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Development and validation of a social vulnerabilities survey for medical inpatients

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Development and validation of a social vulnerabilities survey for medical inpatients

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ABSTRACT

Objectives: Our objective was to validate a Social Vulnerabilities Survey that was developed to identify patient barriers in the following domains: 1) salience or priority of health; 2) social support; 3) transportation; and 4) finances.

Design: Cross-sectional psychometric study.

Questions for one domain (health salience) were developed *de novo* while questions for the other domains were derived from national surveys and/or previously validated questionnaires. We tested construct (i.e. convergent and discriminative) validity for these new questions through hypothesis testing of correlations between question responses and patient characteristics.

Exploratory and confirmatory factor analyses were conducted to determine structural validity of the survey as a whole.

Setting: Patients admitted to the inpatient internal medicine service at a tertiary care hospital in Calgary, Canada

Participants: A total of 406 patients were included in the study.

Results: The mean age of respondents was 55.5 (SD 18.6) years, with the majority being male (55.4%). Hypothesis testing of the health salience questions revealed that the majority of observed correlations were exactly as predicted. Exploratory factor analysis of the global survey revealed the presence of five factors (eigenvalue > 1): social support, health salience, drug insurance, transportation barriers, and drug costs. Four questions had factor loadings <0.5 and were removed. The five-factorial structure for the final 29-question survey was found to be valid, with a comparative fit index of 0.978, and root mean square error of approximation of 0.036 (90% CI 0.025, 0.045).

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3 **Conclusions:** The Social Vulnerabilities Survey has face, construct and structural validity. It can
4
5 be used to measure modifiable social vulnerabilities, such that their effects on health outcomes
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7 can be explored and understood.
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Strengths and limitations of the study

- The Social Vulnerabilities Survey is a newly developed questionnaire that meets an important gap, being one of few tools to identify modifiable social vulnerabilities that may affect the ability of patients to maintain their health
- The domains covered by the survey are those identified by patients as barriers after hospital discharge in prior qualitative studies
- This study uses multiple methods to comprehensively assess validity of the survey – including face, construct (convergent, discriminant, and discriminative), and structural validity
- Validity was assessed only in the inpatient setting at a single large tertiary care hospital, which may limit generalizability

INTRODUCTION

Hospital discharge is a time of transition from hospital to home, where responsibility for health maintenance shifts from inpatient care providers to patients. This transition period signifies a particularly vulnerable time for adverse medical events, with up to 35% of patient being re-admitted within 3 months.^{1 2} Hospital readmissions may be attributable to patient, provider, or organizational factors.³ Of these, patient characteristics appear to account for most of the variation in readmission rates across institutions,⁴ and patient-level interventions are therefore the focus of multi-disciplinary efforts to improve post-discharge outcomes.⁵

Self-management of chronic conditions after hospital discharge requires adequate knowledge, planning, and ability on the patient's part,⁶ and can therefore be affected by the social determinants of health and more downstream social vulnerabilities (e.g. transportation, financial, and social support barriers).⁷⁻¹⁰ Despite their importance, social vulnerabilities are rarely studied, hampering the development of discriminative models to predict hospital readmission and effective interventions to mitigate them.^{5 11} The main barriers to measuring social vulnerabilities in hospitalized patients are that: 1) they are not routinely collected or available in registry or administrative data, and 2) there is a lack of widely accepted, validated questionnaires. Though Greysen et al. created a 22-item survey to measure patient understanding,⁷ patient engagement with care, and barriers to self-care in the post-discharge period, this survey is not specific to patient-level social vulnerabilities (i.e. it includes provider and organization factors), and does not sufficiently detail tangible barriers that can be targeted by interventions. For example, patients are asked whether they had difficulty following a recommended diet, or difficulty taking

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3 medications, but there are no other questions in the survey that delve into *why* patients face such
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5 difficulties.
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10 A validated survey that interrogates the social barriers that patients face in managing their health
11 is essential to identify risk factors for hospital readmissions, in developing effective interventions
12 that directly address these risk factors, and in creating predictive models so that high risk
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14 populations can be prioritized and targeted by effective interventions. In this study, we describe
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16 the development and validation of the Social Vulnerabilities Survey (SVS) in a cohort of medical
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18 inpatients in Calgary, Canada.
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27 **METHODS**

28 **Development of SVS**

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30 The SVS was developed to explore the role of social vulnerabilities in a patient's ability to
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32 access care and self-manage chronic conditions. It covers four domains of social vulnerabilities,
33
34 which were selected based on prior qualitative studies of post-discharge barriers in patients with
35
36 low socioeconomic status.^{9 10} These domains were: transportation barriers, financial barriers,
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38 poor social support, and low salience of health due to competing priorities.^{9 10} Three of these four
39
40 domains have been previously explored in national surveys or questionnaires validated in
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42 international populations.¹²⁻¹⁴ Questions in the SVS within these three domains were therefore
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44 obtained from these prior sources, where available:
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- 50 **1. Financial Constraints:** Drug cost and non-adherence questions were adapted from the
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52 Barriers to Care for People with Chronic Conditions (BCPCHC) Survey, administered by
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54 Statistics Canada to Western Canadian respondents of the 2011 CCHS with one or more
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3 chronic conditions.¹² Adaptations included the addition of questions asking about total
4 medication costs for patients themselves as well as for their households, and whether the
5 patient declined filling a prescription due to cost-related concerns in the past year.
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10 **2. Transportation:** Questions regarding the modes of transportation used and frequency of
11 driving were taken directly from the transportation section of the national 2008-2009
12 CCHS-Healthy Aging Questionnaire.¹³
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14 **3. Social Support:** Questions were taken directly from the modified Medical Outcomes
15 Study Social Support Survey,¹⁴ assessing the domains of emotional and instrumental
16 social support.
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25 The fourth domain (health salience in the context of competing priorities) has not previously
26 been studied, with no prior questions or questionnaire designed to explore this concept. Seven
27 questions were created for this domain. The entire SVS consisted of 33 questions covering the
28 four aforementioned social vulnerabilities (Appendix 1). We assessed acceptability, feasibility,
29 face validity and structural validity of the SVS as a whole.
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38 Because the objective of the SVS is to identify modifiable and diverse social vulnerabilities in
39 medical inpatients, a single “SVS score” would not be clinically meaningful. Furthermore, we
40 did not pursue domain-specific scoring algorithms for a number of reasons: 1) Questions from
41 three of the four domains were derived from existing questionnaires, of which one (social
42 support) already had a scoring algorithm that had been developed and validated;¹⁴ 2) Questions
43 within the domains consisted of different types of responses (binary, categorical, and open-
44 ended) that are not only difficult to synthesize into a single score, but that also make the meaning
45 of a domain-specific score unclear; 3) For prediction of outcomes, there is evidence to suggest
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3 that the use of individual facets (or variables) within a domain may be superior to the use of
4 scores because different facets may have different associations with outcomes.¹⁵
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10 **Patient and Public Involvement**

11 While patients took part as participants of the study, they were not involved in the design,
12
13 conduct, or reporting of the study.
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16 **Study population**

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20 Study participants were patients admitted to the internal medical service at the Foothills Medical
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22 Centre in Calgary, Alberta. Patients were recruited from December 2014 to October 2015 by the
23
24 research team. Inclusion criteria were that patients must be residents of Alberta and that the
25
26 discharge destination was home or an independent living facility. Patients discharged to non-
27
28 independent facilities were excluded, as direct patient care is provided in these settings, making
29
30 social vulnerabilities and the need for self-management less relevant.
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38 **Feasibility**

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40 Feasibility of the SVS was assessed for the first 107 patients, based on the time to completion
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42 and the proportion of incomplete surveys. These patients were additionally asked to comment on
43
44 the SVS' acceptability, clarity, and comprehensiveness. Feedback about the content, response
45
46 choices, and wording of the questions was specifically elicited.
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52 **Data Analysis**

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3 Descriptive statistics for sociodemographic and clinical characteristics of the sample population
4 were conducted. For categorical variables, we reported frequencies and proportions. Means and
5
6 standard deviations were calculated for continuous variables. Because questions were developed
7
8 entirely *de novo* for only one (health salience) of the four domains of the SVS, descriptive
9
10 statistics of response characteristics and hypothesis and known-groups testing (for construct
11
12 validity – see below) were performed only for this domain.
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19 **Construct validity**

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21 Construct validity was assessed through hypothesis testing. First, the research team formulated *a*
22
23 *priori* hypotheses about the expected correlations between the health salience questions and
24
25 patient sociodemographic characteristics, self-rated health, subjective social status,^{16 17} and
26
27 perceived stress, based on literature. Similar and overlapping constructs were hypothesized to be
28
29 positively correlated (convergent validity).¹⁸ All hypotheses included the direction and strength
30
31 of correlations: small ($0.1 \leq r < 0.3$ or $-0.3 \leq r < -0.1$), moderate ($0.3 \leq r < 0.5$ or $-0.5 \leq r < -0.3$),
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33 or large (≥ 0.5 or ≤ -0.5).¹⁹ Constructs that had no logical overlap were hypothesized to have no
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35 correlation, $r < 0.1$ (discriminant validity).^{18 19} Observed correlations from the data were compared
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37 with the hypothesized correlations.
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45 Hypotheses were also formulated about differences in responses to health salience questions
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47 across known groups, known as discriminative validity.¹⁸ The patient cohort was divided into
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49 known groups based on income, access to permanent housing, employment status, and number
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51 and type of comorbidities. Hypotheses were tested by comparing distribution of responses to the
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3 health salience questions across these known groups, through chi-square testing. P-values <0.05
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5 were considered to be statistically significant.
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10 ***Exploratory and Confirmatory factor analysis***

11 Structural validity of the entire SVS was determined through item factor analysis.¹⁸ Exploratory
12 factor analysis based orthogonal factor rotation using the varimax method was first conducted, as
13
14 the factor structure and the number of dimensions explored in the SVS were unclear (because
15
16 questions were compiled from different sources, and in some cases, created *de novo*). Questions
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18 with a non-response rate of >20% and questions eliciting nominal data were excluded from the
19
20 analysis. Observations with missing responses for binary variables were dropped. Missing
21
22 responses for ordinal and continuous variables were imputed with the median. The number of
23
24 factors ultimately retained were based on the following: eigenvalues >1.0, examination of the
25
26 scree plot, and the point at which adding more factors minimally changes the cumulative
27
28 explained variance. A minimum loading of 0.5 was determined to be the threshold at which a
29
30 variable was retained within a factor. Internal consistency, or the extent to which items within a
31
32 factor represented the same construct, was evaluated using Cronbach's alpha for each factor.¹⁸
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34 Confirmatory factor analysis was conducted to determine the fit of the hypothesized model
35
36 structure that was developed through exploratory factor analysis. Fit indices were calculated;
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38 comparative fit index (CFI) of 0.95 or higher, and a root mean square error of approximation
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40 (RMSEA) of 0.08 or lower, represented a good fit.²⁰
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51 **RESULTS**

52 **Patient characteristics**

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3 A total of 470 patients were recruited into the study. Of these, 64 were excluded (16 were not
4 internal medicine patients, 19 were not discharged home or to an independent living facility, 2
5 died in hospital, 14 withdrew consent, 13 were not residents of Alberta). A total of 406 patients
6 were included in the analysis. The mean age was 55.5 (SD 18.6) years (Table 1). The majority of
7 the sample was male (55.4%), Caucasian (68.0%), born in Canada (72.4%), and reported English
8 as their first language (85.2%). Approximately 30.5% of the sample were employed, while 9.1%
9 were unemployed and 38.9% were retired. Only 11.1% of the sample had no comorbidities,
10 while 21.1%, 27.3%, and 20.6% had one, two, and three comorbidities respectively.
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24 **Questionnaire characteristics**

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26 The SVS comprised of 33 questions (Appendix 1) in the following domains: transportation (9
27 questions), health salience (7 questions), social support (9 questions), and finances (8 question).
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30 To provide context to health care use and social vulnerabilities, we administered a separate
31 background information survey (Appendix 2) comprising of 37 questions, asking about
32 sociodemographic characteristics (13 questions), baseline function based on Older Americans
33 Resources and Services questionnaire (6 questions),²¹ Perceived Stress Scale (4 questions),²²
34 health beliefs (7 questions),²³ self-rated health (1 question),²⁴ and baseline health care use (6
35 questions).
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47 Feedback from the first 107 patients resulted in modifications to the wording of eight questions
48 on the SVS for clarity. The mean time for completion of the SVS and background information
49 survey together was 17min 25sec (SD 5:48). Nearly all found the length to be acceptable; two
50 (1.9%) of the 107 participants noted that a shortened survey would be preferable, though neither
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3 had suggestions about which questions in the SVS could be removed. No patients terminated the
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5 survey prematurely.
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10 **Response characteristics and construct validity of health salience questions**

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12 Distribution of responses for each of the seven health salience questions of the SVS, are
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14 presented in Table 2. Approximately 12-15% of participants described skipping tests,
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16 medications, or medical appointments due to other life circumstances taking priority; an even
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18 higher proportion (30.7%) described difficulty following lifestyle recommendations for this same
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20 reason. Despite this, 77.9% of patients indicated that their health was “very important”, and
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22 60.2% believed that it would be “very easy” or “easy” to find the time and energy to keep
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24 healthy after hospital discharge. When asked about competing priorities that would make it
25
26 difficult to focus on health, the most commonly reported was finances.
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33 We determined convergent and discriminant validity of the health salience questions through
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35 hypothesis testing of correlations. We developed a total of 99 hypotheses (Appendix 3), 35 of
36
37 which predicted no correlation between responses to certain health salience questions and
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39 background socio-demographic characteristics (discriminant validity), and 64 of which predicted
40
41 the presence of weak, moderate, or strong correlations (convergent validity). These hypotheses
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43 were informed by literature suggesting the presence of associations between adherence to
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45 lifestyle changes, medications, and/or medical appointment-keeping and stress,²⁵ self-rated
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47 health,²⁶ subjective social status,²⁷ age,²⁸⁻³¹ income,³² and employment status.³³⁻³⁵ Of these 64
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49 hypotheses, 39 (61%) observed correlations were as predicted in both strength and direction,
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3 with another 16 (25%) in the same direction (but not the same strength) as predicted (Tables 3
4 and 4).
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10 For discriminant validity, one of the 35 hypotheses could not be tested due to the number of
11 missing responses. We demonstrated no correlation, as predicted, between health salience
12 questions and 18 (53%) sociodemographic characteristics (Tables 3 and 4). The remaining 16
13 hypotheses demonstrated primarily small correlations, only two of which met statistical
14 significance.
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24 Discriminative validity was determined through known groups testing. As hypothesized, we
25 observed the following:
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- 28 • Patients with cardiovascular disease or cardiovascular risk factors were more likely to
29 have had lifestyle changes recommended than those without these conditions (67.5% vs
30 41.2%, $p<0.01$)
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- 33 • Patients with three or more comorbidities were more likely to have had laboratory or
34 imaging tests ordered than those with fewer than three comorbidities (91.0% vs 83.4%,
35 $p=0.02$)
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- 38 • Patients with low income were more likely to state that money-related concerns made it
39 difficult to focus on health (47.2% vs 22.1%, $p<0.01$)
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- 42 • Patients not currently working were more likely than those who were working to state
43 that both money-related and job-security concerns made it difficult to focus on health
44 (50.0% vs 26.4%, $p<0.01$; and 23.9% vs 9.6%, $p<0.01$)
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- Patients without permanent housing were more likely to state that their housing situation made it difficult to focus on health (58.8 vs 9.3%, $p<0.01$)
- Students were more likely to state that school-related concerns made it difficult to focus on health (50.0% vs 1.3%, $p<0.01$)
- Stay at home parents were more likely to state that domestic responsibilities made it difficult to focus on health (47.2% vs 22.1%, $p<0.01$)

Factor analysis of the Social Vulnerabilities Survey

Exploratory factor analysis was conducted for 27 of the 33 questions in the SVS due to exclusions from high non-response rates ($n=4$ questions) and data being nominal in nature ($n=2$ questions). Exploratory factor analysis demonstrated that five factors had eigenvalues over 1 (see Figure 1 - scree plot), and that these five factors accounted for 61.4% of the total variance. The five factors were: 1) social support; 2) health salience; 3) drug insurance; 4) transportation barriers; and 5) drug costs (see Appendix 4, with associated variables and their factor loadings). All questions loaded only to one factor. Four questions did not load to any factor; these were therefore removed from the survey and excluded from confirmatory factor analysis. Internal consistency, as measured by Cronbach's alpha, was reasonable, at 0.94 for factor 1 (social support), 0.78 for factor 2 (health salience), 0.91 for factor 3 (drug insurance), 0.58 for factor 4 (transportation), and 0.74 for factor 5 (drug costs). Within each factor, all variables were correlated with each other (correlation coefficients ≥ 0.2), but no correlations were >0.9 . That is, each factor comprised of correlated but likely not redundant variables.¹⁸

