School Closure
**New School Open

Table 9: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest New School

Year	École Le Sommet					Riverview East School	Gibson-Neill Memorial Elementary School
	13070101	13070102	13070113	13070325	13070326	13060007	13100170
2008	-9.3%	-0.9%	6.3%	20.9%	14.1%	2.4%	8.9%
2009	2.9%	-1.0%	8.9%	8.9%	6.2%	4.1%	7.5%
2010	1.4%	2.9%	12.6%	20.5%	5.8%	2.0%	-1.8%
2011	5.6%	0.0%	10.7%	13.5%	0.5%	0.6%	2.5%
2012	-1.3%	1.9%	11.4%	11.6%	1.5%	-0.3%	4.8%
5-year pre-event average	**-0.1%**	**0.6%**	**10.0%**	**15.1%**	**5.6%**	**1.7**	**4.4%**
2013*	**0.0%***	**0.0%***	**7.9%***	**8.4%***	**2.5%***	**0.0%***	**-1.2%***
2014	0.0%	-3.7%	21.5%	19.4%	1.0%	3.8%	0.6%
2015	2.7%	-1.0%	9.6%	7.5%	-1.4%	-0.8%	4.9%
2016	-2.6%	-1.0%	6.6%	5.8%	1.9%	3.9%	1.9%
2017	-4.1%	0.0%	5.4%	-0.3%	0.9%	0.5%	4.9%
2018	4.2%	1.0%	3.4%	1.4%	-2.8%	0.0%	-1.8%
5-year post-event average	**0.0%**	**-0.9%**	**9.3%**	**6.8%**	**-0.1%**	**1.5%**	**2.1%**

* New School Open

Table 10: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest New School

Year	Bliss Carman Middle School				Northrop Frye School		
	13100231	**13100232**	**13100233**	**13100234**	**13070322**	**13070323**	**13070324**
2004	1.8%	-1.0%	1.0%	-1.9%	17.3%	4.8%	7.1%
2005	1.8%	1.1%	-2.0%	1.0%	18.4%	8.0%	6.7%
2006	-2.4%	-6.3%	0.0%	3.9%	13.0%	17.0%	12.5%
2007	2.4%	3.3%	-8.3%	8.5%	11.0%	14.5%	4.4%
2008	2.4%	3.2%	-1.1%	-2.6%	8.3%	15.1%	4.3%
5-year pre-event average	**0.8%**	**2.4%**	**-1.8%**	**2.5%**	**13.6%**	**11.9%**	**7.0%**
2009*	**-2.3%***	**-4.7%***	**0.0%***	**-0.9%***	**9.9%***	**11.7%***	**2.0%***
2010	2.4%	-1.0%	4.5%	9.7%	10.4%	8.6%	0.0%
2011	1.7%	6.0%	-1.1%	1.6%	7.9%	6.8%	-2.0%
2012	-0.6%	-2.8%	1.1%	0.0%	0.6%	4.3%	-1.0%
2013	0.6%	1.0%	-5.4%	3.2%	5.5%	4.6%	23.7%
2014	-2.3%	1.0%	0.0%	8.5%	7.1%	2.4%	18.3%
5-year post-event average	**0.4%**	**0.8%**	**-0.2%**	**4.6%**	**6.3%**	**5.3%**	**7.8%**

* New School Open

Table 11: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest Hospital

Year	DAs with repurposed hospital Hotel-Dieu of St. Joseph		DAs with open (never closed) hospital Edmundston Hospital	
	13120079	**13120080**	**13130081**	**13130082**
2003	2.1%	-2.9%	-3.2%	7.0%
2004	-2.1%	-1.5%	5.4%	-4.3%
2005	0.0%	-1.5%	0.0%	1.1%
2006	1.1%	1.6%	-2.1%	0.0%
2007	1.1%	-3.1%	-4.2%	-2.2%
5-year pre-event average	**0.4%**	**-1.5%**	**-0.8%**	**0.3%**
2008*	-3.1%*	-3.2%*	-3.3%	-4.6%
2009	4.3%	-3.3%	-2.3%	6.0%
2010	0.0%	0.0%	-2.3%	-2.3%
2011	-2.1%	-5.1%	1.2%	3.5%
2012	-4.2%	-3.6%	3.5%	-1.1%
2013	2.2%	0.0%	0.0%	2.3%
5-year post-event average	**0.0%**	**-2.4%**	**0.0%**	**1.7%**

*Year in which the hospital converted to a small health centre

Table 12: Population Change (%) in DAs (8-digit code) with Shortest Distance (Under 2 km) to Nearest Hospital

Year	DA with repurposed hospital Tobique Valley Hospital	DA with closed hospital Northern Carleton Hospital	DAs with closed hospital Carleton Memorial Hospital				
	13120063	**13110088**	**13110063**	**13110064**	**13110066**	**13110067**	**13110068**
2003	3.7%	-6.2%	-4.1%	0.9%	-1.0%	-4.2%	1.0%
2004	0.9%	3.3%	1.1%	2.7%	6.1%	-2.7%	1.0%
2005	0.9%	-0.8%	1.1%	1.7%	1.9%	-2.7%	-2.0%
2006	-2.6%	-4.0%	-1.0%	5.1%	0.9%	-0.9%	-2.0%
2007	-1.8%	-3.3%	11.6%	-2.4%	-2.8%	-2.8%	1.0%
5-year pre-event average	**0.2%**	**-2.2%**	**1.7%**	**1.6%**	**1.0%**	**-2.7%**	**-0.2%**
2008*	**-0.9%***	**3.4%***	**2.8%***	**-4.1%***	**-7.6%***	**-2.9%***	**-1.0%***
2009	-1.9%	-5.0%	4.6%	-1.7%	-2.1%	1.0%	10.2%
2010	-2.8%	-2.6%	2.6%	-2.6%	3.2%	-3.0%	-10.2%
2011	0.0%	0.0%	-4.3%	-0.9%	2.0%	3.1%	6.2%
2012	1.0%	-4.5%	2.7%	0.0%	-1.0%	8.9%	-3.9%
2013	0.0%	-5.7%	1.7%	-1.8%	2.0%	-0.9%	5.1%
5-year post-event average	**-0.7%**	**-3.6%**	**1.5%**	**-1.4%**	**0.8%**	**1.8%**	**1.5%**

*Hospital Closure/Converted into Community Health Centre

Table 13: Population Change (%) in DAs (8-digit code) with Shortest Distance (2 km to under 10 km) to Nearest New Hospital (Upper River Valley)

Year	Upper River Valley Hospital			
	13110054	**13110055**	**13110053**	**13110056**
2004	-4.7%	1.0%	-1.0%	-1.7%
2005	0.0%	1.0%	2.0%	0.0%
2006	1.2%	2.0%	-1.0%	-3.4%
2007	8.4%	-2.0%	3.0%	7.0%
2008	1.1%	1.0%	-1.9%	3.3%
5-year pre-event average	**1.2%**	**0.6%**	**0.2%**	**1.0%**
2009*	**0.0%***	**3.0%***	**-1.0%***	**-1.6%***
2010	-2.2%	-4.8%	-1.0%	0.0%
2011	1.1%	-2.0%	-1.0%	0.0%
2012	-6.7%	-1.0%	3.0%	-1.6%
2013	-8.3%	-1.0%	2.0%	0.0%
2014	9.1%	0.0%	3.8%	-6.6%
5-year post-event average	**-1.4%**	**-1.8%**	**1.4%**	**-1.6%**

*Hospital Open