



## The value of admissions characteristics for predicting the practice location of University of Saskatchewan College of Medicine graduates

## La valeur prédictive des éléments du dossier d'admission pour déterminer le lieu de pratique futur des diplômés de la faculté de médecine de l'Université de la Saskatchewan

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Résumé de l'article

**Contexte :** La main-d'œuvre médicale en Saskatchewan dépend de la rétention des médecins formés dans la province. Les informations recueillies au moment de la demande d'admission à la faculté de médecine peuvent permettre de prédire le lieu de pratique futur, mais ces liens n'ont pas été explorés.

**Méthodes :** Nous avons trouvé le lieu de pratique actuel des diplômés de la faculté de médecine de l'Université de la Saskatchewan qui se sont inscrits entre 2000 et 2013 et avons extrait de leurs demandes d'admission les données concernant le sexe, l'âge, l'école secondaire et l'université précédente fréquentées, et le lieu de résidence au moment de la demande. Nous avons ensuite effectué des analyses univariées et multivariées pour évaluer les liens entre ces éléments et la pratique en milieu rural et en Saskatchewan.

**Résultats :** Nous avons trouvé le lieu de pratique actuel de 1 001 (98,9 %) des diplômés des cohortes incluses. La fréquentation d'une école secondaire de la Saskatchewan ( $p < 0,001$ ), d'une école secondaire dans une petite agglomération ( $p < 0,01$ ) et d'une université de la Saskatchewan ( $p < 0,001$ ) étaient des facteurs prédictifs de la pratique en Saskatchewan. La fréquentation d'une école secondaire à l'extérieur de la Saskatchewan ( $p < 0,05$ ), d'une école secondaire dans une petite agglomération ( $p < 0,001$ ) et le fait de vivre dans une petite agglomération au moment de la demande d'admission ( $p < 0,05$ ) étaient des facteurs prédictifs d'une pratique en milieu rural à l'intérieur ou à l'extérieur de la Saskatchewan.

**Conclusion :** Les caractéristiques démographiques recueillies au moment de la demande d'admission à la faculté de médecine sont corrélées à la pratique future en Saskatchewan et en milieu rural. Ces résultats guideront les politiques d'admission en Saskatchewan et pourraient éclairer les pratiques d'admission d'autres facultés de médecine.

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# The value of admissions characteristics for predicting the practice location of University of Saskatchewan College of Medicine graduates

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## Abstract

**Background:** The physician workforce in Saskatchewan depends upon the retention of locally trained physicians. Characteristics collected at the time of medical school application may predict future practice location, but these associations have not been explored.

**Methods:** We identified the current practice location of University of Saskatchewan College of Medicine graduates who matriculated between 2000 and 2013 and extracted data from their admission applications including gender, age, high school, previous university, and current location at the time of application. We then conducted univariate and multivariate analyses to evaluate associations between these characteristics and rural- and Saskatchewan-based practice.

**Results:** We identified the current practice location of 1,001 (98.9%) of the graduates of the included cohorts. Attending a Saskatchewan high school ( $p < 0.001$ ), a high school in a smaller population center ( $p < 0.01$ ), and a Saskatchewan university ( $p < 0.001$ ) were predictive of Saskatchewan-based practice. Attending a high school outside of Saskatchewan ( $p < 0.05$ ), a high school in a smaller population center ( $p < 0.001$ ), and living in a small population centre at the time of application ( $p < 0.05$ ) were predictive of rural-based practice within or outside of Saskatchewan.

**Conclusion:** Demographic characteristics collected at time of medical school application are associated with future Saskatchewan- and rural-based practice. These findings will guide admissions policies in Saskatchewan and may inform admission practices of other medical schools.

## Résumé

**Contexte :** La main-d'œuvre médicale en Saskatchewan dépend de la rétention des médecins formés dans la province. Les informations recueillies au moment de la demande d'admission à la faculté de médecine peuvent permettre de prédire le lieu de pratique futur, mais ces liens n'ont pas été explorés.