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3 We examined the factorial validity of this five-factor structure using confirmatory factor analysis
4 which confirmed that this structure was the best fit for the data (RMSEA=0.036, 90%CI= [0.025,
5 0.045], and CFI=0.978). See Appendix 5 for the factorial structure. Model fit, as assessed using
6 root mean square error of approximation represented good fit.
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14 **DISCUSSION**

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16 The SVS is a new tool that assesses modifiable social vulnerabilities that may impact the ability
17 of patients to maintain their health. While questions from three domains (transportation,
18 financial, and social support barriers) were adapted from prior surveys and instruments, seven
19 questions were created for the domain of health salience in the presence of competing priorities.
20 These questions were found to have high convergent and discriminant validity, with the SVS as a
21 whole demonstrating high structural and factorial validity.
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33 The importance of measuring social vulnerabilities cannot be overstated. In a population, only
34 10% - 20% of preventable mortality can be attributed to medical care; in contrast, social factors
35 are overwhelmingly influential in affecting health behaviours and outcomes.³³ If any
36 improvement to population health is to be achieved, then a better understanding of social
37 vulnerabilities is necessary. The SVS, as a validated instrument, serves to facilitate the collection
38 of these pertinent data. Other potential uses of the SVS are to identify and characterize patient
39 needs, so that they can be addressed by policies, programs, and interventions. For example, if
40 transportation is identified by the SVS to be a barrier linked to adverse outcomes, then these data
41 can be used to forge partnerships with transportation providers (e.g. to negotiate discounted rates
42 for public transportation and taxis).³⁶ If prescription drug costs are found to be prohibitive to
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3 good health and well-being, then improved drug coverage will need to be prioritized at a
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5 governmental level. Barriers cannot be addressed if there is no accurate way to measure them.
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7 The SVS is therefore a validated instrument that has the potential to inform and empower the
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9 delivery of health care and healthcare resources to the population.
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15 Despite their importance, there are few existing validated measures for social vulnerabilities and
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17 the social determinants of health. The Social Needs Screening Tool from the American Academy
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19 of Family Physicians, and the Accountable Health Communities Screening Tool from the
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21 Centers for Medicaid and Medicare Services both ask about housing stability, food insecurity,
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23 utilities, transportation, and personal safety, with additional questions included about family
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25 support/assistance, child care, employment, education, and financial strain.^{37 38} A similar tool,
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27 Protocol for Responding to and Assessing Patient Assets, Risks, and Experiences (PRAPARE)
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29 instrument has been implemented in health centres across the United States, and includes
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31 questions about personal characteristics, family and home (e.g. housing status), money and
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33 resources (e.g. education, employment, food/utilities/clothing/phone security), and social and
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35 emotional needs.³⁶ These tools are broad in scope as they are intended to “identify any unmet
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37 need likely to have a negative impact on health”.³⁷ Criticisms of this breadth include the resultant
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39 difficulty in prioritizing unmet needs and, more fundamentally, whether identified needs (that
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41 span from inadequate housing/food/supports, to transportation needs, to social integration, to
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43 stress) are truly actionable by the healthcare provider or healthcare system.³³ Furthermore, there
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45 are no published validation studies of any of the previously mentioned questionnaires. Our study
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47 addresses these gaps by validating a new tool that focuses on social vulnerabilities that are
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49 prevalent,³⁶ evidence-based,^{9 10} and actionable.
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6 The main limitation to our study is that we only conducted validation of the SVS in an inpatient
7 cohort. Given the prevalence of social vulnerabilities, and that the social determinants of health
8 influence health and well-being in not just the inpatient population but rather than general
9 population as a whole, the SVS is likely to be applicable and relevant in any patient population.
10 However, we recognize the limitations of extrapolating our data outside of the inpatient cohort.
11 Another limitation was that test-retest reliability was not assessed due to study design and
12 feasibility considerations. Lastly, the social vulnerabilities covered in the SVS were derived from
13 prior qualitative studies describing social barriers post-hospital discharge. Other social
14 vulnerabilities influencing health may exist that are not covered by the SVS. However, in our
15 feasibility testing, patients did not identify other social vulnerabilities when explicitly asked.
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30 **CONCLUSION**

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32 Despite the recognition that social determinants of health and their downstream social
33 vulnerabilities are important correlates of patient well-being and ability to self-manage
34 conditions, there has thus far not been a questionnaire that delves into these social barriers. The
35 SVS is a reliable and valid instrument that identifies modifiable social barriers in medical
36 inpatients. An understanding of these social vulnerabilities is essential in developing
37 interventions, health, and social policy that mitigates these vulnerabilities to improve health
38 outcomes.
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DECLARATIONS

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Authors' contributions: Each of the six authors meets the authorship requirements as established by the International Committee of Medical Journal Editors in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals. KT, MS, and WG conceived of the study and were involved in study design. LT conducted data collection. KT, TS, and OL were involved in statistical analyses. All authors were involved in data interpretation. KT drafted the manuscript and all authors critically revised the manuscript. All authors have read and approved the manuscript.

REFERENCES

1. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *New England Journal of Medicine* 2009;360(14):1418-28. doi: 10.1056/NEJMsa0803563 [published Online First: 2009/04/03]
2. Gilmour J, Southern D, WA G. Readmission Rates and Determinants in a Higher-Risk Inpatient GIM Population. *Canadian Journal of General Internal Medicine* 2013;18(2):5.
3. Vest JR, Gamm LD, Oxford BA, et al. Determinants of preventable readmissions in the United States: a systematic review. *Implementation Science* 2010;5:88. doi: 10.1186/1748-5908-5-88 [published Online First: 2010/11/19]
4. Singh S, Lin YL, Kuo YF, et al. Variation in the risk of readmission among hospitals: the relative contribution of patient, hospital and inpatient provider characteristics. *J Gen Intern Med* 2014;29(4):572-8. doi: 10.1007/s11606-013-2723-7 [published Online First: 2013/12/07]
5. Hansen LO, Young RS, Hinami K, et al. Interventions to reduce 30-day rehospitalization: a systematic review. *Annals of internal medicine* 2011;155(8):520-28.
6. Horwitz LI. Self-care after hospital discharge: knowledge is not enough. *BMJ Quality and Safety* 2016;26(1) doi: 10.1136/bmjqs-2015-005187
7. Greysen SR, Harrison JD, Kripalani S, et al. Understanding patient-centred readmission factors: a multi-site, mixed-methods study. *BMJ Quality and Safety* 2017;26(1):33-41. doi: 10.1136/bmjqs-2015-004570 [published Online First: 2016/01/16]
8. Greysen SR, Hoi-Cheung D, Garcia V, et al. “Missing Pieces”—Functional, Social, and Environmental Barriers to Recovery for Vulnerable Older Adults Transitioning from Hospital to Home. *Journal of the American Geriatrics Society* 2014;62(8):1556-61. doi: 10.1111/jgs.12928
9. Kangovi S, Barg FK, Carter T, et al. Challenges faced by patients with low socioeconomic status during the post-hospital transition. *J Gen Intern Med* 2014;29(2):283-9. doi: 10.1007/s11606-013-2571-5 [published Online First: 2013/08/07]
10. Strunin L, Stone M, Jack B. Understanding rehospitalization risk: can hospital discharge be modified to reduce recurrent hospitalization? *J Hosp Med* 2007;2(5):297-304. doi: 10.1002/jhm.206 [published Online First: 2007/10/16]
11. Kansagara D, Englander H, Salanitro A, et al. Risk prediction models for hospital readmission: a systematic review. *JAMA* 2011;306(15):1688-98. doi: 10.1001/jama.2011.1515 [published Online First: 2011/10/20]
12. Statistics Canada. Barriers to Care for People with Chronic Health Conditions (BCPCHC) 2012 [Available from: <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5189&lang=en&db=imdb&adm=8&dis=2> accessed January 25 2015.
13. Statistics Canada. Canadian Community Health Survey (CCHS): Healthy Aging 2008-2009 [Available from: http://www23.statcan.gc.ca/imdb/pIX.pl?Function=showStaticArchiveHTML&a=1&fl=http://www23.statcan.gc.ca/imdb-bmdi/instrument/5146_Q1_V2-eng.htm&Item_Id=53430 accessed January 25 2015.
14. Moser A, Stuck AE, Silliman RA, et al. The eight-item modified Medical Outcomes Study Social Support Survey: psychometric evaluation showed excellent performance. *Journal*

- 1
2
3 *of clinical epidemiology* 2012;65(10):1107-16. doi: 10.1016/j.jclinepi.2012.04.007
4 [published Online First: 2012/07/24]
5
6 15. Strauss ME, Smith GT. Construct validity: advances in theory and methodology. *Annu Rev*
7 *Clin Psychol* 2009;5:1-25. doi: 10.1146/annurev.clinpsy.032408.153639
8
9 16. Adler NE, Epel ES, Castellazzo G, et al. Relationship of subjective and objective social
10 status with psychological and physiological functioning: preliminary data in healthy
11 white women. *Health psychology* 2000;19(6):586-92. [published Online First:
12 2000/12/29]
13
14 17. University of California San Francisco. The MacArthur Scale of Subjective Social Status
15 2008 [Available from: <https://macses.ucsf.edu/research/psychosocial/subjective.php>
16 accessed April 5 2019].
17
18 18. De Vet HC, Terwee CB, Mokkink LB, et al. Measurement in medicine: a practical guide:
19 Cambridge University Press 2011.
20
21 19. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, New
22 Jersey: Lawrence Erlbaum Associates 1988.
23
24 20. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis:
25 Conventional criteria versus new alternatives. *Structural Equation Modeling: A*
26 *Multidisciplinary Journal* 1999;6(1):1-55. doi: 10.1080/10705519909540118
27
28 21. Fillenbaum GG, Smyer MA. The development, validity, and reliability of the OARS
29 multidimensional functional assessment questionnaire. *J Gerontol* 1981;36(4):428-34.
30 [published Online First: 1981/07/01]
31
32 22. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of*
33 *health and social behavior* 1983:385-96.
34
35 23. Jette AM, Cummings KM, Brock BM, et al. The structure and reliability of health belief
36 indices. *Health services research* 1981;16(1):81-98. [published Online First: 1981/01/01]
37
38 24. DeSalvo KB, Bloser N, Reynolds K, et al. Mortality Prediction with a Single General Self-
39 Rated Health Question: A Meta-Analysis. *J Gen Intern Med* 2006;21(3):267-75. doi:
40 10.1111/j.1525-1497.2005.00291.x
41
42 25. Ng DM, Jeffery RW. Relationships Between Perceived Stress and Health Behaviors in a
43 Sample of Working Adults. *Health Psychology* 2003;22(6):638-42. doi: 10.1037/0278-
44 6133.22.6.638
45
46 26. Idler EL, Benyamini Y. Self-Rated Health and Mortality: A Review of Twenty-Seven
47 Community Studies. *Journal of Health and Social Behavior* 1997;38(1):21-37. doi:
48 10.2307/2955359
49
50 27. D'Hooge L, Achterberg P, Reeskens T. Mind over matter. The impact of subjective social
51 status on health outcomes and health behaviors. *PLoS ONE* 2018;13(9):e0202489. doi:
52 10.1371/journal.pone.0202489
53
54 28. Berrigan D, Dodd K, Troiano RP, et al. Patterns of health behavior in U.S. adults. *Preventive*
55 *Medicine* 2003;36(5):615-23. doi: 10.1016/S0091-7435(02)00067-1
56
57 29. Rolnick SJ, Pawloski PA, Hedblom BD, et al. Patient characteristics associated with
58 medication adherence. *Clinical medicine & research* 2013;11(2):54-65. doi:
59 10.3121/cm.2013.1113
60
61 30. Lawlor Debbie A, Allgar Victoria L, Hussain-Gambles M, et al. Reasons for and
62 consequences of missed appointments in general practice in the UK: questionnaire survey
63 and prospective review of medical records. *BMC Family Practice* 2005;6(1):47. doi:
64 10.1186/1471-2296-6-47
65

31. Ellis D, McConnachie A, Wilson P, et al. Morbidity, mortality and missed appointments in healthcare: a national retrospective data linkage study. *BMC Medicine* 2019;17(1) doi: 10.1186/s12916-018-1234-0
32. Campbell DJT, Ronksley PE, Manns BJ, et al. The association of income with health behavior change and disease monitoring among patients with chronic disease. *PLoS ONE* 2014;9(4) doi: 10.1371/journal.pone.0094007
33. Adler KG. Screening for Social Determinants of Health: An Opportunity or Unreasonable Burden? *Fam Pract Manag* 2018;25(3):3. [published Online First: 2018/07/11]
34. Braveman P, Gottlieb L. The social determinants of health: it's time to consider the causes of the causes. *Public Health Rep* 2014;129 Suppl 2:19-31. [published Online First: 2014/01/05]
35. Dubinsky M. Predictors of appointment non-compliance in community mental health patients. *Community Ment Health J* 1986;22(2):142-46. doi: 10.1007/BF00754552
36. Weir RC, Proser M, Jester M, et al. Collecting Social Determinants of Health Data in the Clinical Setting: Findings from National PRAPARE Implementation. *Journal of health care for the poor and underserved* 2020;31(2):1018-35. doi: 10.1353/hpu.2020.0075
37. Billioux A, Verlander K, Anthony S, et al. Standardized Screening for Health-Related Social Needs in Clinical Settings: The Accountable Health Communities Screening Tool. NAM Perspectives. Washington, DC: National Academy of Medicine, 2017.
38. American Academy of Family Physicians. The EveryONE Project: Assessment and Action 2020 [Available from: <https://www.aafp.org/family-physician/patient-care/the-everyone-project/toolkit/assessment.html> accessed December 2 2020.

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Figure Legends

Figure 1- Scree plot of eigenvalues of the Social Vulnerabilities Survey

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Table 1: Sample characteristics

		Frequency (%) N=406
Age	Mean (SD)	55.5 (18.6)
Male		225 (55.4%)
First language English		346 (85.2%)
Born in Canada		293 (72.4%)
Ethnicity	Caucasian	274 (68.0%)
	Aboriginal	38 (9.4%)
	Chinese	22 (5.5%)
	South Asian	20 (5.0%)
	Other	49 (12.2%)
Marital Status	Married	182 (44.7%)
	Common-Law	37 (9.1%)
	Widowed	34 (8.4%)
	Divorced/Separated	52 (12.8%)
	Single	102 (25.1%)
Education	Less Than High School	80 (19.8 %)
	High School Graduate	98 (24.2%)
	Certificate or Diploma	37 (9.1%)
	Some postgraduate	108 (26.7%)
	Post-secondary graduate	82 (20.3%)
Employment	Currently Working	124 (30.5%)
	Unemployed	37 (9.1%)
	Temporary LOA	28 (6.9%)
	Permanently Unable to Work	29 (7.1%)
	Retired	158 (38.9%)
	Other	30 (7.4%)
Household Income	<\$15 000	44 (10.9%)
	\$15 000 - \$24 999	42 (10.4%)
	\$25 000 - \$49 999	57 (14.1%)
	\$50 000 - \$74 999	48 (11.9%)
	\$75 000 - \$99 999	31 (7.7%)
	\$100 000 - \$124 999	19 (4.7%)
	\$125 000 - \$149 999	7 (1.7%)
	\$150 000 - \$174 999	9 (2.2%)
	\$175 000 - \$199 999	6 (1.5%)
≥\$200 000	24 (6.0%)	
Do not know, Do not wish to answer	116 (28.8%)	
Number of Individuals dependent on this household Income	1	133 (33.0%)
	2	155 (38.5%)
	3	52 (12.9%)
	4	37 (9.2%)
	5 or greater	26 (6.5%)
Currently Homeless		17 (4.2%)
Societal SSS	Mean (SD)	5.7 (2.1%)
Community SSS	Mean (SD)	5.4 (2.4%)
Number of Elixhauser Comorbidities	0	43 (11.1%)
	1	82 (21.1%)
	2	106 (27.3%)
	3	80 (20.6%)
	4	41 (10.6%)
	5 or greater	36 (9.3%)

Abbreviations: LOA- leave of absence; SSS- subjective social status; SD- standard deviation

