An analytical approach for describing, prioritizing and acting on health inequities at the local level in Canada.

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Abstract

Objectives: We present the Saskatoon Health Region's health inequities analytical approach to examine health equity. This approach enables health regions prioritize action on health inequities.

Design: Data from hospitalizations, physician billing, reportable diseases, vital statistics, and childhood immunizations in the city of Saskatoon were analyzed in years ranging from 1995 to 2011. Data was aggregated to the dissemination area level. The Pampalon deprivation index was used as the measure of socioeconomic status. We calculated annual rates per 1000 people for each outcome; rate ratios, rate differences, area level concentration curves, and area level concentration coefficients quantified inequality. An Inequalities Prioritization Matrix (IPM) was developed to prioritize action for the outcomes demonstrating the greatest inequity.

Main outcome measures: The outcomes measures were cancer, intentional self-harm, COPD, mental illness, heart disease, diabetes, injury, stroke, chlamydia, tuberculosis, gonorrhea, Hepatitis C, high birth weight, low birth weight, teen abortion, teen pregnancy, infant mortality and all cause mortality.

Results: The IPM showed that the first and second priorities to address related to inequities in hospitalizations are injuries and COPD. For physician billing, mental disorders and diabetes are high priority areas. Teen pregnancy and all cause mortality are the most inequitable in the vital statistics data. For STI infections, Hepatitis C is the highest priority.

Conclusions: The health inequities analytic approach is an effective, replicable method for identifying areas of concern that require further inquiry, action planning, and evaluation to reduce health inequities.

Introduction

Health equity is the principle of and commitment to incorporating social justice into health by reducing health inequalities. It implies that all people can reach their full health potential and should not be disadvantaged from attaining it because of their race, ethnicity, religion, gender, age, social class, socioeconomic status or other socially determined circumstances.[1] Health inequities occur in the absence of health equity.

Measuring health inequity is a difficult task, and requires two steps. First health inequalities are measured, which are differences in health outcomes between different groups in the same population. Second, health inequalities become health inequities when these differences are deemed unnecessary, avoidable, unjust and unfair.[1]

The health sector plays an important role in perpetuating or reducing health inequities.[3,4] The *Health Disparities Task Group of the Federal Provincial Territorial Advisory Committee on Population Health and Health Security* suggests that the health sector can reduce or increase health inequities depending on how their programs and policies are implemented and taken up by the population.[5] Focused health sector efforts to improve health care equity have the potential to reduce inequities in health

outcomes.[5–7] Health care equity means that health care services should be available, accessible, and acceptable to everyone in the population, while also maintaining a high degree of quality.[8]

Today, provincial governments and regional health authorities may not have the required data (available via primary data collection or through administrative datasets) to assess health inequalities, let alone determine whether inequity exists.[9,10] Limited evaluations of health inequalities may also be due to limitations in health regions' organizational capacity or lack of practical methods for health regions to use for planning.[11] In Saskatchewan, the Ministry of Health's Strategic and Operational Directions 2013–2014 identifies collaborating with communities, other Ministries and different levels of government to close the gap in health inequalities and promote health equity.[12] However, the Ministry does not identify specific measures or targets for evaluating health inequalities. Potential measures and targets could be identified using health administrative data.

Practically, health outcomes are compared between SES groups in the population, which presents both challenges and opportunities when using health administrative data to

examine socio-economic status (SES) variation in health.[13] Administrative data often does not contain individual-level SES variables.[9] Despite evidence of individual- and area-level SES being associated with differential health outcomes in the population[14-16], health officials often lack data about their local context,[17] leading to potential underestimations of the extent of the inequities and limited ability to undertake evidence-based policy making to reduce inequities.[18]

As part of an ongoing commitment to address health inequities, Saskatoon Health Region has previously compared rate ratios between the highest and lowest income neighbourhoods within the city of Saskatoon.[17,19] This paper presents the Health Region's analytic approach to addressing health equity, building on the Region's past work and research conducted in Manitoba.[20], 21] This approach includes three major components: data, analysis, and prioritization.

Data: Data sources, health outcomes, and adapting disparity measures to the local context

The health inequities analytic approach begins by selecting relevant health outcomes. Outcomes are defined by either ICD codes or specific definitions used within the region. Appendix 1 shows the complete outcomes list, and definition and data source for each

outcome.

In Saskatchewan, the majority of health outcomes data are available in the hospital and medical services databases of the Government of Saskatchewan. The hospital service database includes all acute care in-patient separations, day surgeries, and in-patient psychiatric separations on patients treated in hospitals. The medical service database includes physicians' fee-for-service claims. Physicians under non fee-for-service arrangements submit shadow billings. Data for communicable diseases was available from the Saskatchewan Ministry of Health Integrated Public Health System. Childhood immunization data was available from the Saskatchewan Immunization Management System. Vital statistics data from the Ministry of Health was available for all cause mortality, infant mortality, low and high birth weight, teen pregnancy, and teen abortion.

