

INTRODUCTION

Shortly after a measles outbreak was declared in the rural parts of the province of Alberta, Canada in late 2013, an outbreak was declared in Alberta's two largest cities, Calgary (1.266 million in 2014) and Edmonton (928,182 in 2014) in April 2014 after nine confirmed cases in Calgary and seven cases in Edmonton. This study assesses the coverage rate changes that occurred as a result of the outbreak mitigation measures taken in these two cities, from an equity perspective. Specifically, this study investigates one-dose by age-2 Measles, Mumps and Rubella immunization rates stratified by four socio-economic indicators: neighborhood household income, %-Aboriginal population, %-Immigrant population, and %-homeownership, to assess equity of the respective Measles outbreak mitigation responses.

Childhood vaccinations programming is a specific health care service that local public health agencies have immediate influence over in Canada and is a potential indicator of whether public health institutions can and do engage in reducing health inequities. This is especially salient for when an outbreak occurs as pockets of persistent vulnerability amidst an active spread of pathogens may result in the clustering of possibly deadly health outcomes among already materially and socially deprived populations.

OBJECTIVES

To assess:

1. The equity-based MMR immunization coverage rate changes associated with the Measles outbreak of 2014 in Calgary and Edmonton
2. The differential Measles outbreak MMR immunization interventions deployed in Calgary and Edmonton in 2014

METHODS

A mixed-methods comparative case study analysis methodology was employed to assess the neighborhood-level immunization statuses before (2013), during (2014) and after (2015) an active measles outbreak in Calgary and Edmonton, Alberta, Canada, and to investigate the outbreak mitigation strategies deployed in each city.

Quantitative:

Quantitative data included **one-dose by age-2 MMR immunization coverage rates** collected from Calgary and Edmonton, by postal code for the years 2013, 2014 and 2015. The postal code rates were restricted to those with the first 3-characters that Canada Post deems within the municipal area. These coverage rates by postal code were then aggregated up to neighborhood rates using 2015 neighborhood boundaries. Publicly-available **neighborhood-level after-tax median income, %-homeownership, %-aboriginal and %-immigrant population** statistics were collected, and neighborhoods were assigned into quintiles for the indicator (five groups, each representing 20% of the population), for each year.

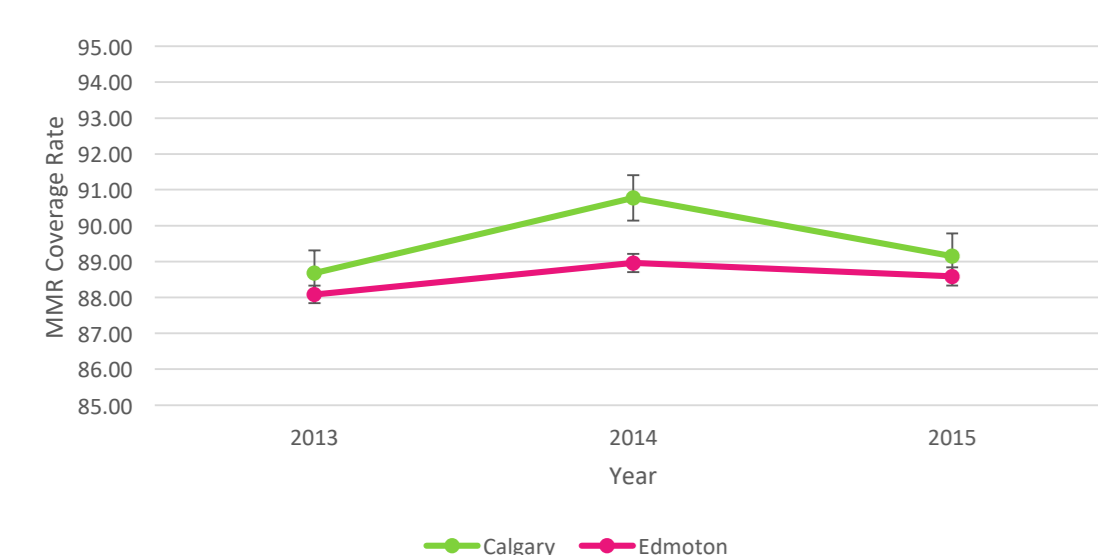
Qualitative:

Document content analysis is an iterative process of examination and interpretation of textual documents. This analysis is appropriate for detecting specific elements of textual documents for exploratory use, quantifying qualitative data into units of analysis. The purpose of using this method in this study was to specifically detect, in often complex multi-subject documents, where and in what manner concepts related to childhood immunization during the 2013/2014 Measles outbreak are specifically mentioned. Documents analysis was conducted on Alberta Health (2013-2015) and Alberta Health Services (2013-2015) annual reports, publicly-available operational newsletters published around the months of the outbreak in Calgary and Edmonton (January – July 2014), and a survey of news stories associated with the 2014 measles outbreak in those cities. The analysis involved text-based search of all documents for the terms "equity", "equality", "vulnerable", "child", "childhood", "immunization", "measles", and "MMR"; and extraction of content that involved childhood immunization programming regarding measles during the measles outbreak of 2014.