**Méthodes :** Nous avons trouvé le lieu de pratique actuel des diplômés de la faculté de médecine de l'Université de la Saskatchewan qui se sont inscrits entre 2000 et 2013 et avons extrait de leurs demandes d'admission les données concernant le sexe, l'âge, l'école secondaire et l'université précédente fréquentées, et le lieu de résidence au moment de la demande. Nous avons ensuite effectué des analyses univariées et multivariées pour évaluer les liens entre ces éléments et la pratique en milieu rural et en Saskatchewan.

**Résultats :** Nous avons trouvé le lieu de pratique actuel de 1 001 (98,9 %) des diplômés des cohortes incluses. La fréquentation d'une école secondaire de la Saskatchewan ( $p < 0,001$ ), d'une école secondaire dans une petite agglomération ( $p < 0,01$ ) et d'une université de la Saskatchewan ( $p < 0,001$ ) étaient des facteurs prédictifs de la pratique en Saskatchewan. La fréquentation d'une école secondaire à l'extérieur de la Saskatchewan ( $p < 0,05$ ), d'une école secondaire dans une petite agglomération ( $p < 0,001$ ) et le fait de vivre dans une petite agglomération au moment de la demande d'admission ( $p < 0,05$ ) étaient des facteurs prédictifs d'une pratique en milieu rural à l'intérieur ou à l'extérieur de la Saskatchewan.

**Conclusion :** Les caractéristiques démographiques recueillies au moment de la demande d'admission à la faculté de médecine sont corrélées à la pratique future en Saskatchewan et en milieu rural. Ces résultats guideront les politiques d'admission en Saskatchewan et pourraient éclairer les pratiques d'admission d'autres facultés de médecine.

## Introduction

Local medical schools are major contributors to the physician workforce in their regions.<sup>1</sup> In addition, previous studies identified pre-admission factors including where applicants graduated from high school,<sup>2-7</sup> years they spent living in an area,<sup>1,8-10</sup> spousal ties,<sup>5,6,11,12</sup> intentions to practice family medicine,<sup>2,13,14</sup> and community orientation<sup>6,15</sup> that are associated with future practice location. Our study sought to identify predictive factors for practicing in Saskatchewan and in rural locations.

At the University of Saskatchewan (U of S) College of Medicine (CoM) we seek to implement evidence-informed admissions policies that meet Saskatchewan's (SK) needs by selecting applicants that will practice medicine in the province, including in rural settings, following the completion of their training. However, despite longstanding archiving of the matriculants' applications at the U of S CoM, we have not analyzed pre-admission characteristics associated with future SK- and rural-based practice to guide the development of admissions policies that would achieve these goals.

We analyzed the demographic characteristics of graduates of the U of S CoM at the time of matriculation to identify medical school application characteristics that are predictive of future SK- and rural-based practice.

## Methods

### Research Ethics Board approval

The University of Saskatchewan Behavioural Ethics Board Chair deemed this project exempt from ethical review as per Article 2.5 of the Tri-Council Policy Statement.<sup>16</sup>

### Study design & sample

This retrospective cohort study investigated the pre-admission characteristics and practice location of U of S CoM graduates who matriculated between 2000 and 2013. Students were excluded if they did not complete medical school, are not currently practicing medicine, or their current practice location could not be determined.