For each data source, the most responsible diagnosis was used to calculate the numerator for each health outcome. Patients with multiple separations within one day were counted only once. Transfers of the same patient between hospitals were removed to avoid double counting.

The Saskatchewan Population Registry, which includes all residents eligible for Saskatchewan Health benefits, on June 30th of the study year, was used as the denominator.

Because individual-level SES data is not available, the unit of analysis is the dissemination area (DA). DAs have populations ranging between 400 to 700 people. DA as the unit of analysis was chosen because it is the smallest area of Canadian census geography, we can calculate rates within each DA using reliable population denominator data for each health outcome, and measures of deprivation are available for each DA. As well, DA and deprivation data are publicly available, which facilitates replication.

Deprivation scores for each dissemination area (DA) in Saskatoon were obtained from the *Institut National de Santé Publique du Quebec* (INSPQ) using the deprivation index developed by Pampalon et al. and calculated for Saskatoon.[22,23] The deprivation index includes factors for material and social deprivation derived from the 2006 Canadian Census. The material deprivation factor includes the proportion of people age 15 years and older without a high school diploma, employment/population ratio of people aged 15 years and older, and the average income of people ages 15 years and older in the DA. The social deprivation factor includes the proportion of individuals aged 15 years and older living

alone, the proportion of individuals aged 15 years and older who are separated, divorced or widowed, and the proportion of single-parent families. Quintiles of total deprivation are calculated by combining quintiles of material and social deprivation using the matrix developed by the Canadian Institute for Health Information (CIHI), see Appendix 2.

Analysis: Measures and methods

The methods used to examine inequality are the disparity rate ratio (DRR), disparity rate difference (DRD), and area-level concentration coefficient (ALCC). The (DRR) compares the relative socioeconomic variation on an outcome, by dividing the rate of the highest by the rate of the lowest area deprivation group at a given time period.(24-27]

The disparity rate difference (DRD) compares the absolute socioeconomic variation in a health outcome, by subtracting the rate of the lowest area deprivation group from the rate of the highest area deprivation group.(24-27]

While the DRR and DRD are good measures of difference between the two extreme quintiles (i.e. Q1 vs. Q5), they are unable to examine difference across the quintiles (i.e. Q1 through Q5). To examine distribution across the quintiles, an area-level concentration curve (ALCC), was used.[28] Detailed methodological descriptions for calculating ALCC curves and ALCC coefficients have been published and are available in many statistical packages.[26] Appendix 3 shows the equations used for the calculation of the cumulative proportion of population by deprivation quintile, the cumulative proportion of each outcome by deprivation quintile, and the ALCC coefficient. ALCC coefficient values can range from zero to one. The Manitoba Centre for Health Policy suggests that ALCC coefficients represent low (ALCC < 0.06), medium (ALCC 0.06-0.20), and high (ALCC > 0.20) degrees of health inequality.[20,29,30] Figure 1 shows three possible scenarios for the ALCC coefficient (coefficient=0.05, 0.13 and 0.25).

To examine health inequalities over time, we compare yearly changes in DRR, DRD, and ALCC coefficient. We used the most recent available data for the analysis. Hospital services data was available from 1995 to 2011, physician billing data was available from 1996 to 2009, communicable disease data was available from 2004 to 2010, childhood immunization

data was available from 2002 to 2011, and vital statistics data was available from 1995 to 2009.

Results

Table 2 shows the rate of each outcome per 1000 population in Saskatoon in the given time period, the DRR, the DRD and the ALCC coefficient.

Hospital services, 1995 to 2011, COPD and intentional self-harm are the most unequal conditions based on the ALCC coefficient, this, despite a significant decrease in the ALCC coefficient for these outcomes between 1995 and 2011.

Physician billing, 1996 to 2009, all outcomes are high inequality. Diabetes (ALCC=0.39), stroke (ALCC=0.38), mental disorders (ALCC=0.38), and heart disease (ALCC=0.37) where the most unequal. Also of note, the overall rate of diabetes in the physician billing data has increased from 5.21 per 1000 in 1995 to 11.20 in 2009.

Communicable diseases, 2004 to 2010, all outcomes are high inequality. Tuberculosis (TB) had the highest inequality. Of note, there were no cases of TB in the least deprived

quintile from 1995-1999, 2002-2003, and in 2008. The rates for childhood immunization in 2011 were 653.9 per 1000 in Q5 (most deprived) and 838.8 per 1000 in Q1 (least deprived), with a rate ratio of 653.9/838.8=0.76. The interpretation for immunization is somewhat counter-intuitive because high immunization rates are positive.

Vital statistics, 1995 to 2009, show high inequality for all cause mortality (ALCC=0.23) and teen pregnancy (ALCC=0.25). Teen abortion is also highly unequal though in the opposite direction, with the least deprived quintile having more abortions than the most deprived quintiles.