RESULTS

The epidemiological trend data suggests that both Edmonton and Calgary experienced higher overall one-dose MMR coverage rates by age-2 as a result of their responses to the Measles outbreak in 2014 compared to 2013. Calgary shows a more dramatic increase in coverage rates than Edmonton between 2013 and 2014. (Figure 1)

Changes in MMR Coverage Rates In Calgary and Edmonton Between 2013 – 2015

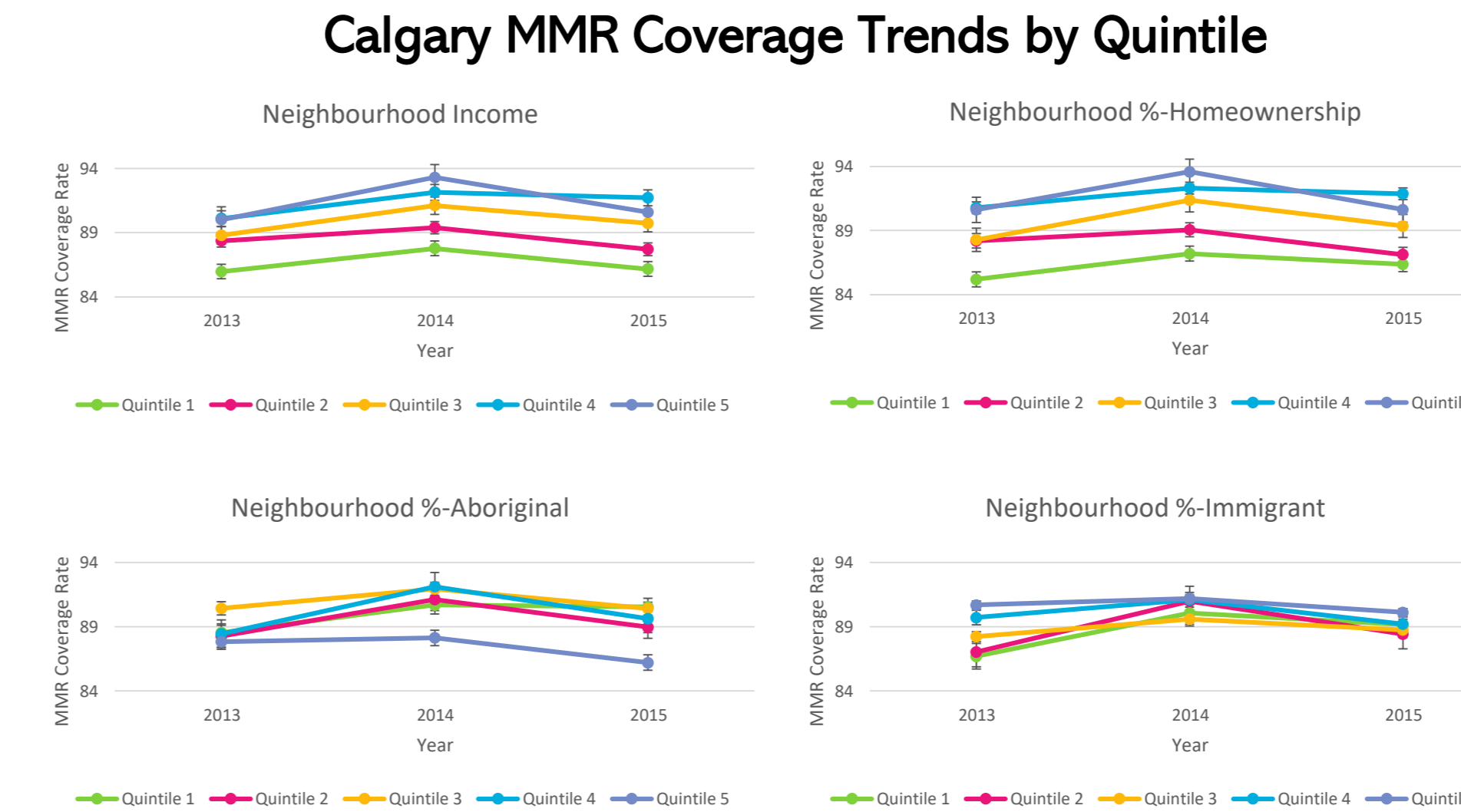


City	Year		
	2013	2014	2015
Calgary	88.68	90.77	89.15
Edmonton	88.09	88.96	88.59

RESULTS CONT.