Table 2: Salience of health questions and response characteristics

Question	Response	n (%) ^a
Q1 In the past 1 year, have you had difficulty following suggestions from a health care provider to make lifestyle changes (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at that time?	Yes	122 (30.7)
	No	120 (30.2)
	N/A: No lifestyle changes have been recommended	155 (39.0)
Q2 In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?	Yes	63 (15.9)
	No	277 (69.9)
	N/A: No tests have been ordered	56 (14.4)
Q3 In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?	Yes	49 (12.4)
	No	326 (82.3)
	N/A: I am not on any medications	21 (5.3)
Q4 In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?	Yes	56 (14.1)
	No	326 (82.3)
	N/A: I have not had any appointments	14 (3.5)
Q5 In your current circumstance, how important is your health to you?	Not important at all	0 (0.0)
	Not very important	1 (0.3)
	Neutral	15 (3.8)
	Important	71 (18.1)
	Very important	306 (77.9)
Q6 How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?	Very hard	5 (1.3)
	Hard	67 (17.1)
	Neutral	84 (21.4)
	Easy	174 (44.4)
	Very easy	62 (15.8)
Q7 What areas in your life make it difficult to focus on your health? ^b	No area makes it difficult	162 (39.9)
	Worrying about money	126 (32.2)
	Worrying about basic needs (e.g. food)	38 (9.7)
	Housing situation is unstable	46 (11.8)
	Working about job security	51 (13.0)
	I have too many job responsibilities	39 (10.0)
	I have too many household responsibilities	28 (7.2)
	Worrying about school	10 (2.6)
	Relationship issues or conflict	48 (12.3)
	I am a caregiver for a friend/family member who is ill	25 (6.4)
Other	34 (8.7)	

^a Total number of respondents for each question: Q1 – 397; Q2 to Q4 – 396; Q5 – 393; Q6 – 392; Q7 – 391

^b Respondents may check up to three items

Abbreviations: N/A- not applicable; Q- question number

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Table 3: Correlation matrix of salience of health with self-reported and demographic variables

	Self-Rated Health	Perceived Stress Scale Score	Societal SSS	Community SSS	Sociodemographics				
					Age	Income	Unemployed / Unable to work	Stay at home parent/spouse	Has regular family doctor
Q1: Difficulty making lifestyle changes	-0.17	0.34	-0.19	-0.17	-0.27	-0.09	0.34	-0.06	-0.19
Q2: Difficulty getting investigations	-0.18	0.33	-0.14	-0.17	-0.30	-0.17	0.39	0.13	-0.22
Q3: Stopping medications	-0.12	0.37	-0.21	-0.16	-0.31	-0.28	0.49	-0.03	-0.27
Q4: Skipping appointments	-0.01	0.37	-0.23	-0.28	-0.41	-0.19	0.55	-0.08	-0.08
Q5: Importance of health	0.03	-0.17	0.11	0.12	0.08	0.09	-0.07	-0.05	0.30
Q6: Perceived difficulty maintaining health	-0.22	0.28	-0.18	-0.20	-0.16	-0.04	-0.08	0.04	-0.13
Q7: Worry about basic needs (housing, basic needs)	-0.31	0.39	-0.32	-0.33	-0.37	-0.62	0.45	0.15	-0.21
Q7: Worry about money	-0.001	0.44	-0.34	-0.40	-0.34	-0.41	0.36	0.07	-0.11
Q7: Worry about domestic responsibilities and caregiving	0.08	0.23	-0.01	0.04	-0.15	0.098	0.09	0.43	0.01
Q7: Worry about school	0.05	0.19	-0.12	0.01	-0.87	0.01	-0.23	0.17	.*
Q7: Number of areas of worry (1 vs 2+)	-0.08	0.49	-0.30	-0.29	-0.48	-0.31	0.40	0.16	-0.11

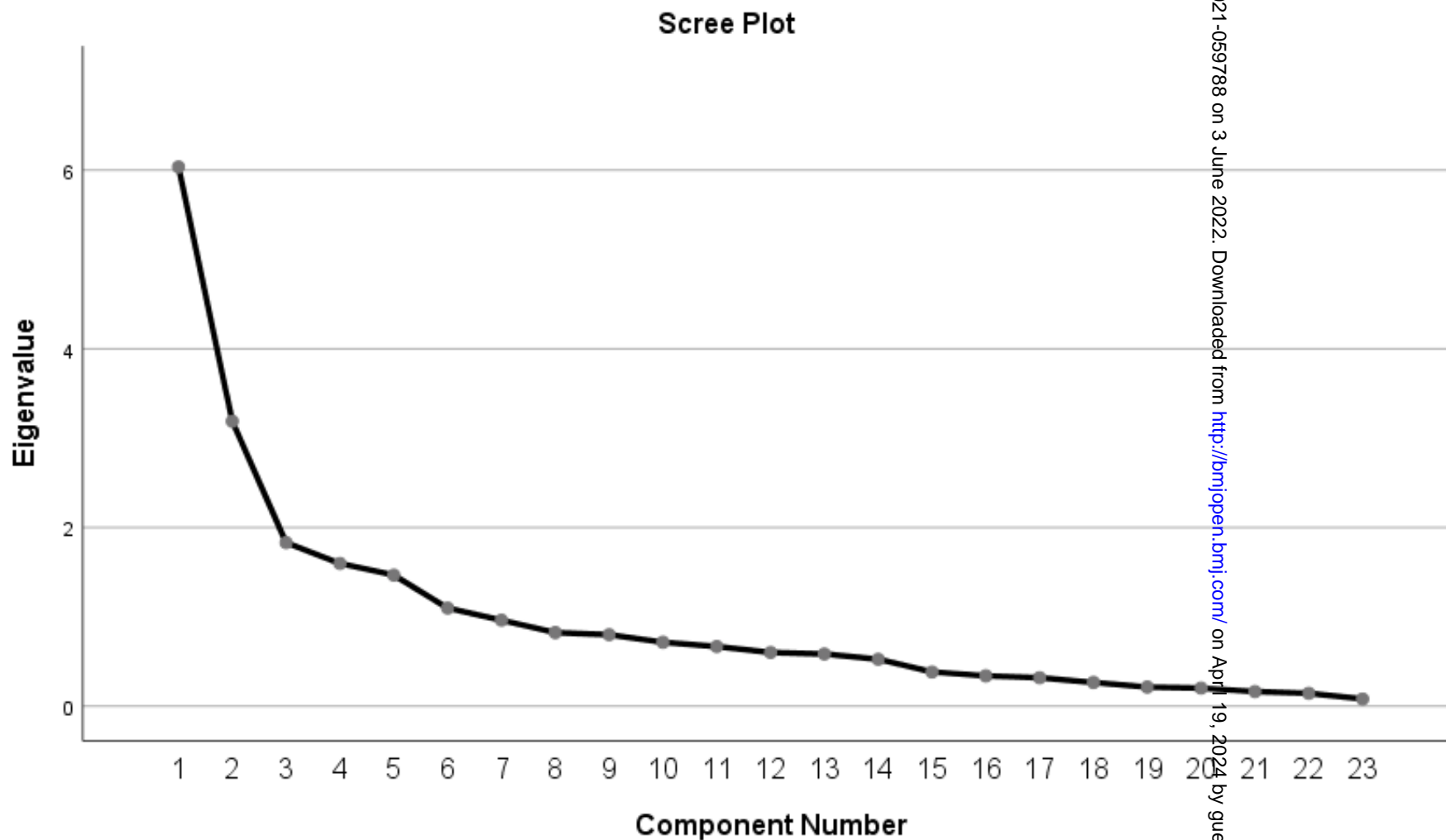
*Unable to calculate due to number of missing observations
 Abbreviations: SSS – subjective social status

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Table 4: Summary of hypothesis testing of correlations

Discriminant Validity		N=34 hypotheses
No correlation as predicted		18 (53%)
Positive correlation demonstrated		7 (21%)
	Small	7
	Moderate	0
	Large	0
Negative correlation demonstrated		9 (26%)
	Small	8
	Moderate	1
	Large	0
Convergent Validity		N=64 hypotheses
Correlation strength and direction exactly as predicted		39 (61%)
No correlation observed while correlation was predicted		8 (13%)
Direction of observed correlation the same as predicted		16 (25%)
	Off by 1 strength category	16
	Off by 2 strength categories	0
Direction of observed correlation direction opposite of predicted		1 (2%)

Figure 1



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Appendix 1: Social Vulnerabilities Survey**A. Transportation**

1. Do you have a valid driver's license?

- Yes
 No

2. In the past month, how often did you drive?

- 6 or 7 days a week
 4 or 5 days a week
 1 to 3 days a week
 1 to 3 days a month
 Not at all in the last month

3. Do you or someone in your household own a car?

- Yes
 No

4. In the past month, which of the following other forms of transportation have you used? *(Check all that apply)*

- Passenger in a motorized vehicle
 Taxi
 Public transportation
 Calgary Handibus or Access Calgary Service
 Cycling
 Walking
 Wheelchair or motorized
 Other. Please specify:

5. What is your most common form of transportation?

- Drive a motor vehicle
 Passenger in a motor vehicle
 Taxi
 Public transportation
 Calgary Handibus or Access Calgary Service
 Cycling
 Walking
 Wheelchair or motorized cart
 Other. Please specify:

6. How long does it take to get to your family doctor's office, using whatever form of transportation you usually use to get there?

(in minutes)

7. How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?

(in minutes)

8. How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?

(in minutes)

9. In the past 1 year, have you had difficulty keeping an appointment with a health care provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?

- Yes

- 1
2 No
3 N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year
4

5 **B. Health Salience**

- 6
7 10. In the past 1 year, have you had difficulty following suggestions from a health care provider to make lifestyle changes
8 (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at that time?
9 Yes
10 No
11 N/A: No lifestyle changes have been recommended
12
- 13 11. In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book
14 them) because other circumstances in your life took priority at that time?
15 Yes
16 No
17 N/A: No tests have been ordered
18
- 19 12. In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that
20 time?
21 Yes
22 No
23 N/A: I am not on any medications
24
- 25 13. In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in
26 your life took priority at that time?
27
28 Yes
29 No
30 N/A: I have not had any appointments
31
- 32 14. In your current circumstance, how important is your health to you?
33 Not very important
34 Not important
35 Neutral
36 Important
37 Very important
38
- 39 15. How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?
40 Very hard
41 Hard
42 Neutral
43 Easy
44 Very easy
45
- 46 16. What areas in your life make it difficult to focus on your health? (*Check up to three*)
47 No area makes it difficult
48 Worrying about money
49 Worrying about basic needs (e.g. food)
50 Housing situation is unstable
51 Worrying about job security
52 I have too many job responsibilities
53 I have too many household responsibilities
54 Worrying about school
55 Relationship issues or conflict
56 I am a caregiver for a friend/family member who is ill
57
58
59
60

Other. Please specify:

C. Social Support

17. If you needed it, how often is someone available to help you if you were confined to bed?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

18. If you needed it, how often is someone available to take you to the doctor?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

19. If you needed it, how often is someone available to prepare your meals if you were unable to do it yourself?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

20. If you needed it, how often is someone available to help you with daily chores if you were sick?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

21. If you needed it, how often is someone available to have a good time with?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

22. If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

23. If you needed it, how often is someone available who understands your problems?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

24. If you needed it, how often is someone available to love and make you feel wanted?

- None of the time
 A little of the time
 Some of the time
 Most of the time
 All of the time

25. a) Do you live alone?

- Yes
 No

25. b) If no: What is your relationship with the people living with you? (*Check all that apply*)

- Spouse or partner
 Children
 Parents
 Extended family (e.g. grandparents, aunts, uncles, nieces, nephews, cousins)
 Friends or roommates
 Tenants
 Other. Please specify:

D. Financial Barriers

26. Do you have drug insurance?

- Yes
 No

27. What percentage of drug costs do you have to pay out-of-pocket?

- 0%
 1-10%
 11-20%
 21-30%
 31-40%
 41-50%
 >50%

28. In the past 1 year, have you not filled a prescription because of cost?

- Yes
 No
 N/A: I have not been on any prescription medications in the past year

29. In the past 1 year, have you not skipped medication doses because of cost (to save money)?

- Yes
 No
 N/A: I have not been on any prescription medications in the past year

30. How much money do you pay out-of-pocket for your own medications, in total, over one year?

(in Canadian dollars)

31. How much money do you or your household pay out-of-pocket for the entire household's own medications over one year?

(in Canadian dollars)

32. In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?

- Yes
 No

N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year

33. a) Do you care, or help to care, for any dependants under 18 years of age?

Yes

No

33. b) If yes: In the past 1 year, have missed an appointment with a health care provider, didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not find or afford child-care

Yes

No

N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year

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Appendix 2: Background Information Survey**A. Self-Rated Health**

1. How would you rate your health today?

- Excellent
- Good
- Fair
- Poor
- Bad

B. Perceived Stress

2. In the last year, how often have you felt that you were unable to control the important things in your life?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

3. In the last year, how often have you felt confident about your ability to handle your personal problems?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

4. In the last year, how often have you felt that things were going your way?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

5. In the last year, how often have you felt that difficulties were piling up so high that you could not overcome them?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

C. Health Beliefs

6. For most kinds of illnesses, it is the doctor who can help you the most.

- Disagree
- Neutral
- Agree

7. Home remedies are often much better than the drugs that doctors prescribe.

- Disagree
- Neutral
- Agree

8. You seem to get illnesses that doctors can't do much for.

- Disagree
- Neutral

- 1
2 Agree
3
4 9. If you follow a doctor's advice, you will have less illness in your lifetime.
5 Disagree
6 Neutral
7 Agree
8
9 10. Whenever you get sick, it seems to be very serious.
10 Disagree
11 Neutral
12 Agree
13
14 11. You get the kinds of illnesses that worry you a great deal.
15 Disagree
16 Neutral
17 Agree
18
19 12. In general, when you get sick, how much does it interfere with your usual activities?
20 Not at all
21 A little
22 A moderate amount
23 A great deal
24

25 **D. Baseline function**
26

- 27 13. In the past month, have you been able to walk:
28 Without help (except from a cane if needed)
29 With some help (from a person, walker, or crutches)
30 Completely unable to walk
31
32 14. In the past month, have you been able to eat:
33 Without help
34 With some help (need help with cutting, etc)
35 Completely unable to feed yourself
36
37 15. In the past month, have you been able to dress and undress:
38 Without help
39 With some help
40 Completely unable to dress or undress yourself
41
42 16. In the past month, have you been able to bathe or shower:
43 Without help
44 With some help (getting in and out of the tub, or need special attachments to the tub)
45 Completely unable to bathe or shower yourself
46
47 17. In the past month, have you been able to do your housework:
48 Without help
49 With some help (can do light housework but need help with heavy work)
50 Completely unable to do housework
51
52 18. In the past month, have you been able to prepare your meals:
53 Without help
54 With some help (can prepare some things but cannot cook full meals)
55 Completely unable to prepare any meals
56
57
58
59
60

E. Health care use

19. Do you have a regular family doctor?

- Yes
 No

20. In the past 1 year, have you used mobile lab services (where you get lab tests done in your home)?

- Yes
 No
 N/A: I have needed to get any lab tests in the past year

21. a) Do you have home care publicly provided to you (for example, through Alberta Health Services)?

- Yes
 No

21. b) If yes: What does home care help you with? (*Check all that apply*)

- Personal hygiene (bathing, grooming, oral care)
 Dressing/undressing
 Toileting and/or catheter maintenance
 Mobilizing and transferring
 Help with dining
 Help with medications
 Wound care
 Other. Please specify:

22. a) Do you pay privately for home care or for a caregiver (excluding help with housework or preparation of meals)?

- Yes
 No

22. b) If yes: What does home care help you with? (*Check all that apply*)

- Personal hygiene (bathing, grooming, oral care)
 Dressing/undressing
 Toileting and/or catheter maintenance
 Mobilizing and transferring
 Help with dining
 Help with medications
 Wound care
 Other. Please specify:

23. In the past month, have you or your household paid for someone to do the housework in your home?

- Yes
 No

24. In the past month, have you or your household paid for someone to prepare your meals?

- Yes
 No

F. Socio-demographics

25. Are you a:

- Man
 Woman

26. Is English the language that you speak best?

- Yes

- 1
2 No
3
4 27. a) Were you born in Canada?
5 Yes
6 No
7
8 27. b) If no: In what country were you born?
9 27. c) If no: What year did you come to Canada?
10
11
12 28. What is your cultural or ethnic background?
13 Aboriginal
14 Arab/West Asian (e.g. Armenian, Egyptian, Iranian, Lebanese, Moroccan)
15 Black (e.g. African, Haitian, Jamaican, Somali)
16 Chinese
17 Filipino
18 Japanese
19 Korean
20 Latin American
21 South Asian (e.g. Bengali, East Indian, Nepali, Pakistani, Sri Lankan)
22 South East Asian (e.g. Indonesian, Malaysian, Thai, Cambodian, Singaporean, Vietnamese)
23 White (Caucasian)
24 French-Canadian
25 Other. Please specify:
26
27 29. What is your age?
28
29 30. What is your marital status?
30 Married
31 Living common-law
32 Widowed
33 Divorced
34 Separated
35 Single, never married
36
37 31. What is your occupation?
38
39 32. Which statement best describes your work situation just before coming into hospital?
40 Currently working
41 Unemployed or looking for work
42 Stay at home spouse or parent
43 Student
44 Unpaid volunteer
45 Temporary leave of absence
46 Permanently unable to work
47 Retired
48
49 33. What is the highest level of education you completed?
50 Less than high school
51 High school graduate
52 Apprenticeship or trades certificate or diploma
53 Some post-secondary (college or university)
54 Post-secondary graduate
55
56
57
58
59
60

1
2 34. a) What is your best estimate of the total income, before taxes and deductions, of all household members from all
3 sources in the past 12 months?