### Data collection

Historical records were available for students who matriculated from the U of S CoM between 2000 and 2013. We extracted pre-admission data including gender, age at admission, province of where the student graduated high school, population of community where the student graduated high school, province where they had attended university, province where they were currently living, and

population of community where they were currently living. We then identified their practice location in May/June 2020 by searching for their names in the publicly available College of Physicians and Surgeons of Saskatchewan physician registry, searching the internet (Google) and social media (Facebook and LinkedIn), and inquiring with their classmates who still work in SK. The practice location of graduates practicing within Canada was further confirmed through their provincial physician registry and stratified using the Statistics Canada reference population definitions (Large Urban (>100,000), Medium (30,000-99,999), Small (1,000-29,999), and Rural (<1,000)).<sup>17</sup>

### Data analysis

We analyzed this data using SPSS Version 26.0 (SPSS Inc., Chicago, Illinois). Statistical significance was set at a p-value <0.05. When data was missing for a given variable the affected graduate was excluded from that analysis. Chi-square tests were used to measure the univariate relationships for goodness of fit between practice locations and gender, age quartiles, population of the community in which they attended high school, SK/non-SK high school, SK/non-SK previous university, and location at the time of admission.

Variables that were statistically significant on chi-square analyses were included in regression analyses. We conducted a backward stepwise logistic regression to identify which variables independently predicted SK-based practice. Variables that did not contribute to the model were removed. We conducted a multiple linear regression using a backward method to identify which variables predicted practicing in a community within smaller population centers.

## Results

Of the 1019 matriculants from 2000-2013 18 were excluded from the analysis (seven did not graduate, four did not complete residency, two died, one retired, and four did not have an identifiable practice location) leaving a final sample of 1001 graduates (98.9%) with known practice location for the analysis. Most graduates had some connection to SK (attended high school or postsecondary within SK or applied from a location within SK) and grew up in a large urban community (>100,000). Appendix A contains the admission characteristics of these graduates. The figure presented in Appendix B illustrates the current practice location of the 978 U of S CoM graduates in the study cohort who were practicing in Canada (23 were practicing outside of Canada).

Table 1. Regression analyses summary of variables predicting practicing in SK

Practice Location: SK vs Non-SK	B(SE)	95% Confidence Interval		
		Lower	Odds Ratio	Upper
SK/non-SK previous university	.8 (.2)*	1.3	2.1	3.4
SK/non-SK high school	.7 (.2)*	1.3	2.0	3.0
High school population	.2 (.1)*	1.1	1.3	1.4
* $p < .05$				

There was a significant association between practicing in SK and graduation from a SK high school, graduation from a smaller population high school, previously attending a SK university, and applying from a residence within SK. While residing in SK at the time of application had a significant association, it was excluded from the regression analysis due to redundancy with attending high school and university in SK. Appendix C contrasts the characteristics of the graduates with SK-based practices with those who practice elsewhere. The stepwise logistic regression (Table 1) accurately predicts SK/non-SK practice location in 60.8% of cases ( $X^2(3) = 54.1, p < .001$ ). This was an increase of 7% from the null model. Attending university in SK, attending high school in SK, and attending high school in a smaller community were predictive of SK-based practice

Table 2. Regression analyses summary of variables predicting practicing in a smaller community

Population of Practice Location	B	95% Confidence Interval		$\beta$	t	p
		Lower	Upper			
High school population	.1	0.1	0.2	.2	5.8	< .001
SK/non-SK high school	-.2	-0.3	-0.1	-.1	-3.0	.003
Application population	.1	0.0	0.2	.1	2.3	.024

Graduates were significantly more likely to have a rural-based practice if they either graduated from a smaller population high school, graduated from a high school outside of SK, and/or were living in a smaller population center at the time of admission. Appendix D contrasts the characteristics of graduates practicing in smaller and larger population centers. Multiple regression analyses (Table 2) indicate that attending high school in a smaller community, living in a smaller community at the time of application,

and attending high school outside of SK independently predict practicing in a smaller location. Together, these three variables account for 5.8% of the variance of the population of the community in which physicians practice ( $R^2 = .058, F(3,990) = 20.3, p < .001$ ).