Calgary Measles Outbreak MMR Immunization Interventions

- Three mass immunization clinics
- Measles and immunization-related news reports, communications and website
- Provided immunizations to children as young as six-months, rather than the previous one-year old cut-off for regions experiencing outbreaks

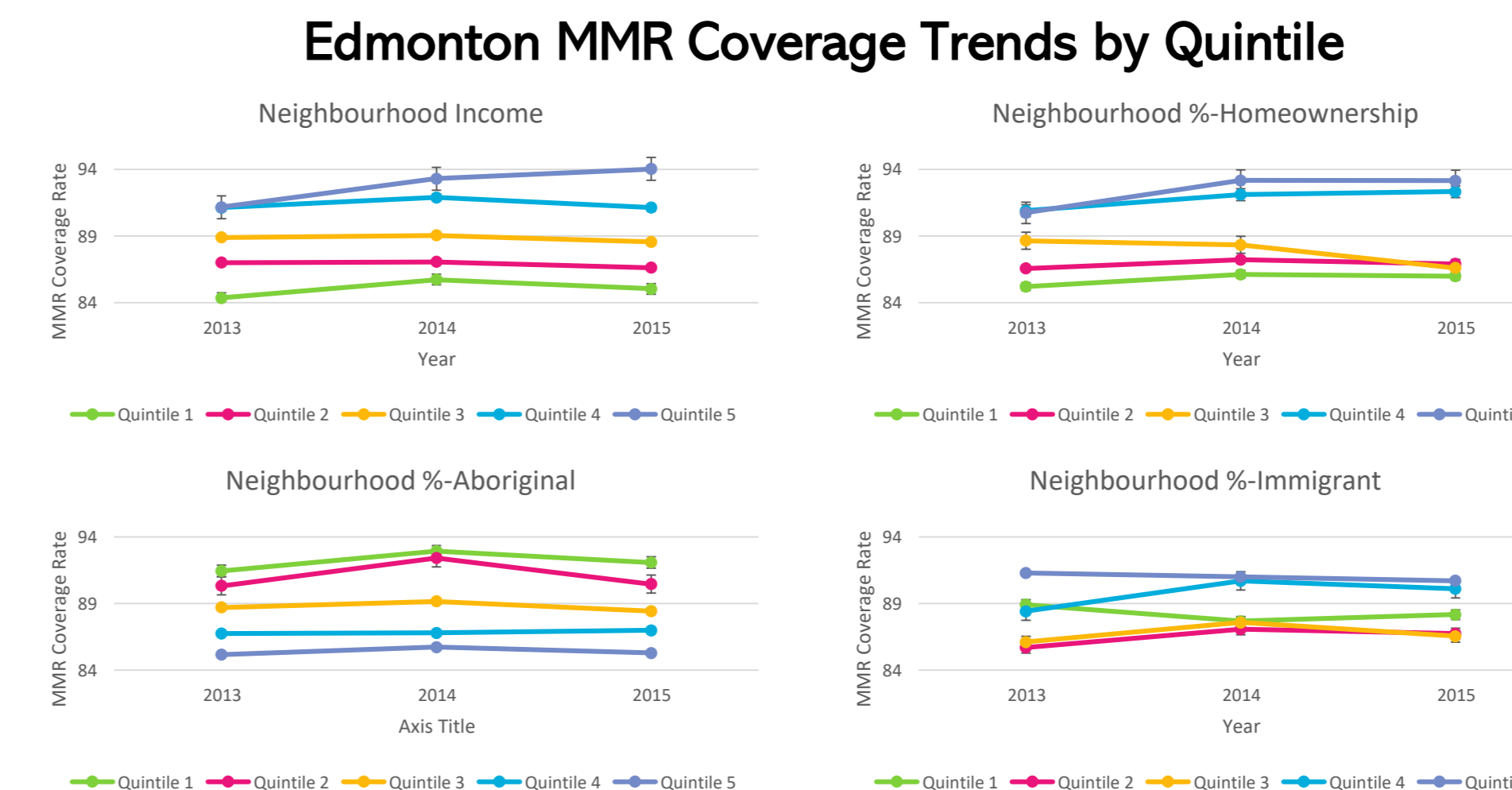


Calgary Coverage Rate Difference between 2013 and 2014

Quintiles	Income		% -Home Ownership		% -Aboriginal		% -Immigrant	
	Difference between 2013 and 2014	2014 coverage rate*	Difference between 2013 and 2014	2014 coverage rate*	Difference between 2013 and 2014	2014 coverage rate	Difference between 2013 and 2014	2014 coverage rate
Quintile 5 (Highest)	+3.29	93.30	+2.95	93.58	+0.31	88.01	+0.51	91.19
Quintile 4	+2.04	92.14	+1.53	92.31	+3.69	92.10	+1.38	91.09
Quintile 3	+0.32	91.11	+3.09	91.37	+1.51	91.16	+1.35	89.58
Quintile 2	+1.03	89.39	+0.87	89.07	+2.85	89.84	+3.95	90.98
Quintile 1 (Lowest)	+1.80	87.77	+2.00	87.20	+2.15	92.05	+3.37	90.06

Edmonton Measles Outbreak MMR Immunization Interventions

- Measles and immunization-related news reports, communications and website
- Provided immunizations to children as young as six-months, rather than the previous one-year old cut-off for regions experiencing outbreaks



Edmonton Coverage Rate Difference between 2013 and 2014

Quintiles	Income		% -Home Ownership		% -Aboriginal		% -Immigrant	
	Difference between 2013 and 2014	2014 coverage rate*	Difference between 2013 and 2014	2014 coverage rate*	Difference between 2013 and 2014	2014 coverage rate	Difference between 2013 and 2014	2014 coverage rate
Quintile 5 (Highest)	+1.38	93.29	+0.92	93.16	+1.48	85.73	-1.24	91.00
Quintile 4	+0.06	91.89	+0.65	92.10	+2.09	86.79	-1.36	90.69
Quintile 3	+0.14	89.04	-0.31	88.33	+0.46	89.16	-1.46	87.57
Quintile 2	+0.76	87.07	+1.20	87.23	+0.05	92.41	-2.28	87.07
Quintile 1 (Lowest)	+2.12	85.74	+2.42	86.13	+0.56	92.92	-0.28	87.67

Calgary showed increasing inequities across all stratifiers between 2013 and 2014:

- Neighborhood income: In 2014, the highest income quintile coverage rate surpassed all the other quintiles in terms of coverage rates, resulting in a sequential gradient in coverage rates: highest income quintiles shows the highest coverage rates, second-highest income quintile shows the second-highest coverage rate, and so on in descending order.