- 4 Less than \$15,000
5 \$15,000 to less than \$25,000
6 \$25,000 to less than \$50,000
7 \$50,000 to less than \$75,000
8 \$75,000 to less than \$100,000
9 \$100,000 to less than \$125,000
10 \$125,000 to less than \$150,000
11 \$150,000 to less than \$175,000
12 \$175,000 to less than \$200,000
13 \$200,000 and over
14 Do not know
15 Do not wish to answer

16
17 35. How many people, including yourself, are dependent on this income?
18

19 36. MacArthur Scale of Subjective Social Status: Community
20

21 **Think of this ladder as representing where people stand in their communities.**

22
23 People define community in different ways; please define it in whatever way is most meaningful
24 to you. At the **top** of the ladder are the people who have the highest standing in their community.
25 At the **bottom** are the people who have the lowest standing in their community.

26 **Where would you place yourself on this ladder?**

27
28 Please place a large "X" on the rung where you think you stand
29 at this time in your life, relative to other people in your community.



37. MacArthur Scale of Subjective Social Status: Society (*Replace "United States" with "Canada"*)

Think of this ladder as representing where people stand in the United States.

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?

Please place a large "X" on the rung where you think you stand at this time in your life, relative to other people in the United States.



Appendix 3: Hypothesized correlations between health salience questions and patient background characteristics

	Self-Rated Health	Perceived Stress	Societal SSS	Community SSS	Socio-demographics				
					Age	Income	Unemployed or Unable to work permanently or temporarily	Employed as stay-at-home parent or spouse	Regular family doctor
Q1: Difficulty making lifestyle changes	-1	+2	-1	-1	-1	-2	+2	0	0
Q2: Difficulty getting investigations	-1	+2	-1	-1	-1	-2	+2	0	0
Q3: Stopping medications	-1	+2	-1	-1	-1	-2	+2	0	0
Q4: Skipping appointments	-1	+2	-1	-1	-1	-1	+2	0	0
Q5: Importance of health	0	0	0	0	0	0	0	0	+1
Q6: Perceived difficulty maintaining health	-2	+2	-1	-1	+2	-2	+2	0	0
Q7: Worry about basic needs (housing, basic needs)	-2	+3	-2	-1	-1	-3	+2	0	-1
Q7: Worry about money	0	+2	-2	-1	-1	-2	+2	0	-1
Q7: Worry about domestic responsibilities and caregiving	0	+1	-1	-2	-1	-1	0	+3	0
Q7: Worry about school	0	0	0	0	-3	0	0	0	0
Q7: Number of areas of worry (1 vs 2+)	-1	+2	-1	-1	0	-2	+2	0	0

Where -2=moderate negative correlation; -1= small negative correlation; 0= no correlation; +1 = small positive correlation; +2=moderate positive correlation; +3= strong positive correlation
 Abbreviations: Q- question number, SSS – subjective social status

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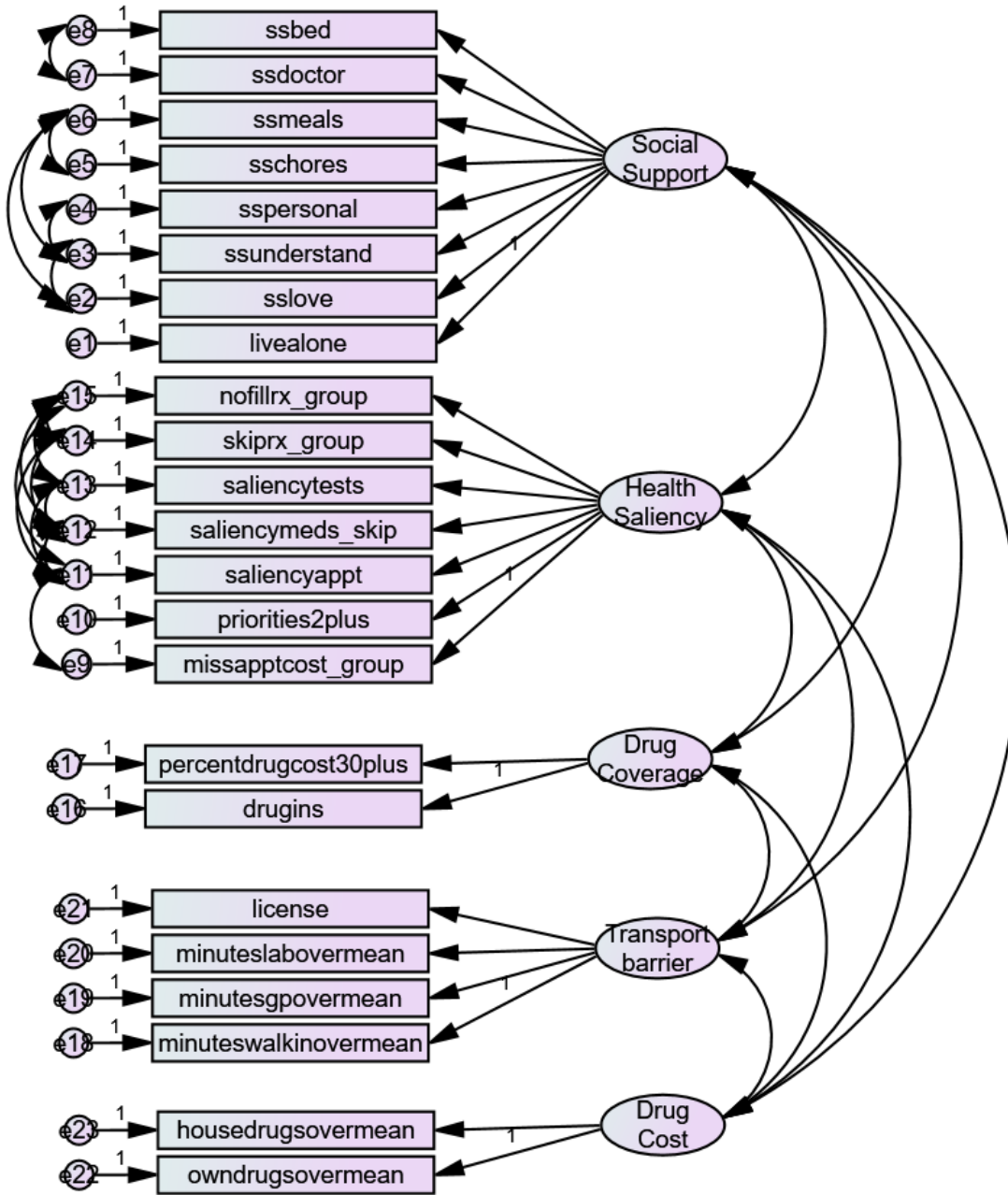
Appendix 4: Factor loadings of social vulnerability questions

Question	Factor 1: Social Support	Factor 2: Saliency of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have a valid driver's license?				-0.536	
Do you or someone in your household own a car?					
How long does it take to get to your family doctor's office, using whatever form of transportation you usually use to get there?				0.619	
How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?				0.680	
How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?				0.767	
In the past 1 year, have you had difficulty keeping an appointment with a health care provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?					
In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?		0.644			
In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?		0.704			
In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?		0.783			
In your current circumstance, how important is your health to you?					
How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?					
What areas in your life make it difficult to focus on your health? (2 or more items checked)		0.560			
If you needed it, how often is someone available to help you if you were confined to bed?	0.877				
If you needed it, how often is someone available to help you to take you to the doctor?	0.837				
How often is someone available to prepare your meals if you were unable to do it yourself?	0.922				
How often is someone available to help you with daily chores if you were sick?	0.898				
If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?	0.818				
How often is someone available who understands your problems?	0.808				
How often is someone available to love and make you feel wanted?	0.761				

Question	Factor 1: Social Support	Factor 2: Saliency of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have drug insurance?			-0.906		
What percentage of drug costs do you have to pay out-of-pocket?			0.916		
In the past 1 year, have you not filled a prescription because of cost?		0.581			
In the past 1 year, have you skipped medication doses because of cost (to save money)?		0.654			
Do you live alone?	-0.526				
How much money do you or your household pay out-of-pocket in total for the entire household's medications over one year?					0.880
How much money do you pay out-of-pocket for your own medications in total, over one year?					0.857
In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?		0.569			
Empty cells represent factor loadings <0.3					

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Appendix 5: Confirmatory factor analysis five factor model



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Reporting guideline/checklist

From: Kelley K, Clark B, Brown V, Sitzia J. Good practice in the conduct and reporting of survey research. *Int J Qual Health Care*. 2003 Jun;15(3):261-6. doi: 10.1093/intqhc/mzg031. PMID: 12803354.

Key points	Manuscript page number
Explain the purpose or aim of the research, with the explicit identification of the research question	6
Explain why the research was necessary and place the study in context, drawing upon previous work in relevant fields	5-16
Describe in detail how the research was done: <ul style="list-style-type: none"> a. State the chosen research method(s) and justify why this method was used b. Describe the research tool c. Describe how the sample was selected and how the data were collected including: <ul style="list-style-type: none"> i. How were potential subjects identified ii. How many and what type of attempts were made to contact subjects iii. Who approached potential subjects iv. Where were the potential subjects approached v. How was informed consent obtained vi. How many agreed to participate vii. How did those who agreed differ from those who did not agree viii. What was the response rate? 	6, 7, 9, 10 6-7 8 1-8 8 1-11 1-19 Not available 1-24
Describe and justify the methods and tests used for data analysis	8-9, 10
Present results of the research	1-15
Interpret and discuss the findings	1-17
Present conclusions and recommendations	1

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Development and validation of a social vulnerabilities survey for medical inpatients

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ABSTRACT

Objectives: Our objective was to validate a Social Vulnerabilities Survey that was developed to identify patient barriers in the following domains: 1) salience or priority of health; 2) social support; 3) transportation; and 4) finances.

Design: Cross-sectional psychometric study.

Questions for one domain (health salience) were developed *de novo* while questions for the other domains were derived from national surveys and/or previously validated questionnaires. We tested construct (i.e. convergent and discriminative) validity for these new questions through hypothesis testing of correlations between question responses and patient characteristics.

Exploratory factor analysis was conducted to determine structural validity of the survey as a whole.

Setting: Patients admitted to the inpatient internal medicine service at a tertiary care hospital in Calgary, Canada

Participants: A total of 406 patients were included in the study.

Results: The mean age of respondents was 55.5 (SD 18.6) years, with the majority being male (55.4%). In feasibility testing of the first 107 patients, the Social Vulnerabilities Survey was felt to be acceptable, comprehensive, and met face validity. Hypothesis testing of the health salience questions revealed that the majority of observed correlations were exactly as predicted.

Exploratory factor analysis of the global survey revealed the presence of five factors (eigenvalue > 1): social support, health salience, drug insurance, transportation barriers, and drug costs. All but four questions loaded to these five factors.

1
2
3 **Conclusions:** The Social Vulnerabilities Survey has face, construct and structural validity. It can
4 be used to measure modifiable social vulnerabilities, such that their effects on health outcomes
5
6 can be explored and understood.
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Strengths and limitations of the study

- The Social Vulnerabilities Survey is a newly developed questionnaire that meets an important gap, being one of few tools to identify modifiable social vulnerabilities that may affect the ability of patients to maintain their health
- The domains covered by the survey are those identified by patients as barriers after hospital discharge in prior qualitative studies of patients facing socioeconomic disadvantage
- This study uses multiple methods to comprehensively assess validity of the survey – including face, construct (convergent, discriminant, and discriminative), and structural validity
- Validity was assessed only in the inpatient setting at a single large tertiary care hospital, which may limit generalizability

INTRODUCTION

Hospital discharge signifies a particularly vulnerable time for adverse medical events, with up to 35% of patient being re-admitted within 3 months.^{1 2} Hospital readmissions may be attributable to patient, provider, or organizational factors.³ Of these, patient characteristics appear to account for most of the variation in readmission rates across institutions,⁴ and patient-level interventions are therefore the focus of multi-disciplinary efforts to improve post-discharge outcomes.⁵

Self-management of chronic conditions after hospital discharge requires adequate knowledge, planning, and ability on the patient's part,⁶ and can therefore be affected by the social determinants of health and more downstream social vulnerabilities (e.g. transportation, financial, and social support barriers).⁷⁻¹⁰ In a recent study, patients that reported barriers due to at least two measures of social determinants of health were twice as likely to have preventable readmission than those without these barriers, with the majority of patients reporting the need for more general (non-medical) assistance to stay well after discharge.¹¹ Similarly, in a study of over 13 million patients, there appeared to be a dose-response relationship between health-related social needs and hospital readmissions.¹² Recognizing the importance of addressing social determinants in improving patient care and health equity, the American College of Physicians recommends improved identification of social determinants of health and their downstream social vulnerabilities.¹³

Despite their importance, social vulnerabilities are rarely identified or studied, hampering the development of discriminative models to predict hospital readmission and effective interventions to mitigate them.^{5 14} The main barriers to measuring social vulnerabilities in hospitalized patients

1
2
3 are that: 1) they are not routinely collected or available in registry or administrative data, and 2)
4
5 there is a lack of widely accepted, validated questionnaires. Though Greysen et al. created a 22-
6
7 item survey to measure patient understanding,⁷ patient engagement with care, and barriers to
8
9 self-care in the post-discharge period, this survey is not specific to patient-level social
10
11 vulnerabilities (i.e. it includes provider and organization factors), and does not sufficiently detail
12
13 tangible barriers that can be targeted by interventions. For example, patients are asked whether
14
15 they had difficulty following a recommended diet, or difficulty taking medications, but there are
16
17 no other questions in the survey that delve into *why* patients face such difficulties.
18
19
20
21
22
23

24 Modifiable social vulnerabilities are the barriers to healthcare access that can be intervened upon
25
26 to improve disease prevention and screening, promote early presentation to care, and improve
27
28 access, uptake and adherence to treatment.¹⁵ A validated survey that identifies these social
29
30 vulnerabilities is essential to identify risk factors for hospital readmissions, in identifying
31
32 patients at risk for readmission, and in developing both patient and population level interventions
33
34 that directly address these risk factors. In this study, we describe the development and validation
35
36 of the Social Vulnerabilities Survey (SVS) in a cohort of medical inpatients in Calgary, Canada.
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38
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41

42 **METHODS**

43 **Development of SVS**

44
45 The SVS (Table 1; Appendix 1) was developed to explore the role of social vulnerabilities in a
46
47 patient's ability to access care and self-manage chronic conditions. It covers four domains of
48
49 social vulnerabilities, which were selected based on prior qualitative studies of post-discharge
50
51 barriers in patients with low socioeconomic status.^{9 10} These domains are: transportation barriers,
52
53
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2
3 financial barriers, poor social support, and low salience of health due to competing priorities.^{9 10}

4
5 Three of these four domains have been previously explored in national surveys or questionnaires
6
7 validated in international populations.¹⁶⁻¹⁸ Questions within these three domains were therefore
8
9 obtained from these prior sources where available, with items being selected through discussion
10
11 and consensus of three members of the study team (KT, MS, WG), and adaptations made based
12
13 on patient feedback (see Results section):
14
15

- 16
17 **1. Transportation:** Four questions relating to having a license, modes of transportation, and
18
19 frequency of driving (Questions 1, 2, 4, 5) were obtained directly from the Canadian
20
21 Community Health Survey – Healthy Aging Questionnaire.¹⁷ Two questions relating to
22
23 travel time to a family doctor’s clinic (Question 6) and travel-related barriers in accessing
24
25 health services (Question 9) were taken from the Barriers to Care for People with
26
27 Chronic Conditions (BCPCHC) Survey.¹⁶ Two related questions (Questions 7, 8) were
28
29 added to ask about travel time to other health services such as a walk-in or urgent care
30
31 clinic, and to a laboratory for bloodwork respectively. A question about vehicle
32
33 ownership (Question 3) was added in light of evidence suggesting its associations with
34
35 health and ability to cope with the demands of illness.^{19 20}
36
37
38
39 **2. Social Support:** Questions were taken directly from the modified Medical Outcomes
40
41 Study Social Support Survey,¹⁸ assessing the domains of emotional and instrumental
42
43 social support (Questions 17-24). A single question asking whether patients live alone
44
45 (Question 25) was added, due to its association with healthcare utilization, and to provide
46
47 context to the relative importance of social support based on living arrangements.^{21 22}
48
49
50
51 **3. Financial Constraints:** Financial barrier questions about drug insurance (Question 26),
52
53 not taking medications due to cost (Question 28, 29), out-of-pocket medication costs
54
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(Questions 30, 31), and barriers to care due to inability to take time off work (Question 32) were adapted from the BCPCHC Survey. Two new questions were added - one asking for the percentage of drug costs paid out-of-pocket (Question 27), to provide context to patient-reported absolute medication costs, and another asking about affordability of child-care as a barrier to health care access (Question 33) due to it being a frequently endorsed barriers in the low-income, non-elderly patient population.²³

The fourth domain (health salience in the context of competing priorities) has not previously been studied, with no prior questions or questionnaire designed to explore this concept. Seven questions were created for this domain. The content for Questions 10-13 (which asks whether competing priorities results in ability to self-manage health and access care) and Question 16 (which asks participants to identify competing priorities) are based on the previously-mentioned qualitative studies.^{9 10} Questions about perceived importance of health and ability to keep healthy were added (Questions 13, 14), given the importance of these health beliefs on patient willingness and ability to prioritize health.²⁴

Information about the patient's health was obtained through a separate background information survey (Appendix 2), which was administered along with the SVS. It comprised of 37 questions asking about sociodemographic characteristics, function based on Older Americans Resources and Services questionnaire,²⁵ stress using the Perceived Stress Scale,²⁶ health beliefs,²⁴ self-rated health,²⁷ and prior health care use.