## Discussion

This is the first SK-based study to examine the association of admission characteristics and practice location to identify application characteristics predictive of SK- or rural-based practice. With many rural areas across Canada suffering from physician shortages, this study points to the importance of evaluating the predictive power of admission characteristics. Being able to predict future practice location would allow medical admission committees across Canada the ability to further align with their strategic goals. The predictive factors identified in this study are largely in keeping with previously published studies in other jurisdictions. Previous life experience in smaller population communities is predictive of future rural practice<sup>1,3,9,13,15,18-20</sup> and exposure to specific practice locations is associated with practicing in that area in the future.<sup>2-7,10</sup> Gender and age have inconsistently been associated with rural practice in previous studies,<sup>1,9</sup> however, neither was predictive of SK- or rural-based practice in this study. More research is needed to further explain why CoM graduates that attend high school outside of SK are more likely to practice in rural communities across North America.

Multiple studies from different jurisdictions have demonstrated the positive intended effect of targeted evidence-based strategies used at the time of admission to medical school to address important gaps and meet social goals.<sup>21-24</sup> Building on the experience of the Northern Ontario School of Medicine,<sup>25</sup> the findings of this study will inform a “Saskatchewan-connectedness” index that will replace the categorical provincial residency definition currently used to allocate the vast majority of incoming

seats. Including the index score in admissions decisions will directly address the limitations of the current residency definition with the goal of aligning admissions policies with the strategy aimed at supplying a sustainable future physician work force for the entire province, including rural areas. The impact of the “Saskatchewan-connectedness” index will be closely monitored by the CoM through a program evaluation framework to ensure it is having its intended effects in the short and long-term. Other jurisdictions with similar geography, social mission and physician human resource challenges may consider using local data to drive decisions that might include a similar targeted strategy.

### Strengths and limitations

The strengths of this study are its large sample size and the determination of the practice location of almost all graduates. However, our cross-sectional dataset may not be an accurate indicator of where U of S graduates will practice in the future. Our analysis was limited by the use of historical data as some definitions changed over time, not all data were collected for all admission years, and not all variables of interest were collected. Lastly, some demographic variables were related to each other, which can confound the results. For example, we could not examine the association of residing in SK at the time of application with SK-based based practice due to its redundancy with attending high school and university in SK.

## Conclusion

This study identified pre-admission factors that are predictive of future SK- or rural-based practice in a large contemporary cohort of U of S CoM graduates. These results reinforce the findings of other studies and provide quantitative guidance on the relative association of several factors with future practice location. These findings will guide future admissions practices at the CoM with the goal of increasing the retention of matriculants to serve the entire province of Saskatchewan.