- Neighborhood %-homeownership: A true sequential gradient emerges in 2014 - highest %-homeownership quintiles shows the highest coverage rates, second-highest %-homeownership quintile shows the second-highest coverage rate, and so on in descending order.
- Neighborhood %-Aboriginal: Quintile 5 (highest proportion of %-Aboriginal populated-neighborhoods) showed almost null coverage gains, while the other quintiles increased between 1% to 3.7%.
- Neighborhood %-Immigrant: Dramatic coverage gains are shown in quintiles 1-4 (the lowest to second-highest %-immigrant populated neighborhoods) to reach quintile 5 (highest proportion of %-immigrant populated neighborhoods) coverage levels in 2014.

Edmonton showed decreasing inequities except in %-immigrant stratifier between 2013 and 2014:

- Neighborhood income: Efforts did disproportionately benefit the lowest income quintile compared to the highest income quintile
- Neighborhood %-homeownership: Results show disproportionate gains in lowest %-homeownership quintile compared to the highest %-homeownership quintile
- Neighborhood %-Aboriginal: More gains were made in the highest %-Aboriginal quintile compared to the lowest %-Aboriginal quintile
- Neighborhood %-Immigrant: The equity trend is reversed, where the highest %-immigrant quintile immunizations rates went down to a higher magnitude than the lowest %-immigrant quintile

CONCLUSION

- The measles outbreak of 2013/2014 involved the entirety of Alberta and led to both provincial and city-specific interventions in which Calgary deployed three mass immunization clinics, where Edmonton did not.
- Calgary's additive intervention of three mass immunization clinics appears to have also contributed to an inequitable increase in coverage rates as compared to Edmonton in most cases. Baseline interventions led to equity gains in Edmonton, except with respect to the %-immigrant stratifier.
- Public health policy-makers must be cognizant that large-scale public health efforts must be optimized for accessibility across all socio-economic levels to ensure public and population health gains are realized equitably.