Prioritization: From Data to Intervention Priorities

To make policy and planning recommendations for the Health Region, an Inequalities Priority Matrix (IPM) was developed which combines the results from the DRR, DRD, ALCC coefficient, changes in DRR and DRD, and rate for each outcome. The IPM is not a formal statistical test, but rather acts as a guide for identifying priorities based on changes over time and absolute inequality. The IPM uses measures of inequality and provides a method for assigning value judgments about the equitable distribution of health outcomes

by deprivation quintiles.

The IPM is a seven step process, and Table 3 shows the complete IPM method for each outcome. Each step relies on determining the descending rank order of one of the inequality measures. Therefore the outcomes with the highest degree of inequality have the lowest rank score. The seven outcomes were the most recent ALCC coefficients, most recent DRR, most recent DRD, percent change in DRR between the oldest to most recent year, percent change in DRD between the oldest to most recent year, and overall rate. Scores for each ranking are then summed and sorted in ascending order. Thus, the lower the final score based on the 6 rankings the higher the level of priority for the given outcome.

The IPM analysis was conducted separately for each data source. This reflects the fact that physicians, hospitals and provincial health departments have different priorities both in terms of addressing the most inequitable outcomes and potential intervention levers. Also, the data sources have different limitations, which make comparisons across data sources inappropriate.

Table 3 shows the results of the IPM. The first and second priorities to address related

to inequalities for hospitals are injuries and COPD. The physician billing data shows that inequalities in mental illness and diabetes are high priority areas. In the vital statistics data, the IPM suggests that inequalities in teen pregnancy and all cause mortality should be addressed. For communicable diseases, Hepatitis C is the highest priority for social inequalities. However, it should be noted that Tuberculosis is also a high priority because it has a low incidence and a high degree of inequality. In fact, there were no cases of TB in the least deprived quintile in many years, making it impossible to calculate DRR and DRD.

Discussion

This paper presented Saskatoon Health Region's health inequities analytic approach. The approach identifies health outcomes with high inequalities between population groups that warrant further investigation and should be prioritized for intervention to improve health equity at the health region level. The analytic approach addresses some of the pervasive challenges of health inequities research and practice at the local level. We believe the organizational requirements for applying the approach are reasonable and provide relevant information for policy and service delivery planning. As well, all data is available to

local health authorities across Canada making the analysis replicable.

This paper builds on past research by developing the Inequities Priority Matrix, an empirical method to prioritize further investigation and action. The IPM considers the overall rate of the disease in a given year but prioritizes measures of inequality, and changes in inequality over time. The primary strength of the IPM is that it can be used to assign value judgments about the equitable distribution of health outcomes by deprivation quintiles. This is an approach to empirically addressing health inequities in a local setting.

The IPM has implications for using population or targeted prevention.[33-35] Highly unequal conditions with increasing differences between the most and least deprived quintiles are prioritized. These conditions should be addressed using structural or population interventions that are feasible given the scope of the organization. It is unrealistic for most physicians to attempt to address structural inequalities of income distribution in the population on their own. It is however feasible for physicians to provide additional care for populations with higher rates of mental disorders or diabetes,

while providing culturally competent interventions that improve the acceptability of their health care.

Inequities in all-cause mortality prioritized using vital statistics data could be addressed by broader structural changes through intersectoral partnerships. For example, health regions in Saskatchewan are partners in Regional Intersectoral Committees, which bring together actors from health, education, social services, and justice to develop shared priorities, evaluation plans and outcomes for action. Intersectoral action has the potential to make structural changes to social policy that may reduce social inequalities in general.[36,37]

Despite the focus on highly unequal conditions with a high prevalence in the population, users of the analytic approach should pay special attention to those conditions with a low prevalence and a high degree of inequality. These low prevalent, high inequality outcomes may not respond well to population-level interventions and will likely require interventions based on the notion of vulnerable populations.[38,39] In Saskatoon, Hepatitis C and Tuberculosis are of particular concern because they have the highest degree of inequality and lowest prevalence.

The strengths of the analytic approach are the use of data available to local health regions in Canada. The approach balances the need for replicable and commonly used statistical techniques with available expertise of health region staff. However, despite debate in the literature [31,32], we felt that limiting our methods to three complimentary but distinct measures, the DRR, DRD, and the ALCC coefficient, would capture inequalities and be replicable.

Limitations

The analytic approach has several limitations. Data quality is an issue, particularly with respect to physician billing. In Saskatchewan, approximately 33% of general practitioners, and 38% of specialists shadow bill. Physicians typically don't shadow bill 100% of their work and there is no audit done in Saskatchewan on the accuracy of shadow billing. Health seeking behavior differs between SES groups, which could lead to bias in the disparity calculations. As well, billing does not represent disease, so physicians may systematically report a certain disease when presented with multiple patient complaints leading to differential rates by SES.