We assessed acceptability, feasibility, face validity and structural validity of the SVS as a whole.

1
2
3 Because the objective of the SVS is to identify modifiable and diverse social vulnerabilities in
4 medical inpatients, a single “SVS score” would not be clinically meaningful. Furthermore, we
5
6 did not pursue domain-specific scoring algorithms for a number of reasons: 1) Questions from
7
8 three of the four domains were derived from existing questionnaires, of which one (social
9
10 support) already had a scoring algorithm that had been developed and validated;¹⁸ 2) Questions
11
12 within the domains consisted of different types of responses (binary, categorical, and open-
13
14 ended) that are not only difficult to synthesize into a single score, but that also make the meaning
15
16 of a domain-specific score unclear; 3) For prediction of outcomes, there is evidence to suggest
17
18 that the use of individual facets (or variables) within a domain may be superior to the use of
19
20 scores because different facets may have different associations with outcomes.²⁸
21
22
23
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28 **Patient and Public Involvement**

29
30 While patients took part as participants of the study, they were not involved in the design,
31
32 conduct, or reporting of the study.
33
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36
37

38 **Study population**

39
40 Study participants were patients admitted to the internal medical service at the Foothills Medical
41
42 Centre in Calgary, Alberta between December 2014 to October 2015. Inclusion criteria were that
43
44 patients must be residents of Alberta and that the discharge destination was home or an
45
46 independent living facility. Patients discharged to non-independent facilities were excluded, as
47
48 direct patient care is provided in these settings, making social vulnerabilities and the need for
49
50 self-management less relevant.
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Feasibility and Face Validity

Feasibility of the SVS was assessed for the first 107 study participants, based on the time to completion and the proportion of incomplete surveys. A research assistant administered and timed the completion of both the SVS and the background information survey via an in-person interview. At the conclusion of these surveys, an additional five questions with free-text responses, were administered:

- 1) Was the length of the questionnaire acceptable? Why or why not?
- 2) How comprehensive was the questionnaire in identifying social barriers to health?
- 3) Which, if any, questions would you recommend removing from the questionnaire?
- 4) Are there any questions that you feel are missing and should be added?
- 5) Are there any modifications you would recommend to the wording of the questions to improve clarity?

Responses were transcribed concurrently during the in-person interview. Survey data were collected and stored in Secure REDCap, a web-based data management application.

Data Analysis

Feasibility and Face Validity

Free-text responses were analyzed using thematic content analysis.^{29 30} Because the goal of this analysis was to explore face validity, rather than to develop or explore theory, a qualitative descriptive approach was undertaken.^{31 32} On study investigator (KT) performed open coding, then organized these into themes that captured different aspects of feasibility and face validity of the SVS. Review and interpretation of codes and the development of themes were undertaken through regular meetings between members of the study team (KT, WG). Any proposed

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3 modifications to the SVS based on patient feedback were discussed among three members of the
4 study team (KT, MS, WG), and decisions were made by consensus. A record of changes was
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6 kept.
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10 11 12 ***Descriptive statistics*** 13

14 Descriptive statistics for sociodemographic and clinical characteristics of the sample population
15 were conducted. For categorical variables, we reported frequencies and proportions. Means and
16 standard deviations were calculated for continuous variables. Because questions were developed
17 entirely *de novo* for only one (health salience) of the four domains of the SVS, descriptive
18 statistics of response characteristics and hypothesis and known-groups testing (for construct
19 validity – see below) were performed only for this domain.
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30 31 ***Construct validity*** 32

33 Construct validity was assessed through hypothesis testing. First, the research team formulated *a*
34 *priori* hypotheses about the expected correlations between the health salience questions and
35 patient sociodemographic characteristics, self-rated health, subjective social status,^{33 34} and
36 perceived stress, based on literature. Similar and overlapping constructs were hypothesized to be
37 positively correlated (convergent validity).³⁵ All hypotheses included the direction and strength
38 of correlations: small ($0.1 \leq r < 0.3$ or $-0.3 \leq r < -0.1$), moderate ($0.3 \leq r < 0.5$ or $-0.5 \leq r < -0.3$),
39 or large (≥ 0.5 or ≤ -0.5).³⁶ Constructs that had no logical overlap were hypothesized to have no
40 correlation, $r < 0.1$ (discriminant validity).^{35 36} Observed correlations from the data were compared
41 with the hypothesized correlations.
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Hypotheses were also formulated about expected differences in responses to health salience questions across known groups, known as discriminative validity.³⁵ Five hypotheses were formulated *a priori*:

- Patients with lower income are more likely to state that money-related concerns make it difficult to focus on health than those with higher income
- Patient not currently working are more likely than those who are working to report that money-related and job-security concerns make it difficult to focus on health
- Patients without permanent housing are more likely to state that their housing situation makes it difficult to focus on health
- Students are more likely to state that school-related concerns make it difficult to focus on health
- Stay at home parents are more likely to state that domestic responsibilities make it difficult to focus on health

Hypotheses were tested by comparing distribution of responses across these known groups, through chi-square testing. P-values <0.05 were considered to be statistically significant.

Exploratory factor analysis

Structural validity of the global survey was determined through item factor analysis.³⁵

Exploratory factor analysis based orthogonal factor rotation using the varimax method was first conducted, as the factor structure and the number of dimensions explored in the SVS were unclear (because questions were compiled from different sources, and in some cases, created *de novo*). Categorical variables with a missing data rate of >20% and nominal variables (where responses are categorical with no implicit or explicit order) were excluded from exploratory

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3 factor analysis. Missing responses for ordinal and continuous variables (Questions 6-8, 14, 15,
4 17-24, 27, 30, 31) were imputed with the median. Sensitivity analysis was completed, where
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6 exploratory factor analysis was re-run using raw data without imputation. The number of factors
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8 ultimately retained were based on the following: eigenvalues >1.0, examination of the scree plot,
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10 the point at which adding more factors minimally changes the cumulative explained variance,
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12 and parallel analysis.³⁷ A minimum loading of 0.5 was determined to be the threshold at which a
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14 variable was retained within a factor. Internal consistency, or the extent to which items within a
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16 factor represented the same construct, was evaluated using Cronbach's alpha for each factor.³⁵
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24 RESULTS

25 Patient characteristics

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27 A total of 470 patients were recruited into the study. Of these, 64 were excluded (16 were not
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29 internal medicine patients, 19 were not discharged home or to an independent living facility, 2
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31 died in hospital, 14 withdrew consent, 13 were not residents of Alberta). A total of 406 patients
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33 were included in the analysis. The mean age was 55.5 (SD 18.6) years (**Table 2**). The majority of
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35 the sample was male (55.4%), Caucasian (68.0%), born in Canada (72.4%), and reported English
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37 as their first language (85.2%). Approximately 30.5% of the sample were employed, while 9.1%
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39 were unemployed and 38.9% were retired.
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47 Feasibility and Face Validity

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49 The mean time for completion of the SVS and background information survey together was
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51 17min 25sec (SD 5:48). Nearly all patients (98.1%) found the length to be acceptable. No
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53 patients terminated the survey prematurely, and no removal of questions was suggested. Small
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wording changes were made to Question 26 for brevity and to Questions 6, 9, and 32 to increase specificity (i.e. specifying the mode of transportation when asking about travel time, that “travel barriers” pertained only to transportation barriers, and specifying *which* health services were being examined when asking about barriers to access, respectively). Participants also recommended splitting a single item into two, in two circumstances. First, for cost-related medication non-adherence, they recommended asking about both skipping medications and not filling a prescriptions (Questions 28, 29), as these may reflect different levels of financial constraints. Second, participants felt clarity was needed about *whose* costs were being explored when asking about out-of-pocket drug costs (Questions 30, 31). The final survey contained 33 questions (Table 1; Appendix 1) in the following domains: transportation (9 questions), health salience (7 questions), social support (9 questions), and finances (8 question).

Response characteristics and construct validity of health salience questions

Distribution of responses for the seven health salience questions are presented in Table 3. Approximately 12-15% of participants described skipping tests, medications, or medical appointments due to other life circumstances taking priority; an even higher proportion (30.7%) described difficulty following lifestyle recommendations for this same reason. Despite this, 77.9% of patients indicated that their health was “very important”, and 60.2% believed that it would be “very easy” or “easy” to find the time and energy to keep healthy after hospital discharge. When asked about competing priorities that would make it difficult to focus on health, the most commonly reported was finances.

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3 We determined convergent and discriminant validity of the health salience questions through
4 hypothesis testing of correlations. We developed a total of 99 hypotheses (Appendix 3), 35 of
5 which predicted no correlation between responses to certain health salience questions and
6 background socio-demographic characteristics (discriminant validity), and 64 of which predicted
7 the presence of weak, moderate, or strong correlations (convergent validity). These hypotheses
8 were informed by literature suggesting the presence of associations between adherence to
9 lifestyle changes, medications, and/or medical appointment-keeping with stress,³⁸ self-rated
10 health,³⁹ subjective social status,⁴⁰ age,⁴¹⁻⁴⁴ income,⁴⁵ and employment status.⁴⁶⁻⁴⁸ Of these 64
11 hypotheses, 39 (61%) observed correlations were as predicted in both strength and direction,
12 with another 16 (25%) in the same direction (but not the same strength) as predicted (Tables 4
13 and 5).

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31 For discriminant validity, one of the 35 hypotheses could not be tested due to the number of
32 missing responses. We demonstrated no correlation, as predicted, between health salience
33 questions and 18 (53%) sociodemographic characteristics (Tables 4 and 5). The remaining 16
34 hypotheses demonstrated primarily small correlations, only two of which met statistical
35 significance.

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45 Discriminative validity was determined through known groups testing. We observed significant
46 differences in proportions as hypothesized:

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49 • Patients with low income were more likely to state that money-related concerns made it
50 difficult to focus on health (47.2% vs 22.1%, $p < 0.01$)
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- Patients not currently working were more likely than those who were working to state that both money-related and job-security concerns made it difficult to focus on health (50.0% vs 26.4%, $p<0.01$; and 23.9% vs 9.6%, $p<0.01$)
- Patients without permanent housing were more likely to state that their housing situation made it difficult to focus on health (58.8 vs 9.3%, $p<0.01$)
- Students were more likely to state that school-related concerns made it difficult to focus on health (50.0% vs 1.3%, $p<0.01$)
- Stay at home parents were more likely to state that domestic responsibilities made it difficult to focus on health (47.2% vs 22.1%, $p<0.01$)

Factor analysis of the Social Vulnerabilities Survey

Exploratory factor analysis was conducted for 27 of the 33 questions in the SVS. Questions 2, 10, 21, and 33 were excluded from analysis due to a missing data rate $>20\%$ (Appendix 4). Questions 4 and 5 were additionally excluded from analysis due to the nominal nature of response categories (i.e. modes of transportation). Exploratory factor analysis demonstrated that five factors had eigenvalues over 1 (see Figure 1 - scree plot), and that these five factors accounted for 61.4% of the total variance. The five factors were: 1) social support; 2) health salience; 3) drug insurance; 4) transportation barriers; and 5) drug costs (see Appendix 5, with associated variables and their factor loadings). All questions loaded only to one factor. Four questions (Questions 3, 9, 14, 15) did not load to any factor. Internal consistency, as measured by Cronbach's alpha, was reasonable, at 0.94 for factor 1 (social support), 0.78 for factor 2 (health salience), 0.91 for factor 3 (drug insurance), 0.58 for factor 4 (transportation), and 0.74 for factor 5 (drug costs). Within each factor, all variables were correlated with each other (correlation

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3 coefficients ≥ 0.2), but no correlations were > 0.9 . That is, each factor comprised of correlated but
4 likely not redundant variables.³⁵
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10 Sensitivity analysis was conducted, repeating the exploratory factor analysis on raw data without
11 imputation of variables. Based on parallel analysis,³⁷ five factors were retained. These five
12 factors are the same as the ones noted above (see Appendix 6 for factor loadings). Questions
13 loaded to the same factors as in the original analysis. The same four questions did not load to any
14 factor, with no additional non-loading items demonstrated.
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23 **DISCUSSION**

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26 The SVS is a tool that assesses modifiable social vulnerabilities that may impact the ability of
27 patients to maintain their health. While questions from three domains (transportation, financial,
28 and social support barriers) were adapted from prior surveys and instruments, seven questions
29 were created for the domain of health salience in the presence of competing priorities. These
30 questions were found to have high convergent and discriminant validity, with the SVS as a whole
31 demonstrating high structural and factorial validity.
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42 There are few existing validated measures for social vulnerabilities and the social determinants
43 of health. The Social Needs Screening Tool from the American Academy of Family Physicians,
44 and the Accountable Health Communities Screening Tool from the Centers for Medicaid and
45 Medicare Services both ask about housing stability, food insecurity, utilities, transportation, and
46 personal safety, with additional questions included about family support/assistance, child care,
47 employment, education, and financial strain.^{49 50} A similar tool, Protocol for Responding to and
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3 Assessing Patient Assets, Risks, and Experiences (PRAPARE) instrument has been implemented
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5 in health centres across the United States, and includes questions about personal characteristics,
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7 family and home (e.g. housing status), money and resources (e.g. education, employment,
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9 food/utilities/clothing/phone security), and social and emotional needs.⁵¹ These tools are broad in
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11 scope as they are intended to “identify any unmet need likely to have a negative impact on
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13 health”.⁴⁹ Criticisms of this breadth include the resultant difficulty in prioritizing unmet needs
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15 and, more fundamentally, whether identified needs (that span from inadequate
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17 housing/food/supports, to transportation needs, to social integration, to stress) are truly
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19 actionable by the healthcare provider or healthcare system.⁴⁶ Furthermore, there are no published
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21 validation studies of these questionnaires. Our study addresses these gaps by validating a new
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23 tool that focuses on social vulnerabilities that are prevalent,⁵¹ evidence-based,^{9 10} and actionable.
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31 The importance of measuring social vulnerabilities cannot be overstated. In a population, only
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33 10% - 20% of preventable mortality can be attributed to medical care; in contrast, social factors
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35 are overwhelmingly influential in affecting health behaviours and outcomes.⁴⁶ The SVS can
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37 identify patient and population needs so that these can be addressed in a comprehensive, multi-
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39 level, and multi-faceted way. While approaches to social barriers have traditionally focused on
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41 population level interventions and policy development, individual-level practice changes and
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43 clinical innovations also have an important part to play.⁵² If we take cost-related medication non-
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45 adherence as an example, individual-level interventions include increasing physician awareness
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47 of medication cost through education and provision of resources, so that a more cost-conscious
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49 prescribing approach can be undertaken.⁵³ At the institutional and systemic level, electronic
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51 health records can be customized to display an alert showing medication costs at the time of
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3 prescribing, along with lower cost alternatives.⁵⁴⁻⁵⁵ Default medication orders in electronic health
4 records can also be shifted to generic, lower cost medications (with the ability to opt out).⁵⁶ Both
5 approaches have been shown to be effective in increasing the prescribing of lower cost
6 medications.⁵⁴⁻⁵⁶ At the population level, broadening prescription drug coverage, removal of
7 coverage gaps and caps, and providing “first-dollar” coverage at no direct cost to patients would
8 all reduce out-of-pocket drug costs to patients.⁵⁷⁻⁵⁹ Ultimately, social vulnerabilities cannot be
9 acted upon if there is no accurate way to measure them. The SVS is therefore a validated
10 instrument that has the potential to inform the delivery of more patient-centred, equitable health
11 care.
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26 One limitation to our study is that we only conducted validation of the SVS in an inpatient
27 cohort. Given the prevalence of social vulnerabilities, and that the social determinants of health
28 influence health and well-being in not just the inpatient population but rather than general
29 population as a whole, the SVS is likely to be applicable and relevant in any patient population.
30 However, we recognize the limitations of extrapolating our data outside of the inpatient cohort.
31 Second, our survey was developed based on the social vulnerabilities identified in qualitative
32 studies of low-income patients in the United States, without similar studies having been done in
33 our specific patient population of interest (i.e. general medical patients in Canada). Therefore,
34 the relevance and representativeness of these social vulnerabilities remains unclear. While it is
35 possible that the SVS does not capture other important social vulnerabilities in our patient
36 population, the domains that *are* included likely remain relevant, with increasing evidence
37 demonstrating their prevalence and/or their associations with hospital readmissions in
38 heterogeneous, broad, populations.⁶⁰⁻⁶³ We also note that in our study, we asked specifically
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3 about social vulnerabilities that may be missing from the SVS – no patients felt that additional
4 questions in additional domains were needed. Lastly, we recognize that the generalizability of
5 the SVS may be limited due to the specificity of the questions asked. For example, in densely
6 populated cities, license and car ownership may not be important determinants of healthcare
7 access.
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17 **CONCLUSION**

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19 Despite the recognition that social determinants of health and their downstream social
20 vulnerabilities are important correlates of patient well-being and ability to self-manage
21 conditions, there has thus far not been a questionnaire that delves into these social barriers. The
22 SVS is a reliable and valid instrument that identifies modifiable social barriers in medical
23 inpatients. An understanding of these social vulnerabilities is essential in developing
24 interventions, health, and social policy that mitigates these vulnerabilities to improve health
25 outcomes.
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DECLARATIONS

Competing interests: All authors declare that they have no competing interests.