**Conflicts of Interest:** The authors of this paper have no conflicts of interest to declare.

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## Appendices

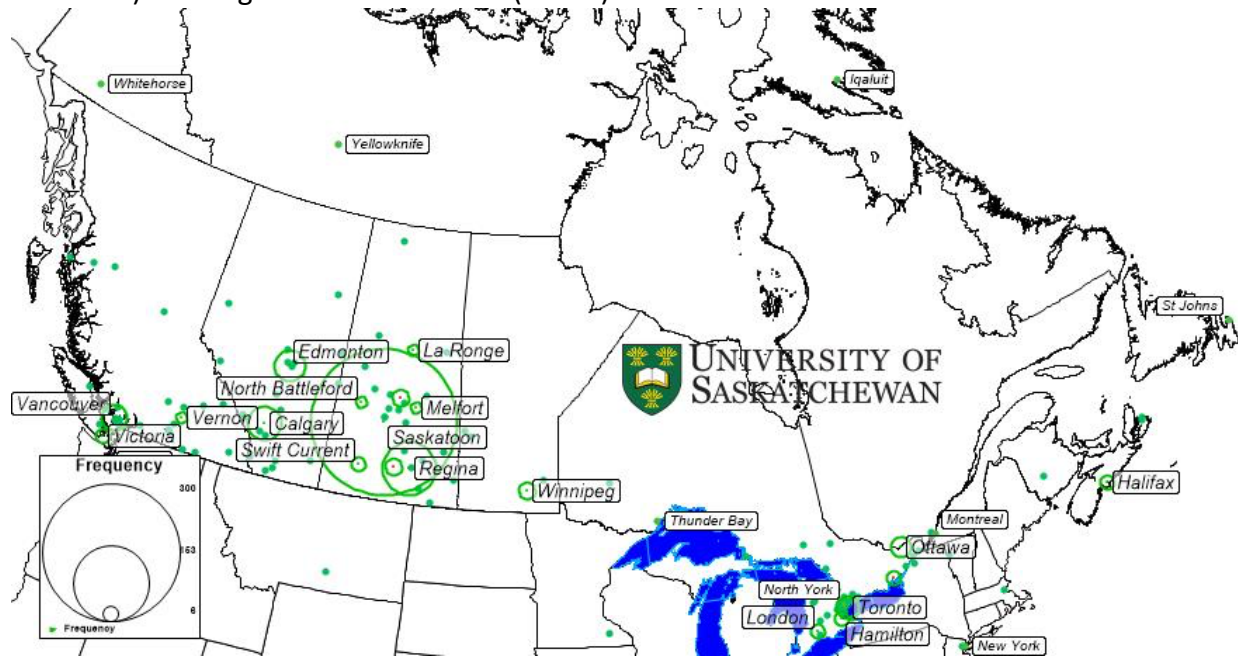
Appendix A: Demographic characteristics of the Saskatchewan graduates included in the study Table, N(%)

Characteristic	Total N (%)
<b>Gender</b>	
Female	521 (52.1)
Male	479 (47.9)
<b>Age at Admission</b>	
<21	140 (14.0)
21	236 (23.6)
22-23	353 (35.3)
24+	271 (27.1)
<b>High School Province</b>	
SK	835 (83.5)
Non-SK	165 (16.5)
<b>High School SK Population</b>	
Large Urban	624 (62.8)
Medium	106 (10.7)
Small	192 (19.3)
Rural	72 (7.2)
<b>Previous University Attended</b>	
SK	846 (84.6)
Non-SK	154 (15.4)
<b>Location Province at Application</b>	
SK	872 (87.2)
Non-SK	128 (12.8)
<b>Location Population at Application</b>	
Large Urban	909 (90.9)
Medium	31 (3.1)
Small	43 (4.3)
Rural	17 (1.7)
<b>Current Practice Province</b>	
SK	536 (53.6)
Non-SK	464 (46.4)
<b>Current Practice Community</b>	
Large Urban	785 (78.5)
Medium	96 (9.6)
Small	117 (11.7)
Rural	2 (0.2)
<i>N, Number of Participants; SK, Saskatchewan;</i>	

### Definitions of the characteristics of admitted students from the 2000-2013 cohorts of College of Medicine graduates

Characteristic	Definition
<b>Gender</b>	The gender (male or female) reported on the graduate's application
<b>Age at Admission</b>	The age in years of graduate reported at the time of admission
<b>High School</b>	The location where the graduate completed high school
<b>Previous University</b>	If the graduate ever attended a SK based university prior to application to medical school
<b>Location at Admission</b>	The location where the graduate reported they were located at time of admission. Province and population status
<b>Current Practice Location</b>	Where the graduate is currently practicing medicine. Province and population status
<b>Population Status</b>	Large Urban (>100,000), Medium (30,000-99,999), Small (1,000-29,999), and Rural (<1,000). Used to determine population status of high school, location at admission, and current practice location.