In addition, the injury and self-harm data is conflated with the self-harm data. Injury data contains all self-harm attempts.

The IPM is an attempt to prioritize inequalities based on available data. We did not consider change in ALCC coefficient. Multiple iterations of the IPM were developed over the course of this project. We believe the IPM provides sufficient nuance to prioritize conditions, while being replicable.

The analysis is subject to the ecological fallacy.[40] Ideally, health administrative datasets would include information regarding individual's socioeconomic status. As well, the outcomes in this study extend from 1995 to 2011. We used deprivation data from the 2006 census. Our method assumes no change in area-level deprivation between 1995 and 2011 in Saskatoon, leading to potential misclassification bias. Comparisons of area-level deprivation between 2001 and 2006 show that 45% of DAs did not change deprivation quintiles and 37% of changes were within 1 deprivation quintile.

Inequalities in health service utilization data do not always correspond to inequity in quality of care or prevalence of disease. Future studies should attempt to better quantify inequity by analyzing the “service-to-need ratio” taking into account both service utilization and service need, rather than only service utilization.

Conclusion

The Saskatoon Health Region’s health inequities analytic approach uses an empirical method, and available data to describe, and prioritize action to address health inequities at the local level. The health inequities analytic approach is replicable as it uses available data and common methods.

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Figure 1. Three possible scenarios for the area level concentration curve (ALCC) coefficient (coefficient =0.05, 0.13 and 0.25) and (ALCC) curve based on the recommendations of the Manitoba Centre for Health Policy.

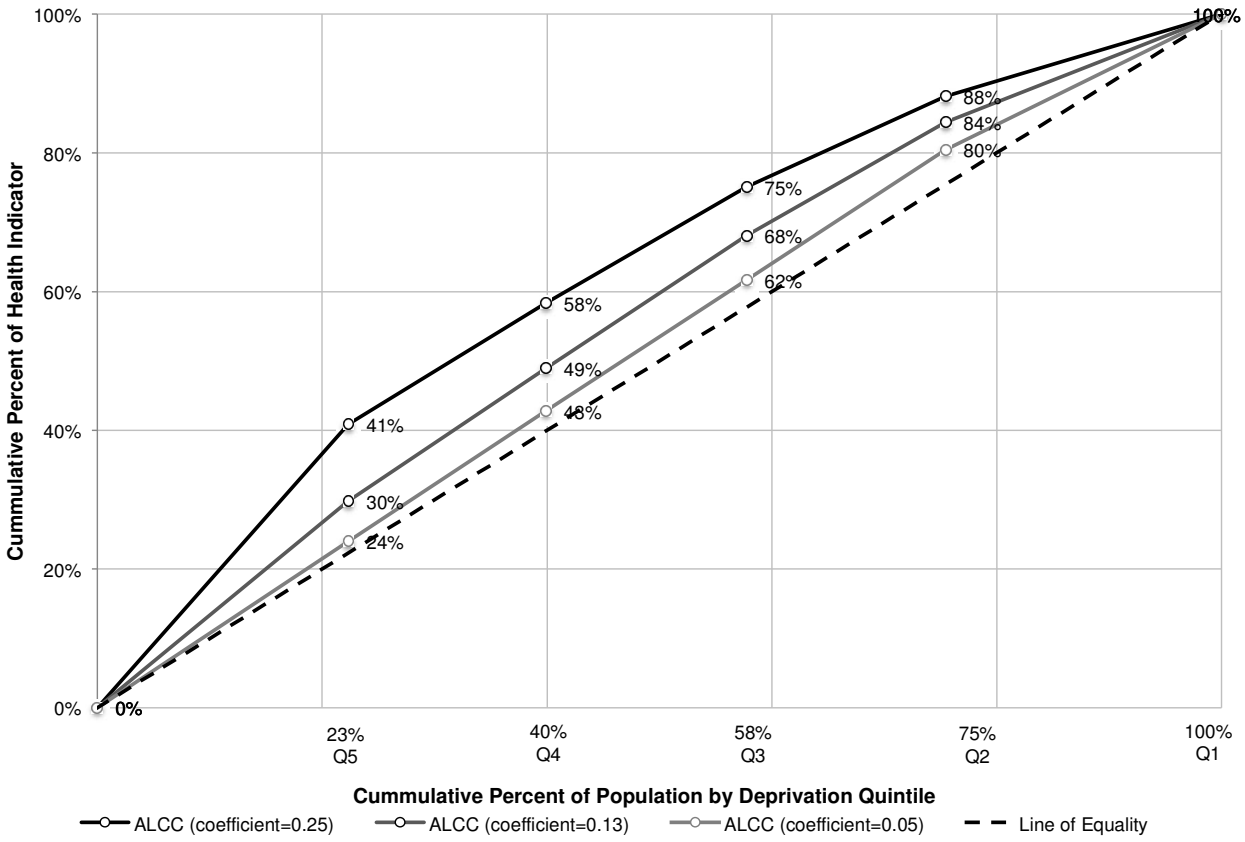


Table 2. Overall rates, rate ratios, rate differences, % change in rate ratio, % change in rate difference and area level concentration curve (ALCC) coefficients for each health outcome used in the Saskatoon health inequities analytic approach.