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Data sharing: No additional data available

Ethics statement: Ethics approval was obtained from the Conjoint Health Research Ethics Board at the University of Calgary (REB 14-0696). Each participant included in the study provided written informed consent to participate.

Authors' contributions: Each of the six authors meets the authorship requirements as established by the International Committee of Medical Journal Editors in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals. KT, MS, and WG conceived of the study and were involved in study design. LT conducted data collection. KT, TS, and OL were involved in statistical analyses. All authors were involved in data interpretation. KT drafted the manuscript and all authors critically revised the manuscript. All authors have read and approved the manuscript.

REFERENCES

1. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *New England Journal of Medicine* 2009;360(14):1418-28. doi: 10.1056/NEJMsa0803563 [published Online First: 2009/04/03]
2. Gilmour J, Southern D, WA G. Readmission Rates and Determinants in a Higher-Risk Inpatient GIM Population. *Canadian Journal of General Internal Medicine* 2013;18(2):5.
3. Vest JR, Gamm LD, Oxford BA, et al. Determinants of preventable readmissions in the United States: a systematic review. *Implementation Science* 2010;5:88. doi: 10.1186/1748-5908-5-88 [published Online First: 2010/11/19]
4. Singh S, Lin YL, Kuo YF, et al. Variation in the risk of readmission among hospitals: the relative contribution of patient, hospital and inpatient provider characteristics. *J Gen Intern Med* 2014;29(4):572-8. doi: 10.1007/s11606-013-2723-7 [published Online First: 2013/12/07]
5. Hansen LO, Young RS, Hinami K, et al. Interventions to reduce 30-day rehospitalization: a systematic review. *Annals of internal medicine* 2011;155(8):520-28.
6. Horwitz LI. Self-care after hospital discharge: knowledge is not enough. *BMJ Quality and Safety* 2016;26(1) doi: 10.1136/bmjqs-2015-005187
7. Greysen SR, Harrison JD, Kripalani S, et al. Understanding patient-centred readmission factors: a multi-site, mixed-methods study. *BMJ Quality and Safety* 2017;26(1):33-41. doi: 10.1136/bmjqs-2015-004570 [published Online First: 2016/01/16]
8. Greysen SR, Hoi-Cheung D, Garcia V, et al. "Missing Pieces"—Functional, Social, and Environmental Barriers to Recovery for Vulnerable Older Adults Transitioning from Hospital to Home. *Journal of the American Geriatrics Society* 2014;62(8):1556-61. doi: 10.1111/jgs.12928
9. Kangovi S, Barg FK, Carter T, et al. Challenges faced by patients with low socioeconomic status during the post-hospital transition. *J Gen Intern Med* 2014;29(2):283-9. doi: 10.1007/s11606-013-2571-5 [published Online First: 2013/08/07]
10. Strunin L, Stone M, Jack B. Understanding rehospitalization risk: can hospital discharge be modified to reduce recurrent hospitalization? *J Hosp Med* 2007;2(5):297-304.
11. Carter J, Ward C, Thorndike A, et al. Social Factors and Patient Perceptions Associated With Preventable Hospital Readmissions. *J Patient Exp* 2020;7(1):19-26. doi: 10.1177/2374373518825143 [published Online First: 2019/02/07]
12. Bensken WP, Alberti PM, Koroukian SM. Health-Related Social Needs and Increased Readmission Rates: Findings from the Nationwide Readmissions Database. *J Gen Intern Med* 2021;36(5):1173-80. doi: 10.1007/s11606-021-06646-3
13. Daniel H, Bornstein SS, Kane GC. Addressing Social Determinants to Improve Patient Care and Promote Health Equity: An American College of Physicians Position Paper. *Annals of Internal Medicine* 2018;168(8):577-78. doi: 10.7326/M17-2441
14. Kansagara D, Englander H, Salanitro A, et al. Risk prediction models for hospital readmission: a systematic review. *JAMA* 2011;306(15):1688-98. doi: 10.1001/jama.2011.1515 [published Online First: 2011/10/20]
15. Carrillo JE, Carrillo VA, Perez HR, et al. Defining and Targeting Health Care Access Barriers. *J Health Care Poor Underserved* 2011;22(2):562-75. doi: 10.1353/hpu.2011.0037

16. Statistics Canada. Barriers to Care for People with Chronic Health Conditions (BCPCHC) 2012
[Available from:
<http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5189&lang=en&db=imdb&adm=8&dis=2> accessed January 25 2015.
17. Statistics Canada. Canadian Community Health Survey (CCHS): Healthy Aging 2008-2009
[Available from:
http://www23.statcan.gc.ca/imdb/piX.pl?Function=showStaticArchiveHTML&a=1&fl=html://www23.statcan.gc.ca/imdb-bmdi/instrument/5146_Q1_V2-eng.htm&Item_Id=53430 accessed January 25 2015.
18. Moser A, Stuck AE, Silliman RA, et al. The eight-item modified Medical Outcomes Study Social Support Survey: psychometric evaluation showed excellent performance. *Journal of clinical epidemiology* 2012;65(10):1107-16. doi: 10.1016/j.jclinepi.2012.04.007 [published Online First: 2012/07/24]
19. Kountz DS. Strategies for Improving Low Health Literacy. *Postgraduate Medicine* 2009;121(5):171-77. doi: 10.3810/pgm.2009.09.2065
20. Macintyre S, Ellaway A, Kearns A, et al. Housing tenure and car ownership: why do they predict health and longevity?: Health Variations Programme 2000.
21. Dreyer K, Steventon A, Fisher R, et al. The association between living alone and health care utilisation in older adults: a retrospective cohort study of electronic health records from a London general practice. *BMC Geriatrics* 2018;18(1):269. doi: 10.1186/s12877-018-0939-4
22. Shah SJ, Fang MC, Wannier SR, et al. Association of Social Support With Functional Outcomes in Older Adults Who Live Alone. *JAMA Internal Medicine* 2022;182(1):26-32. doi: 10.1001/jamainternmed.2021.6588
23. Ahmed SM, Lemkau JP, Nealeigh N, et al. Barriers to healthcare access in a non-elderly urban poor American population. *Health Soc Care Community* 2001;9(6):445-53. doi: 10.1046/j.1365-2524.2001.00318.x [published Online First: 2002/02/16]
24. Jette AM, Cummings KM, Brock BM, et al. The structure and reliability of health belief indices. *Health services research* 1981;16(1):81-98. [published Online First: 1981/01/01]
25. Fillenbaum GG, Smyer MA. The development, validity, and reliability of the OARS multidimensional functional assessment questionnaire. *J Gerontol* 1981;36(4):428-34. [published Online First: 1981/07/01]
26. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of health and social behavior* 1983;385-96.
27. DeSalvo KB, Bloser N, Reynolds K, et al. Mortality Prediction with a Single General Self-Rated Health Question: A Meta-Analysis. *J Gen Intern Med* 2006;21(3):267-75. doi: 10.1111/j.1525-1497.2005.00291.x
28. Strauss ME, Smith GT. Construct validity: advances in theory and methodology. *Annu Rev Clin Psychol* 2009;5:1-25. doi: 10.1146/annurev.clinpsy.032408.153639
29. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2006;3(2):77-101. doi: <http://dx.doi.org/10.1191/1478088706qp063oa>
30. Garcia J, Evans J, Reshaw M. "Is There Anything Else You Would Like to Tell Us" – Methodological Issues in the Use of Free-Text Comments from Postal Surveys. *Quality and Quantity* 2004;38(2):113-25. doi: 10.1023/B:QUQU.0000019394.78970.df

- 1
- 2
- 3
- 4 31. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications
- 5 for conducting a qualitative descriptive study. *Nurs Health Sci* 2013;15(3):398-405. doi:
- 6 10.1111/nhs.12048 [published Online First: 2013/03/14]
- 7
- 8 32. Colorafi KJ, Evans B. Qualitative Descriptive Methods in Health Science Research. *Herd*
- 9 2016;9(4):16-25. doi: 10.1177/1937586715614171 [published Online First: 2016/01/23]
- 10
- 11 33. Adler NE, Epel ES, Castellazzo G, et al. Relationship of subjective and objective social status
- 12 with psychological and physiological functioning: preliminary data in healthy white
- 13 women. *Health psychology* 2000;19(6):586-92. [published Online First: 2000/12/29]
- 14
- 15 34. University of California San Francisco. The MacArthur Scale of Subjective Social Status 2008
- 16 [Available from: <https://macses.ucsf.edu/research/psychosocial/subjective.php>
- 17 accessed April 5 2019.
- 18
- 19 35. De Vet HC, Terwee CB, Mokkink LB, et al. Measurement in medicine: a practical guide:
- 20 Cambridge University Press 2011.
- 21
- 22 36. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, New
- 23 Jersey: Lawrence Erlbaum Associates 1988.
- 24
- 25 37. Glorfeld LW. An Improvement on Horn's Parallel Analysis Methodology for Selecting the
- 26 Correct Number of Factors to Retain. *Educational and Psychological Measurement*
- 27 1995;55(3):377-93. doi: 10.1177/0013164495055003002
- 28
- 29 38. Ng DM, Jeffery RW. Relationships Between Perceived Stress and Health Behaviors in a
- 30 Sample of Working Adults. *Health Psychology* 2003;22(6):638-42. doi: 10.1037/0278-
- 31 6133.22.6.638
- 32
- 33 39. Idler EL, Benyamini Y. Self-Rated Health and Mortality: A Review of Twenty-Seven
- 34 Community Studies. *Journal of Health and Social Behavior* 1997;38(1):21-37. doi:
- 35 10.2307/2955359
- 36
- 37 40. D'Hooge L, Achterberg P, Reeskens T. Mind over matter. The impact of subjective social
- 38 status on health outcomes and health behaviors. *PLoS ONE* 2018;13(9):e0202489. doi:
- 39 10.1371/journal.pone.0202489
- 40
- 41 41. Berrigan D, Dodd K, Troiano RP, et al. Patterns of health behavior in U.S. adults. *Preventive*
- 42 *Medicine* 2003;36(5):615-23. doi: 10.1016/S0091-7435(02)00067-1
- 43
- 44 42. Rolnick SJ, Pawloski PA, Hedblom BD, et al. Patient characteristics associated with
- 45 medication adherence. *Clinical medicine & research* 2013;11(2):54-65. doi:
- 46 10.3121/cmr.2013.1113
- 47
- 48 43. Lawlor Debbie A, Allgar Victoria L, Hussain-Gambles M, et al. Reasons for and consequences
- 49 of missed appointments in general practice in the UK: questionnaire survey and
- 50 prospective review of medical records. *BMC Family Practice* 2005;6(1):47. doi:
- 51 10.1186/1471-2296-6-47
- 52
- 53 44. Ellis D, McConnachie A, Wilson P, et al. Morbidity, mortality and missed appointments in
- 54 healthcare: a national retrospective data linkage study. *BMC Medicine* 2019;17(1) doi:
- 55 10.1186/s12916-018-1234-0
- 56
- 57 45. Campbell DJT, Ronksley PE, Manns BJ, et al. The association of income with health behavior
- 58 change and disease monitoring among patients with chronic disease. *PLoS ONE*
- 59 2014;9(4) doi: 10.1371/journal.pone.0094007
- 60
46. Adler KG. Screening for Social Determinants of Health: An Opportunity or Unreasonable
- Burden? *Fam Pract Manag* 2018;25(3):3. [published Online First: 2018/07/11]

- 1
2
3 47. Braveman P, Gottlieb L. The social determinants of health: it's time to consider the causes of
4 the causes. *Public Health Rep* 2014;129 Suppl 2:19-31. [published Online First:
5 2014/01/05]
6
- 7 48. Dubinsky M. Predictors of appointment non-compliance in community mental health
8 patients. *Community Ment Health J* 1986;22(2):142-46. doi: 10.1007/BF00754552
9
- 10 49. Billioux A, Verlander K, Anthony S, et al. Standardized Screening for Health-Related Social
11 Needs in Clinical Settings: The Accountable Health Communities Screening Tool. NAM
12 Perspectives. Washington, DC: National Academy of Medicine, 2017.
- 13 50. American Academy of Family Physicians. The EveryONE Project: Assessment and Action
14 2020 [Available from: [https://www.aafp.org/family-physician/patient-care/the-](https://www.aafp.org/family-physician/patient-care/the-everyone-project/toolkit/assessment.html)
15 [everyone-project/toolkit/assessment.html](https://www.aafp.org/family-physician/patient-care/the-everyone-project/toolkit/assessment.html) accessed December 2 2020.
16
- 17 51. Weir RC, Proser M, Jester M, et al. Collecting Social Determinants of Health Data in the
18 Clinical Setting: Findings from National PRAPARE Implementation. *Journal of health care*
19 *for the poor and underserved* 2020;31(2):1018-35. doi: 10.1353/hpu.2020.0075
20
- 21 52. Gottlieb L, Sandel M, Adler NE. Collecting and Applying Data on Social Determinants of
22 Health in Health Care Settings. *JAMA Internal Medicine* 2013;173(11):1017-20. doi:
23 10.1001/jamainternmed.2013.560
- 24 53. Korn LM, Reichert S, Simon T, et al. Improving physicians' knowledge of the costs of
25 common medications and willingness to consider costs when prescribing. *J Gen Intern*
26 *Med* 2003;18(1):31-37.
27
- 28 54. Gipson G, Kelly JL, McKinney CM, et al. Optimizing prescribing practices of high-cost
29 medications with computerized alerts in the inpatient setting. *American Journal of*
30 *Medical Quality* 2017;32(3):278-84.
31
- 32 55. Monsen CB, Liao JM, Gaster B, et al. The effect of medication cost transparency alerts on
33 prescriber behavior. *Journal of the American Medical Informatics Association*
34 2019;26(10):920-27. doi: 10.1093/jamia/ocz025
- 35 56. Patel MS, Day S, Small DS, et al. Using Default Options Within the Electronic Health Record
36 to Increase the Prescribing of Generic-Equivalent Medications. *Annals of Internal*
37 *Medicine* 2014;161(10_Supplement):S44-S52. doi: 10.7326/M13-3001
38
- 39 57. Brandt J, Shearer B, Morgan SG. Prescription drug coverage in Canada: a review of the
40 economic, policy and political considerations for universal pharmacare. *Journal of*
41 *Pharmaceutical Policy and Practice* 2018;11(1):28. doi: 10.1186/s40545-018-0154-x
42
- 43 58. Kesselheim AS, Huybrechts KF, Choudhry NK, et al. Prescription Drug Insurance Coverage
44 and Patient Health Outcomes: A Systematic Review. *American Journal of Public Health*
45 2014;105(2):e17-e30. doi: 10.2105/AJPH.2014.302240
- 46 59. Morgan SG, Boothe K. Universal prescription drug coverage in Canada: Long-promised yet
47 undelivered. *Healthcare Management Forum* 2016;29(6):247-54. doi:
48 10.1177/0840470416658907
49
- 50 60. Cakir B, Kaltounis S, K DJ, et al. Hospital Readmissions from Patients' Perspectives. *South*
51 *Med J* 2017;110(5):353-58. doi: 10.14423/smj.0000000000000646 [published Online
52 First: 2017/05/04]
53
- 54 61. Dupre ME, Xu H, Granger BB, et al. Access to routine care and risks for 30-day readmission
55 in patients with cardiovascular disease. *Am Heart J* 2018;196:9-17. doi:
56 10.1016/j.ahj.2017.10.001 [published Online First: 2018/02/09]
57
58
59