Appendix B: Current practice location of University of Saskatchewan College of Medicine Graduates (admitted years 2000-2013) Practicing in Canada in June 2020 ( $n = 978$ )





## Appendix C: Pre-admission characteristics of graduates with Saskatchewan- and non-Saskatchewan-based practices, N(%)

Characteristic	SK Practice N(%)	Non-SK Practice N(%)	X <sup>2</sup>	p-value
<b>Gender</b>			1.5	0.2
Male	289 (53.9)	232 (50.0)		
Female	247 (46.1)	232 (50.0)		
<b>Age at Admission</b>			2.1	0.5
<21	68 (12.7)	72 (15.5)		
21	126 (23.5)	110 (23.7)		
22-23	197 (36.8)	156 (33.6)		
24+	145 (27.1)	126 (27.2)		
<b>Province of High School Graduation</b>			34.6	<0.001
SK	482 (89.9)	353 (76.1)		
Non-SK	54 (10.1)	111 (23.9)		
<b>Population of SK High School Graduation</b>			14.5	0.002
Large Urban	316 (59.1)	308 (67.1)		
Medium	51 (9.5)	55 (12.0)		
Small	120 (22.4)	72 (15.7)		
Rural	48 (9.0)	24 (5.2)		
<b>Previous University Attended</b>			31.5	<0.001
SK	500 (93.3)	379 (81.7)		
Non-SK	36 (6.7)	85 (18.3)		
<b>Location Province at Application</b>			27.5	<0.001
SK	495 (92.4)	377 (81.3)		
Non-SK	41 (7.6)	87 (18.8)		
<b>Location Population at Application</b>			3.6	0.3
Large Urban	490 (91.4)	419 (90.3)		
Medium	12 (2.2)	19 (4.1)		
Small	23 (4.3)	20 (4.3)		
Rural	11 (2.1)	6 (1.3)		

*N, Number of Participants; SK, Saskatchewan;*

## Appendix D: Characteristics of graduates practicing in various sizes of population center, N(%)

Characteristic	Large Urban Practice N(%)	Medium Practice N(%)	Small Practice N(%)	Rural Practice N(%)	X <sup>2</sup>	p-value
<b>Gender</b>					1.2	0.7
Male	376 (47.9)	50 (52.1)	52 (44.4)	1 (50)		
Female	409 (52.1)	46 (47.9)	65 (55.6)	1 (50)		
<b>Age at Admission</b>					12.6	0.2
<21	115 (14.6)	12 (12.5)	13 (11.1)	0		
21	199 (25.4)	13 (13.5)	24 (20.5)	0		
22-23	272 (34.6)	38 (39.6)	42 (32.5)	1 (50.0)		
24+	199 (25.4)	33 (34.4)	38 (32.5)	1 (50.0)		
<b>Province of High School Graduation</b>					11.3	0.01
SK	671 (85.5)	72 (75)	90 (76.9)	2 (100)		
Non-SK	114 (14.5)	24 (25)	27 (23.1)	0 (0)		
<b>Population of SK High School Graduation</b>					78.4	<0.001
Large Urban	524 (63)	51 (53.1)	49 (41.9)	0 (0)		
Medium	75 (9.6)	21 (21.9)	10 (8.5)	0 (0)		
Small	135 (17.3)	17 (17.7)	40 (34.2)	0 (0)		
Rural	45 (5.8)	7 (7.3)	18 (15.4)	2 (100)		
<b>Previous University Attended</b>					3.3	0.3
SK	697 (88.8)	82 (85.4)	98 (83.8)	2 (100)		
Non-SK	88 (11.2)	14 (14.6)	19 (16.2)	0 (0)		
<b>Location Province at Application</b>					2.7	0.4
SK	691 (88)	81 (84.4)	98 (83.8)	2 (100)		
Non-SK	94 (12)	15 (15.6)	19 (16.2)	0 (0)		
<b>Location Population at Application</b>					62.1	<0.001
Large Urban	730 (93)	80 (83.3)	98 (83.8)	1 (50)		
Medium	17 (2.2)	10 (10.4)	4 (3.4)	0 (0)		
Small	27 (3.4)	6 (6.3)	10 (8.5)	0 (0)		
Rural	11 (1.4)	0 (0)	5 (4.3)	1 (50)		

*N, Number of Participants; SK, Saskatchewan;*