	Rate per 1000	Rate per 1000	% Change in Rate	Disparity Rate Ratio	Disparity Rate Ratio	DRR % change	Disparity rate difference	Disparity rate difference	DRD % change	ALCC Coefficient	ALCC Coefficient	% Change in ALCC
Hospitalization Data												
	1995	2011	1995 to 2011	1995	2011	1995 to 2011	1995	2011	1995 to 2011	1995	2011	1995 to 2011
Cancer	8.03	4.66	↓ 42% *	1.13	1.18	↓ 4%	0.92	0.84	↓ 9%	0.13	0.04	↓ 68% *
Self-Harm	0.84	0.39	↓ 54% *	5.58	3.58	↓ 36%	1.28	0.48	↓ 63%	0.28	0.23	↓ 17% *
COPD	2.82	1.71	↓ 39% *	2.59	3.42	↑ 32% *	2.61	2.19	↓ 16%	0.33	0.28	↓ 15% *
Mental Disorders	6.17	3.48	↓ 44% *	2.9	2.44	↓ 16%	6.35	3.28	↓ 48%	0.20	0.18	↓ 10%
Heart Disease	5.56	2.37	↓ 57% *	1.41	1.75	↑ 24% *	1.64	1.43	↓ 13%	0.15	0.16	↑ 10%
Diabetes	1.13	1.16	↑ 3%	1.74	2.75	↑ 58% *	0.6	1.31	↑ 116%	0.18	0.19	↑ 8%
Injury	6.91	5.79	↓ 16%	1.82	2.35	↑ 29% *	4.35	5.11	↑ 18%	0.17	0.2	↑ 14%
Stroke	2.41	1.19	↓ 51% *	1.67	2.03	↑ 21% *	1.24	0.76	↓ 39%	0.23	0.16	↓ 28% *
Physician Billing												
	1996	2009	1996 to 2009	1996	2009	1996 to 2009	1996	2009	1996 to 2009	1996	2009	1996 to 2009
Stroke	1.81	1.19	↓ 34% *	4.85	6.16	↑ 27%	2.6	2.26	↓ 13%	0.42	0.38	↓ 9%
Diabetes	5.21	11.2	↑ 115% *	8.28	9.91	↑ 20%	8.58	22.73	↑ 165%	0.40	0.39	↓ 4%
Heart Disease	5.32	5.96	↑ 12%	5.02	7.29	↑ 45% *	6.93	11.2	↑ 62%	0.36	0.37	↑ 1%
Mental Disorders	31.87	41.95	↑ 32% *	6.81	9.05	↑ 33% *	51.86	81.44	↑ 57%	0.35	0.38	↑ 10%

Injury	62.41	44.52	↓ 29% *	5.23	7.41	↑ 42% *	85.49	71.43	↓ 17%	0.30	0.33	↑ 12%
Cancer	5.66	7.54	↑ 33%	3.91	5.56	↑ 42%	6.13	11.09	↑ 81%	0.25	0.28	↑ 13%
COPD	26.65	20.91	↓ 22%	6.23	9.26	↑ 49% *	40.38	38.05	↑ 6%	0.32	0.37	↑ 13%
STI Infections Data												
	2004	2010	2004 to 2010	2004	2010	2004 to 2010	2004	2010	2004 to 2010	2004	2010	2004 to 2010
Chlamydia	3.31	4.85	↑ 47%	4.22	2.96	↓ 30% *	4.94	5.24	↑ 6%	0.29	0.25	↓ 16%
Tuberculosis	0.013	0.064	↑ 392%	N/A	N/A	N/A	N/A	N/A	N/A	0.58	0.56	↓ 4%
Gonorrhea	0.46	0.40	↓ 13%	8.4	4.79	↓ 43%	0.93	0.73	↓ 21%	0.40	0.47	↑ 19%
HEP C	0.81	0.37	↓ 54% *	7.84	11.14	↑ 42%	1.94	1.54	↓ 21%	0.43	0.51	↑ 20% *
Vital Statistics												
	1995	2009	1995 to 2009	1995	2009	1995 to 2009	1995	2009	1995 to 2009	1995	2009	1995 to 2009
High Birth Weight	106.37	134.82	↑ 27%	0.73	0.95	↑ 30% *	-33.71	-6.54	↓ 81%	0.15	0.08	↓ 46% *
Teen Abortion	245.45	195.61	↓ 20%	0.63	0.93	↑ 49% *	-119.36	-13.19	↓ 89%	0.31	0.21	↓ 32% *
All Cause Mortality	6.09	5.88	↓ 3%	2.28	2.34	↑ 3% *	4.61	5.38	↑ 17%	0.28	0.23	↓ 17%
Infant Mortality	10.73	8.36	↓ 22% *	2.87	1.61	↓ 44%	10.71	3.39	↓ 69%	0.18	0.17	↓ 5%
Low Birth Weight	65.95	61.49	↓ 7%	2.27	1.53	↓ 33%	54.5	27.79	↓ 49%	0.06	0.06	→ 0%
Teen Pregnancy	87.09	56.64	↓ 35% *	4.19	8.63	↑ 106% *	113.31	114.25	↑ 1%	0.17	0.25	↑ 50% *
Immunizations Data												
	2002	2011	2002 to 2011	2002	2011	2002 to 2011	2002	2011	2002 to 2011	2002	2011	2002 to 2011
Child Immunization	624.90	745.87	↑ 19%	0.32	0.76	↑ 136% *	-312.1	-202.86	↓ 35%	0.09	0.07	↓ 22%