- 1
2
3 62. Schultz BE, Corbett CF, Hughes RG, et al. Scoping review: Social support impacts hospital
4 readmission rates. *J Clin Nurs* 2021 doi: 10.1111/jocn.16143
5
6 63. Holbrook AM, Wang M, Lee M, et al. Cost-related medication nonadherence in Canada: a
7 systematic review of prevalence, predictors, and clinical impact. *Systematic Reviews*
8 2021;10(1):11. doi: 10.1186/s13643-020-01558-5
9
10
11
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Figure Legends

Figure 1- Scree plot of eigenvalues of the Social Vulnerabilities Survey

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Table 1: Social Vulnerabilities Survey Questionnaire

Question	Response variable		
	Categorical	Ordinal	Continuous
1. Do you have a valid driver's license? ^a	✓		
2. In the past month, how often did you drive? ^a	✓		
3. Do you or someone in your household own a car?	✓		
4. In the past month, which of the following other forms of transportation have you used? ^a	✓		
5. In general, which is your most common form of transportation? ^a	✓		
6. How long does it take to get to your family doctor's office, using whatever form of transportation you usually use to get there?			✓
7. How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?			✓
8. How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?			✓
9. In the past 1 year, have you had difficulty keeping an appointment with a healthcare provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?	✓		
10. In the past year, have you had difficulty following suggestions from a healthcare provider to make lifestyle changes (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at the time?	✓		
11. In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?	✓		
12. In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?	✓		
13. In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?	✓		
14. In your current circumstance, how important is your health to you?		✓	
15. How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?		✓	
16. What areas in your life make it difficult to focus on your health?	✓		
17. If you needed it, how often is someone available to help you if you were confined to bed? ^b		✓	
18. If you needed it, how often is someone available to take you to the doctor? ^b		✓	
19. If you needed it, how often is someone available to prepare your meals if you were unable to do it yourself? ^b		✓	
20. If you needed it, how often is someone available to help you with daily chores if you were sick? ^b		✓	
21. If you needed it, how often is someone available to have a good time with? ^b		✓	
22. If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem? ^b		✓	
23. If you needed it, how often is someone available who understands your problems? ^b		✓	
24. If you needed it, how often is someone available to love and make you feel wanted? ^b		✓	
25. a) Do you live alone?	✓		
b) If no: What is your relationship with the people living with you?	✓		
26. Do you have drug insurance?	✓		
27. What percentage of drug costs do you have to pay out-of-pocket?		✓	
28. In the past 1 year, have you not filled a prescription because of cost?	✓		
29. In the past 1 year, have you not skipped medication doses because of cost (to save money)?	✓		
30. How much money do you pay out-of-pocket for your own medications, in total, over one year?			✓
31. How much money do you or your household pay out-of-pocket for the entire household's own medications over one year?			✓
32. In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?	✓		
33. a) Do you care, or help to care, for any dependants under 18 years of age?	✓		
b) If yes: In the past 1 year, have missed an appointment with a health care provider, didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not find or afford child-care	✓		

^a Questions 1, 2, 4, 5 are from the Canadian Community Health Survey – Healthy Aging Questionnaire ¹⁷

^b Questions 17 to 24 are from the 8-item modified Medical Outcomes Study Social Support Survey ¹⁸

Table 2: Sample characteristics

		Frequency (%) N=406
Age	Mean (SD)	55.5 (18.6)
Male		225 (55.4%)
First language English		346 (85.2%)
Born in Canada		293 (72.4%)
Ethnicity	Caucasian	274 (68.0%)
	Aboriginal	38 (9.4%)
	Chinese	22 (5.5%)
	South Asian	20 (5.0%)
	Other	49 (12.2%)
Marital Status	Married	182 (44.7%)
	Common-Law	37 (9.1%)
	Widowed	34 (8.4%)
	Divorced/Separated	52 (12.8%)
	Single	102 (25.1%)
Education	Less Than High School	80 (19.8 %)
	High School Graduate	98 (24.2%)
	Certificate or Diploma	37 (9.1%)
	Some postgraduate	108 (26.7%)
	Post-secondary graduate	82 (20.3%)
Employment	Currently Working	124 (30.5%)
	Unemployed	37 (9.1%)
	Temporary LOA	28 (6.9%)
	Permanently Unable to Work	29 (7.1%)
	Retired	158 (38.9%)
	Other	30 (7.4%)
Household Income	<\$15 000	44 (10.9%)
	\$15 000 - \$24 999	42 (10.4%)
	\$25 000 - \$49 999	57 (14.1%)
	\$50 000 - \$74 999	48 (11.9%)
	\$75 000 - \$99 999	31 (7.7%)
	\$100 000 - \$124 999	19 (4.7%)
	\$125 000 - \$149 999	7 (1.7%)
	\$150 000 - \$174 999	9 (2.2%)
	\$175 000 - \$199 999	6 (1.5%)
≥\$200 000	24 (6.0%)	
Do not know, Do not wish to answer	116 (28.8%)	
Number of Individuals dependent on this household Income	1	133 (33.0%)
	2	155 (38.5%)
	3	52 (12.9%)
	4	37 (9.2%)
	5 or greater	26 (6.5%)
Currently Homeless		17 (4.2%)
Societal SSS	Mean (SD)	5.7 (2.1%)
Community SSS	Mean (SD)	5.4 (2.4%)
Number of Elixhauser Comorbidities	0	43 (11.1%)
	1	82 (21.1%)
	2	106 (27.3%)
	3	80 (20.6%)
	4	41 (10.6%)
	5 or greater	36 (9.3%)

Abbreviations: LOA- leave of absence; SSS- subjective social status; SD- standard deviation

Table 3: Salience of health questions and response characteristics

Question	Response	n (% ^a)
Q1 In the past 1 year, have you had difficulty following suggestions from a health care provider to make lifestyle changes (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at that time?	Yes	122 (30.7)
	No	120 (30.2)
	N/A: No lifestyle changes have been recommended	155 (39.0)
Q2 In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?	Yes	63 (15.9)
	No	277 (69.9)
	N/A: No tests have been ordered	56 (14.4)
Q3 In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?	Yes	49 (12.4)
	No	326 (82.3)
	N/A: I am not on any medications	21 (5.3)
Q4 In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?	Yes	56 (14.1)
	No	326 (82.3)
	N/A: I have not had any appointments	14 (3.5)
Q5 In your current circumstance, how important is your health to you?	Not important at all	0 (0.0)
	Not very important	1 (0.3)
	Neutral	15 (3.8)
	Important	71 (18.1)
	Very important	306 (77.9)
Q6 How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?	Very hard	5 (1.3)
	Hard	67 (17.1)
	Neutral	84 (21.4)
	Easy	174 (44.4)
	Very easy	62 (15.8)
Q7 What areas in your life make it difficult to focus on your health? ^b	No area makes it difficult	162 (39.9)
	Worrying about money	126 (32.2)
	Worrying about basic needs (e.g. food)	38 (9.7)
	Housing situation is unstable	46 (11.8)
	Working about job security	51 (13.0)
	I have too many job responsibilities	39 (10.0)
	I have too many household responsibilities	28 (7.2)
	Worrying about school	10 (2.6)
	Relationship issues or conflict	48 (12.3)
I am a caregiver for a friend/family member who is ill	25 (6.4)	
Other	34 (8.7)	

^a Total number of respondents for each question: Q1 – 397; Q2 to Q4 – 396; Q5 – 393; Q6 – 392; Q7 – 391

^b Respondents may check up to three items

Abbreviations: N/A- not applicable; Q- question number

Table 4: Correlation matrix of salience of health with self-reported and demographic variables

	Self-Rated Health	Perceived Stress Scale Score	Societal SSS	Community SSS	Sociodemographics				
					Age	Income	Unemployed / Unable to work	Stay at home parent/spouse	Has regular family doctor
Q1: Difficulty making lifestyle changes	-0.17	0.34	-0.19	-0.17	-0.27	-0.09	0.34	-0.06	-0.19
Q2: Difficulty getting investigations	-0.18	0.33	-0.14	-0.17	-0.30	-0.17	0.39	0.13	-0.22
Q3: Stopping medications	-0.12	0.37	-0.21	-0.16	-0.31	-0.28	0.49	-0.03	-0.27
Q4: Skipping appointments	-0.01	0.37	-0.23	-0.28	-0.41	-0.19	0.55	-0.08	-0.08
Q5: Importance of health	0.03	-0.17	0.11	0.12	0.08	0.09	-0.07	-0.05	0.30
Q6: Perceived difficulty maintaining health	-0.22	0.28	-0.18	-0.20	-0.16	-0.04	-0.08	0.04	-0.13
Q7: Worry about basic needs (housing, basic needs)	-0.31	0.39	-0.32	-0.33	-0.37	-0.62	0.45	0.15	-0.21
Q7: Worry about money	-0.001	0.44	-0.34	-0.40	-0.34	-0.41	0.36	0.07	-0.11
Q7: Worry about domestic responsibilities and caregiving	0.08	0.23	-0.01	0.04	-0.15	0.098	0.09	0.43	0.01
Q7: Worry about school	0.05	0.19	-0.12	0.01	-0.87	0.01	-0.23	0.17	.*
Q7: Number of areas of worry (1 vs 2+)	-0.08	0.49	-0.30	-0.29	-0.48	-0.31	0.40	0.16	-0.11

*Unable to calculate due to number of missing observations

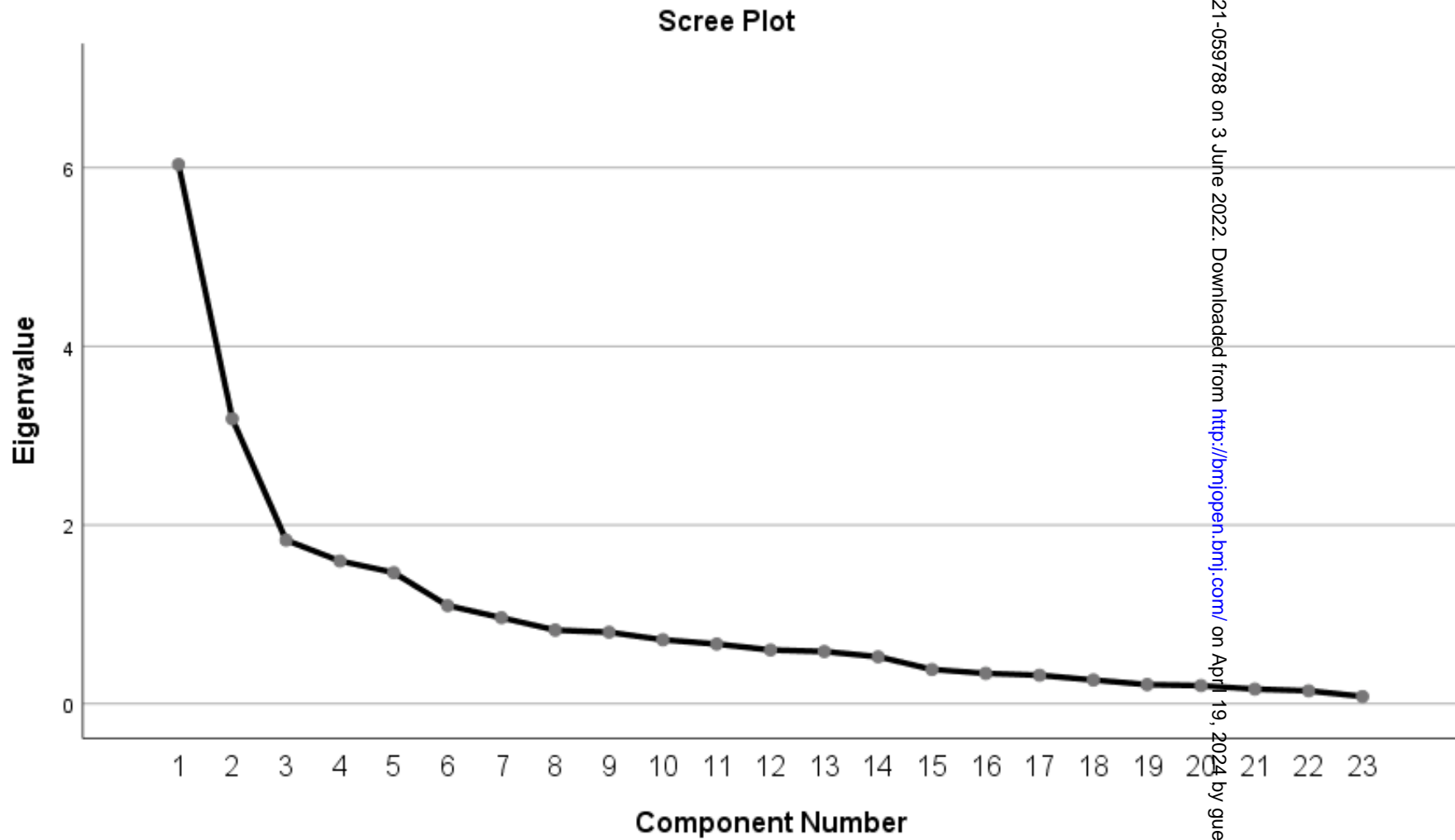
Abbreviations: SSS – subjective social status

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Table 5: Summary of hypothesis testing of correlations

Discriminant Validity		N=34 hypotheses
No correlation as predicted		18 (53%)
Positive correlation demonstrated		7 (21%)
	Small	7
	Moderate	0
	Large	0
Negative correlation demonstrated		9 (26%)
	Small	8
	Moderate	1
	Large	0
Convergent Validity		N=64 hypotheses
Correlation strength and direction exactly as predicted		39 (61%)
No correlation observed while correlation was predicted		8 (13%)
Direction of observed correlation the same as predicted		16 (25%)
	Off by 1 strength category	16
	Off by 2 strength categories	0
Direction of observed correlation direction opposite of predicted		1 (2%)

Figure 1



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Appendix 1: Social Vulnerabilities Survey**A. Transportation**

1. Do you have a valid driver's license?

Yes

No

2. In the past month, how often did you drive?

6 or 7 days a week

4 or 5 days a week

1 to 3 days a week

1 to 3 days a month

Not at all in the last month

3. Do you or someone in your household own a car?

Yes

No

4. In the past month, which of the following other forms of transportation have you used? *(Check all that apply)*

Passenger in a motorized vehicle

Taxi

Public transportation

Calgary Handibus or Access Calgary Service

Cycling

Walking

Wheelchair or motorized

Other. Please specify:

5. What is your most common form of transportation?

Drive a motor vehicle

Passenger in a motor vehicle

Taxi

Public transportation

Calgary Handibus or Access Calgary Service

Cycling

Walking

Wheelchair or motorized cart

Other. Please specify:

6. How long does it take to get to your family doctor's office, using whatever form of transportation you usually use to get there?

(in minutes)

7. How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?

(in minutes)

8. How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?

(in minutes)

9. In the past 1 year, have you had difficulty keeping an appointment with a health care provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?

Yes

- 1
2 No
3 N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year
4

5 **B. Health Salience**

- 6
7 10. In the past 1 year, have you had difficulty following suggestions from a health care provider to make lifestyle changes
8 (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at that time?
9 Yes
10 No
11 N/A: No lifestyle changes have been recommended
12
- 13 11. In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book
14 them) because other circumstances in your life took priority at that time?
15 Yes
16 No
17 N/A: No tests have been ordered
18
- 19 12. In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that
20 time?
21 Yes
22 No
23 N/A: I am not on any medications
24
- 25 13. In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in
26 your life took priority at that time?
27
28 Yes
29 No
30 N/A: I have not had any appointments
31
- 32 14. In your current circumstance, how important is your health to you?
33 Not very important
34 Not important
35 Neutral
36 Important
37 Very important
38
- 39 15. How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?
40 Very hard
41 Hard
42 Neutral
43 Easy
44 Very easy
45
- 46 16. What areas in your life make it difficult to focus on your health? (*Check up to three*)
47 No area makes it difficult
48 Worrying about money
49 Worrying about basic needs (e.g. food)
50 Housing situation is unstable
51 Worrying about job security
52 I have too many job responsibilities
53 I have too many household responsibilities
54 Worrying about school
55 Relationship issues or conflict
56 I am a caregiver for a friend/family member who is ill
57
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59
60

Other. Please specify:

C. Social Support

17. If you needed it, how often is someone available to help you if you were confined to bed?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

18. If you needed it, how often is someone available to take you to the doctor?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

19. If you needed it, how often is someone available to prepare your meals if you were unable to do it yourself?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

20. If you needed it, how often is someone available to help you with daily chores if you were sick?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

21. If you needed it, how often is someone available to have a good time with?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

22. If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

23. If you needed it, how often is someone available who understands your problems?

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

24. If you needed it, how often is someone available to love and make you feel wanted?

- None of the time
 A little of the time
 Some of the time
 Most of the time
 All of the time

25. a) Do you live alone?