Note. Recalculations of the percent change in overall rate, rate ratios, rate difference, and ALCC coefficients are subject to rounding error. The actual calculation was done rounding to the nearest fifth decimal.
* Represents a statistically significant ($p<0.05$) change.
+ N/A = There were no cases of Tuberculosis in the least deprived group.

Table 3. Inequalities Priority Matrix (IPM) steps and final rankings for hospitalization, physician billing, communicable diseases, and vital statistics data.

	STEP 1: Sort Descending & Rank by ALCC score		STEP 2: Sort Descending & Rank by absolute DRR for T5^		STEP 3: Sort Descending & Rank by absolute DRD for T5^		STEP 4: Sort Descending & Rank by % DRR Change for T1 to T5^		STEP 5: Sort Descending & Rank by % DRD Change for T1 to T5^		STEP 6: Sort Descending & Rank by absolute rate per 1000 at T5^		STEP 7: Sum scores from step 1 to 6 & Sort Ascending	
Outcome	**ALCC**	**ALCC Score**	**DRR**	**DRR Score**	**DRD**	**DRD Score**	**Change in DRR**	**DRR Change Score**	**Change in DRD**	**DRD Change Score**	**Rate per 1000**	**Rate per 1000 Score**	***FINAL SCORE***	**PRIORITY RANK**
Hospitalization Data														
Injury	0.20	3	2.35	5	5.11	1	29	3	18	2	5.79	1	15	1
COPD	0.28	1	3.42	2	2.19	3	32	2	-16	5	1.71	5	18	2
Diabetes	0.19	4	2.75	3	1.31	5	58	1	116	1	1.16	7	21	3
Mental Disorders	0.18	5	2.44	4	3.28	2	-16	7	-48	7	3.48	3	28	4
Heart Disease	0.16	6	1.75	7	1.43	4	24	4	-13	4	2.37	4	29	5
Cancer	0.04	8	1.18	8	0.84	6	-4	6	-9	3	4.66	2	33	6
Self-Harm	0.23	2	3.58	1	0.48	8	-36	8	-63	8	0.39	8	35	7
Stroke	0.16	7	2.03	6	0.76	7	21	5	-39	6	1.19	6	37	8
Physician Billing														
Mental Disorders	0.38	3	9.05	3	81.44	1	33	5	57	4	41.95	2	18	1
Diabetes	0.39	1	9.91	1	22.73	4	20	7	165	1	11.20	4	18	1
COPD	0.37	5	9.26	2	38.05	3	49	1	6	5	20.91	3	19	3
Injury	0.33	6	7.41	4	71.43	2	42	3	-17	7	44.52	1	23	4
Heart Disease	0.37	4	7.29	5	11.20	5	45	2	62	3	5.96	6	25	5
Cancer	0.28	7	5.56	7	11.09	6	42	4	81	2	7.54	5	31	6
Stroke	0.38	2	6.16	6	2.26	7	27	6	-13	6	1.19	7	34	7

Communicable Diseases														
Tuberculosis	**0.56**	**1**	**N/A**		**N/A**		**N/A**		**N/A**		**0.06**	**4**	**5**	**1**
HEP C	0.51	2	11.14	1	1.54	2	42	1	-21	2	0.37	3	11	1
Chlamydia	0.25	4	2.96	3	5.24	1	-30	2	6	1	4.85	1	12	2
Gonorrhea	0.47	3	4.79	2	0.73	3	-43	3	-21	3	0.40	2	16	3
Vital Statistics														
Teen Pregnancy	0.25	1	8.63	1	114.25	1	106	1	1	2	56.64	4	10	1
All Cause Mortality	0.23	2	2.34	2	5.38	3	3	4	17	1	5.88	6	18	2
Low Birth Weight	0.06	6	1.53	4	27.79	2	-33	5	-49	3	61.49	3	23	3
Teen Abortion	0.21	3	0.93	6	-13.19	6	49	2	-89	6	195.61	1	24	4
High Birth Weight	0.08	5	0.95	5	-6.54	5	30	3	-81	5	134.82	2	25	5
Infant Mortality	0.17	4	1.61	3	3.39	4	-44	6	-69	4	8.36	5	26	6

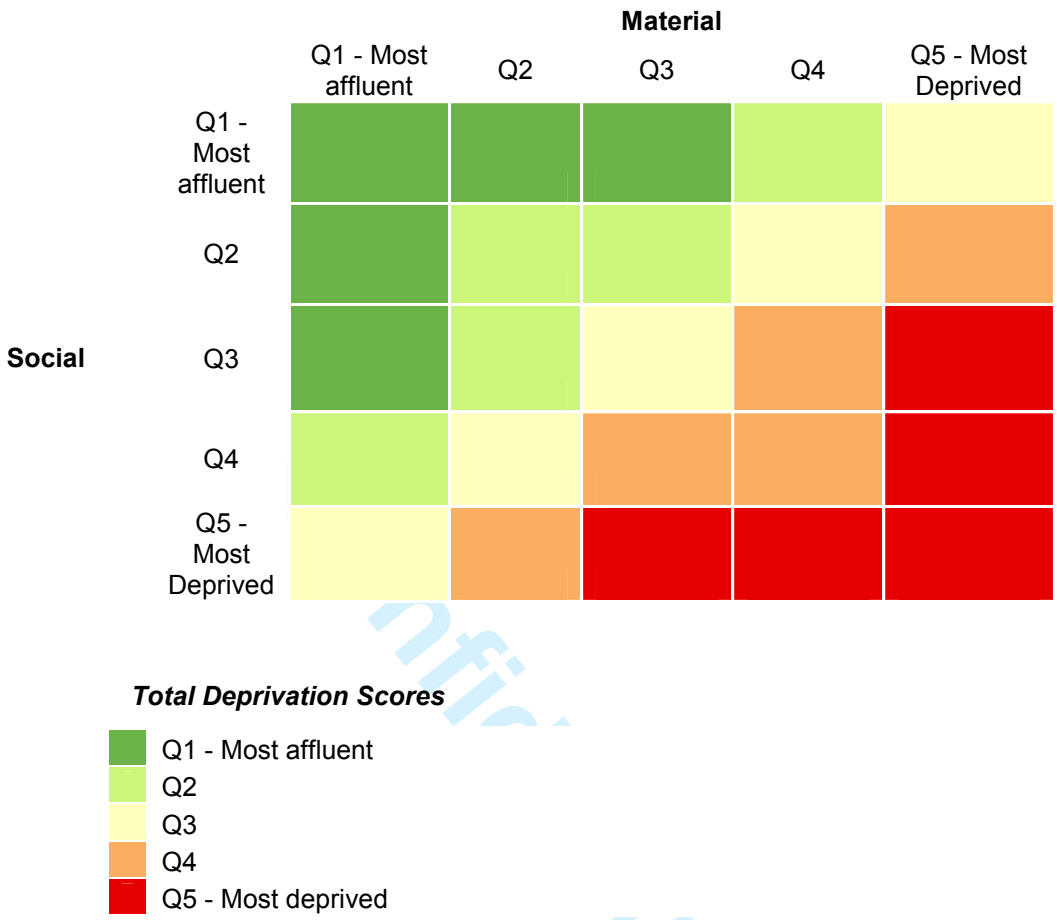
Note. **Bold = Special focus (low prevalence, high inequality**

Appendix 1 - complete indicator list, definition and data sources for each indicator

	Data Source	Definition	Inclusion/Exclusion	Limitations
Mortality data	Saskatchewan Ministry of Health's Vital Statistics Branch	Deaths are those that occur to SHR residents using data from 1991-2006 from Saskatchewan Vital Statistics, Alberta Vital Statistics, and CIHI hospital separations for deaths occurring in all other provinces. ICD-9 codes are used for all deaths before calendar year 2000 and after this date ICD-10 codes are used	Includes those persons with Saskatchewan recorded as their province of residence.	Conversion between ICD-9 and ICD-10 codes can be problematic for certain disease conditions because the codes are not comparable. Vital Statistics data is based on the underlying cause of death, which is limited to one diagnosis, unless there is an injury, then there is a separate code for the external cause. Readers should note that there may be more than one contributing cause of death, but that only the most responsible cause is used.
Birth data	Saskatchewan Ministry of Health's Vital Statistics Branch	births occurring to SHR residents from 1991 to 2006 using data from Saskatchewan Vital Statistics, Alberta Vital Statistics, and CIHI hospital separations for births occurring in all other provinces.	Includes only those mothers who have put Saskatchewan as their province of residence	See Mortality data
Hospital Discharge (Hospitalization) data	Saskatchewan Ministry of Health's year-end hospital files.	Data include all acute care inpatient and psychiatric inpatient hospitalizations. This data is based on total number of hospital discharges, irrespective of how many times the same individual is discharged. For example, one person could present five times in a fiscal year for a mental disorder, and it would be counted as five discharges. As well, a resident may be admitted to one hospital, and be transferred to another hospital which would count as two discharges, even though the individual was hospitalized for the same event.	ICD-9 codes are used for all hospital separations prior to 2000/01 fiscal year, and ICD-10 are used after this date. Some 2001-02 data and 1997-98 to 2003-04 are based on converted codes (to ICD-9 to ICD-10-CA). Differences between data coded in ICD-10 and ICD-9 occur for several reasons. The conversion tables are not perfect due to differences in the structure of the two coding systems.	All acute care inpatient and psychiatric inpatient hospitalizations of SHR residents in Saskatchewan and out-of-province/country hospitals.