- Yes
 No

25. b) If no: What is your relationship with the people living with you? (Check all that apply)

- Spouse or partner
 Children
 Parents
 Extended family (e.g. grandparents, aunts, uncles, nieces, nephews, cousins)
 Friends or roommates
 Tenants
 Other. Please specify:

D. Financial Barriers

26. Do you have drug insurance?

- Yes
 No

27. What percentage of drug costs do you have to pay out-of-pocket?

- 0%
 1-10%
 11-20%
 21-30%
 31-40%
 41-50%
 >50%

28. In the past 1 year, have you not filled a prescription because of cost?

- Yes
 No
 N/A: I have not been on any prescription medications in the past year

29. In the past 1 year, have you not skipped medication doses because of cost (to save money)?

- Yes
 No
 N/A: I have not been on any prescription medications in the past year

30. How much money do you pay out-of-pocket for your own medications, in total, over one year?

(in Canadian dollars)

31. How much money do you or your household pay out-of-pocket for the entire household's own medications over one year?

(in Canadian dollars)

32. In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?

- Yes
 No

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N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year

33. a) Do you care, or help to care, for any dependants under 18 years of age?

- Yes
- No

33. b) If yes: In the past 1 year, have missed an appointment with a health care provider, didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not find or afford child-care

- Yes
- No
- N/A: I have not needed to see a health care provider, or get lab tests or x-rays done in the past year

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Appendix 2: Background Information Survey**A. Self-Rated Health**

1. How would you rate your health today?

- Excellent
 Good
 Fair
 Poor
 Bad

B. Perceived Stress

2. In the last year, how often have you felt that you were unable to control the important things in your life?

- Never
 Almost never
 Sometimes
 Fairly often
 Very often

3. In the last year, how often have you felt confident about your ability to handle your personal problems?

- Never
 Almost never
 Sometimes
 Fairly often
 Very often

4. In the last year, how often have you felt that things were going your way?

- Never
 Almost never
 Sometimes
 Fairly often
 Very often

5. In the last year, how often have you felt that difficulties were piling up so high that you could not overcome them?

- Never
 Almost never
 Sometimes
 Fairly often
 Very often

C. Health Beliefs

6. For most kinds of illnesses, it is the doctor who can help you the most.

- Disagree
 Neutral
 Agree

7. Home remedies are often much better than the drugs that doctors prescribe.

- Disagree
 Neutral
 Agree

8. You seem to get illnesses that doctors can't do much for.

- Disagree
 Neutral

- 1
2 Agree
3
4 9. If you follow a doctor's advice, you will have less illness in your lifetime.
5 Disagree
6 Neutral
7 Agree
8
9 10. Whenever you get sick, it seems to be very serious.
10 Disagree
11 Neutral
12 Agree
13
14 11. You get the kinds of illnesses that worry you a great deal.
15 Disagree
16 Neutral
17 Agree
18
19 12. In general, when you get sick, how much does it interfere with your usual activities?
20 Not at all
21 A little
22 A moderate amount
23 A great deal
24

25 **D. Baseline function**
26

- 27 13. In the past month, have you been able to walk:
28 Without help (except from a cane if needed)
29 With some help (from a person, walker, or crutches)
30 Completely unable to walk
31
32 14. In the past month, have you been able to eat:
33 Without help
34 With some help (need help with cutting, etc)
35 Completely unable to feed yourself
36
37 15. In the past month, have you been able to dress and undress:
38 Without help
39 With some help
40 Completely unable to dress or undress yourself
41
42 16. In the past month, have you been able to bathe or shower:
43 Without help
44 With some help (getting in and out of the tub, or need special attachments to the tub)
45 Completely unable to bathe or shower yourself
46
47 17. In the past month, have you been able to do your housework:
48 Without help
49 With some help (can do light housework but need help with heavy work)
50 Completely unable to do housework
51
52 18. In the past month, have you been able to prepare your meals:
53 Without help
54 With some help (can prepare some things but cannot cook full meals)
55 Completely unable to prepare any meals
56
57
58
59
60

E. Health care use

19. Do you have a regular family doctor?

- Yes
 No

20. In the past 1 year, have you used mobile lab services (where you get lab tests done in your home)?

- Yes
 No
 N/A: I have needed to get any lab tests in the past year

21. a) Do you have home care publicly provided to you (for example, through Alberta Health Services)?

- Yes
 No

21. b) If yes: What does home care help you with? (*Check all that apply*)

- Personal hygiene (bathing, grooming, oral care)
 Dressing/undressing
 Toileting and/or catheter maintenance
 Mobilizing and transferring
 Help with dining
 Help with medications
 Wound care
 Other. Please specify:

22. a) Do you pay privately for home care or for a caregiver (excluding help with housework or preparation of meals)?

- Yes
 No

22. b) If yes: What does home care help you with? (*Check all that apply*)

- Personal hygiene (bathing, grooming, oral care)
 Dressing/undressing
 Toileting and/or catheter maintenance
 Mobilizing and transferring
 Help with dining
 Help with medications
 Wound care
 Other. Please specify:

23. In the past month, have you or your household paid for someone to do the housework in your home?

- Yes
 No

24. In the past month, have you or your household paid for someone to prepare your meals?

- Yes
 No

F. Socio-demographics

25. Are you a:

- Man
 Woman

26. Is English the language that you speak best?

- Yes

- 1
2 No
3
4 27. a) Were you born in Canada?
5 Yes
6 No
7
8 27. b) If no: In what country were you born?
9 27. c) If no: What year did you come to Canada?
10
11
12 28. What is your cultural or ethnic background?
13 Aboriginal
14 Arab/West Asian (e.g. Armenian, Egyptian, Iranian, Lebanese, Moroccan)
15 Black (e.g. African, Haitian, Jamaican, Somali)
16 Chinese
17 Filipino
18 Japanese
19 Korean
20 Latin American
21 South Asian (e.g. Bengali, East Indian, Nepali, Pakistani, Sri Lankan)
22 South East Asian (e.g. Indonesian, Malaysian, Thai, Cambodian, Singaporean, Vietnamese)
23 White (Caucasian)
24 French-Canadian
25 Other. Please specify:
26
27 29. What is your age?
28
29 30. What is your marital status?
30 Married
31 Living common-law
32 Widowed
33 Divorced
34 Separated
35 Single, never married
36
37 31. What is your occupation?
38
39 32. Which statement best describes your work situation just before coming into hospital?
40 Currently working
41 Unemployed or looking for work
42 Stay at home spouse or parent
43 Student
44 Unpaid volunteer
45 Temporary leave of absence
46 Permanently unable to work
47 Retired
48
49 33. What is the highest level of education you completed?
50 Less than high school
51 High school graduate
52 Apprenticeship or trades certificate or diploma
53 Some post-secondary (college or university)
54 Post-secondary graduate
55
56
57
58
59
60

1
2 34. a) What is your best estimate of the total income, before taxes and deductions, of all household members from all
3 sources in the past 12 months?

- 4 Less than \$15,000
5 \$15,000 to less than \$25,000
6 \$25,000 to less than \$50,000
7 \$50,000 to less than \$75,000
8 \$75,000 to less than \$100,000
9 \$100,000 to less than \$125,000
10 \$125,000 to less than \$150,000
11 \$150,000 to less than \$175,000
12 \$175,000 to less than \$200,000
13 \$200,000 and over
14 Do not know
15 Do not wish to answer

16
17 35. How many people, including yourself, are dependent on this income?
18

19 36. MacArthur Scale of Subjective Social Status: Community
20

21 **Think of this ladder as representing where people stand in their communities.**

22
23 People define community in different ways; please define it in whatever way is most meaningful
24 to you. At the **top** of the ladder are the people who have the highest standing in their community.
25 At the **bottom** are the people who have the lowest standing in their community.

26 **Where would you place yourself on this ladder?**

27
28 Please place a large "X" on the rung where you think you stand
29 at this time in your life, relative to other people in your community.



37. MacArthur Scale of Subjective Social Status: Society (*Replace "United States" with "Canada"*)

Think of this ladder as representing where people stand in the United States.

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?

Please place a large "X" on the rung where you think you stand at this time in your life, relative to other people in the United States.



Appendix 3: Hypothesized correlations between health salience questions and patient background characteristics

	Self-Rated Health	Perceived Stress	Societal SSS	Community SSS	Socio-demographics				
					Age	Income	Unemployed or Unable to work permanently or temporarily	Employed as stay-at-home parent or spouse	Regular family doctor
Q1: Difficulty making lifestyle changes	-1	+2	-1	-1	-1	-2	+2	0	0
Q2: Difficulty getting investigations	-1	+2	-1	-1	-1	-2	+2	0	0
Q3: Stopping medications	-1	+2	-1	-1	-1	-2	+2	0	0
Q4: Skipping appointments	-1	+2	-1	-1	-1	-1	+2	0	0
Q5: Importance of health	0	0	0	0	0	0	0	0	+1
Q6: Perceived difficulty maintaining health	-2	+2	-1	-1	+2	-2	+2	0	0
Q7: Worry about basic needs (housing, basic needs)	-2	+3	-2	-1	-1	-3	+2	0	-1
Q7: Worry about money	0	+2	-2	-1	-1	-2	+2	0	-1
Q7: Worry about domestic responsibilities and caregiving	0	+1	-1	-2	-1	-1	0	+3	0
Q7: Worry about school	0	0	0	0	-3	0	0	0	0
Q7: Number of areas of worry (1 vs 2+)	-1	+2	-1	-1	0	-2	+2	0	0

Where -2=moderate negative correlation; -1= small negative correlation; 0= no correlation; +1= small positive correlation; +2=moderate positive correlation; +3= strong positive correlation

Abbreviations: Q- question number, SSS – subjective social status

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Appendix 4: Frequency of missing data

Question	Missing data N=406 n(%)
1. Do you have a valid driver's license?	9 (2.2)
2. In the past month, how often did you drive?	110 (27.1)
3. Do you or someone in your household own a car?	9 (2.2)
4. In the past month, which of the following other forms of transportation have you used?	41 (10.1)
5. What is your most common form of transportation?	10 (2.5)
6. How long does it take to get to your family doctor's office, using whatever form of transportation you usually use to get there?	52 (12.8)
7. How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?	51 (12.6)
8. How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?	26 (6.4)
9. In the past 1 year, have you had difficulty keeping an appointment with a healthcare provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?	9 (2.2)
10. In the past year, have you had difficulty following suggestions from a healthcare provider to make lifestyle changes (e.g. diet, exercise, smoking, alcohol use) because other circumstances took priority at the time?	164 (40.4)
11. In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?	66 (16.3)
12. In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?	10 (2.5)
13. In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?	10 (2.5)
14. In your current circumstance, how important is your health to you?	13 (3.2)
15. How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?	14 (3.5)
16. What areas in your life make it difficult to focus on your health?	15 (3.7)
17. If you needed it, how often is someone available to help you if you were confined to bed?	10 (2.5)
18. If you needed it, how often is someone available to take you to the doctor?	10 (2.5)
19. If you needed it, how often is someone available to prepare your meals if you were unable to do it yourself?	10 (2.5)
20. If you needed it, how often is someone available to help you with daily chores if you were sick?	12 (3.0)
21. If you needed it, how often is someone available to have a good time with?	269 (66.3)
22. If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?	11 (2.7)
23. If you needed it, how often is someone available who understands your problems?	11 (2.7)
24. If you needed it, how often is someone available to love and make you feel wanted? ^a	11 (2.7)
25. Do you live alone?	10 (2.5)
26. Do you have drug insurance?	10 (2.5)
27. What percentage of drug costs do you have to pay out-of-pocket?	42 (10.3)
28. In the past 1 year, have you not filled a prescription because of cost?	35 (8.6)
29. In the past 1 year, have you not skipped medication doses because of cost (to save money)?	35 (8.6)
30. How much money do you pay out-of-pocket for your own medications, in total, over one year?	50 (12.3)
31. How much money do you or your household pay out-of-pocket for the entire household's own medications over one year?	164 (40.4)
32. In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?	18 (4.4)
33. Do you care, or help to care, for any dependants under 18 years of age?	345 (85.0)

Appendix 5: Factor loadings of social vulnerability questions – With imputation of missing ordinal and continuous data

Question	Factor 1: Social Support	Factor 2: Saliency of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have a valid driver’s license?				-0.536	
Do you or someone in your household own a car?					
How long does it take to get to your family doctor’s office, using whatever form of transportation you usually use to get there?				0.619	
How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?				0.680	
How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?				0.767	
In the past 1 year, have you had difficulty keeping an appointment with a health care provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?					
In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?		0.644			
In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?		0.704			
In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?		0.783			
In your current circumstance, how important is your health to you?					
How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?					
What areas in your life make it difficult to focus on your health? (2 or more items checked)		0.560			
If you needed it, how often is someone available to help you if you were confined to bed?	0.877				
If you needed it, how often is someone available to help you to take you to the doctor?	0.837				
How often is someone available to prepare your meals if you were unable to do it yourself?	0.922				
How often is someone available to help you with daily chores if you were sick?	0.898				
If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?	0.818				
How often is someone available who understands your problems?	0.808				
How often is someone available to love and make you feel wanted?	0.761				

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Question	Factor 1: Social Support	Factor 2: Salience of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have drug insurance?			-0.906		
What percentage of drug costs do you have to pay out-of-pocket?			0.916		
In the past 1 year, have you not filled a prescription because of cost?		0.581			
In the past 1 year, have you skipped medication doses because of cost (to save money)?		0.654			
Do you live alone?	-0.526				
How much money do you or your household pay out-of-pocket in total for the entire household's medications over one year?					0.880
How much money do you pay out-of-pocket for your own medications in total, over one year?					0.857
In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?		0.569			
Empty cells represent factor loadings <0.5					

Appendix 6: Factor loadings of social vulnerability questions – Using raw data without imputation

Question	Factor 1: Social Support	Factor 2: Saliency of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have a valid driver’s license?				-0.526	
Do you or someone in your household own a car?					
How long does it take to get to your family doctor’s office, using whatever form of transportation you usually use to get there?				0.724	
How long does it take to get to a walk-in clinic, using whatever form of transportation you usually use to get there?				0.654	
How long does it take to get to a lab to get blood tests done, using whatever form of transportation you usually use to get there?				0.843	
In the past 1 year, have you had difficulty keeping an appointment with a health care provider, getting a lab test or x-ray done, or had difficulty getting the health care you needed because you had no way of getting there?					
In the past 1 year, was there a time when you did not get blood, urine, or imaging tests done (and did not re-book them) because other circumstances in your life took priority at that time?		0.628			
In the past 1 year, have you stopped any medications because other circumstances in your life took priority at that time?		0.690			
In the past 1 year have you skipped any appointments to see a health care provider because other circumstances in your life took priority at that time?		0.724			
In your current circumstance, how important is your health to you?					
How easy do you think it will be to find time and energy to try to keep healthy after you leave the hospital?					
What areas in your life make it difficult to focus on your health? (2 or more items checked)		0.534			
If you needed it, how often is someone available to help you if you were confined to bed?	0.882				
If you needed it, how often is someone available to help you to take you to the doctor?	0.810				
How often is someone available to prepare your meals if you were unable to do it yourself?	0.871				
How often is someone available to help you with daily chores if you were sick?	0.838				
If you needed it, how often is someone available to turn to for suggestions about how to deal with a personal problem?	0.708				
How often is someone available who understands your problems?	0.688				
How often is someone available to love and make you feel wanted?	0.709				

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Question	Factor 1: Social Support	Factor 2: Salience of health	Factor 3: Drug coverage	Factor 4: Transportation barriers	Factor 5: Drug costs
Do you have drug insurance?			-0.823		
What percentage of drug costs do you have to pay out-of-pocket?			0.845		
In the past 1 year, have you not filled a prescription because of cost?		0.676			
In the past 1 year, have you skipped medication doses because of cost (to save money)?		0.702			
Do you live alone?	-0.526				
How much money do you or your household pay out-of-pocket in total for the entire household's medications over one year?					0.905
How much money do you pay out-of-pocket for your own medications in total, over one year?					0.910
In the past 1 year, have you missed an appointment with a health care provider, or didn't get a lab test or x-ray done, or didn't get the health care you needed because you could not financially afford to miss work?		0.504			
Empty cells represent factor loadings <0.5					

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants; describe methods of follow-up	9
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	N/A
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11-13
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement); describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	13
Study size	10	Explain how the study size was arrived at	N/A

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12-13
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11-13
		(b) Describe any methods used to examine subgroups and interactions	12
		(c) Explain how missing data were addressed	12-13
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	N/A
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	
Participants	13*	<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	13
		(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13; Appendix 4
Descriptive data	14*	(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	N/A
		(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13; Table 2
Outcome data	15*	(b) Indicate number of participants with missing data for each variable of interest	Appendix 4
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
		<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	
Main results	16	<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	15-16
		(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-16; Tables 4, 5; Appendices 5, 6
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	17; Appendix 6
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.