Physician Billing data	Saskatchewan Ministry of Health's Medical Services Branch.	Data include diagnosis codes that physicians use when patients come to see them. Diagnosis is in ICD-9 format for all years.	Only one diagnosis code is captured, and is of questionable data quality	Data is not captured for services by salaried physicians (approx. 30% of provincial physician supply.
Sexually Transmitted Infections	Ministry of Health, Integrated Public Health System (iPHIS)	Data include all new communicable diseases (CD) cases reportable to the Regional Health Authority under the Public Health Act, Reportable Disease Regulations, excluding reportable sexually transmitted infections (Chlamydia, gonorrhea, syphilis), HIV/AIDS and tuberculosis.		Gross fluctuations in the trend over a short period of time may be an artefact. Changes in testing methodologies, changes and/or differences in case definitions, improved method of reporting (electronic versus paper), fluctuation in the population denominator, and recent change in the public interest in a particular disease can all affect the trends without there being an actual increase in the true rates. Similarly, calculated rates that are based on small numbers are more prone to fluctuation over time.
Immunizations	Saskatchewan Immunization Management System	Percent of children grouped by year turned 2 years of age, disparity quintile and gender who had received 2 doses of vaccine protective against measles, mumps and rubella by their second birthday.		Of over 37,0000 children in both the 2010 and 2012 extracts born within our years of interest extract over 10,000 have a new address, this means that within 2 years about over 25% of the children will have moved at least once and may no longer be recorded in the their previous disaprity area.

Appendix 2 – Matrix used for combining material and social indicators of the Pampalon index



Appendix 3. Equations used for the calculation the cumulative proportion of population by deprivation quintile, the cumulative proportion of outcome by deprivation quintile, and the Gini coefficient.

1. Cumulative proportion of population by deprivation quintile

Equation 1:

$$x_k = \frac{\sum_{i=1}^{k} p_1}{\mathrm{P}}$$

Where:

$$\mathrm{P} = \sum_{i=1}^{n} p_1 = Total\ population$$

$$\sum_{i=1}^{k} p_1 = Sum\ of\ population\ for\ all\ i\ in\ k$$

$$i = 1, \dots, k$$

$$k = 1, \dots, n$$

$$k = \begin{cases} Q5\ if\ i = 1 \\ Q4\ if\ i = 1 \\ Q3\ if\ i = 1 \\ Q2\ if\ i = 1 \\ Q1\ if\ i = 1 \end{cases}$$

The x-coordinates have the following properties:

$$0 < x_{Q5} < x_{Q4} < x_{Q3} < x_{Q2} < x_{Q1} = 1$$

2. Cumulative proportion of outcome by deprivation quintile

Equation 2:

$$y_k = \frac{\sum_{i=1}^{k} d_1}{\mathrm{D}}$$

Where:

$$\mathrm{D} = \sum_{i=1}^{n} d_1 = Total\ disease\ cases$$

$$\sum_{i=1}^{k} d_1 = Sum\ of\ disease\ cases\ for\ all\ i\ in\ k$$

$$i = 1, \dots, k$$

$$k = 1, \dots, n$$

$$k = \begin{cases} Q5 \; if \; i = 1 \\ Q4 \; if \; i = 1 \\ Q3 \; if \; i = 1 \\ Q2 \; if \; i = 1 \\ Q1 \; if \; i = 1 \end{cases}$$

The y-coordinates have the following properties:

$$0 < y_{Q5} < y_{Q4} < y_{Q3} < y_{Q2} < y_{Q1} = 1$$

3. Gini coefficient

Equation 3:

$$\text{Gini} = \frac{Concentration\ Area}{Maximum\ Concentration\ Area\ (0.5)}$$

$$\text{Z} = \text{ Area under the Lorenz curve}$$

$$\text{Z} = \sum_{i}^{n} \text{Z}_k = \sum_{i}^{n} \frac{(y_k + y_{k-1})(x_k - x_{k-1})}{2}$$

$$\text{Gini} = \frac{\left(\sum_{i}^{n} \frac{(y_k + y_{k-1})(x_k - x_{k-1})}{2}\right) - 0.5}{0.5}$$