Determinants of avoidable hospitalization in chronic disease:

Development of a predictor matrix

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Abstract:

Avoidable hospital admissions are seen as an indicator of a strong primary care system and an effective health system. The rise in hospital admissions for ambulatory-sensitive conditions has been causing alarm for some time. Despite a large amount of research in this area, there is still little clarity about how rates might be reduced. This study is a review of published papers that identify significant predictors of hospitalization. It identified 31 key factors that consistently influenced hospital admission. However, the complexity of these factors was noted in that they interact with each other in a way that is not yet fully understood. Using a model of the social determinants of health, it is possible to identify areas where investment might improve hospitalization rates in future.

In 2001, Mertz (2001) warned that there was “a national crisis looming” (p.1) in the delivery of adequate hospital services to communities in the USA. Similarly, Enderby and Wade (2001) noted that growing demand for hospital beds, especially in the elderly and people with chronic disabling conditions, has created significant concerns in the UK. Australia is no different. It is now widely acknowledged in Australia that “the health system is struggling to maintain and respond to the health and well-being of our communities” (Telfer, 2004, p.1). As a result of current health trends, such as increased life expectancies, a shift from acute to chronic conditions, higher levels of anxiety and depression, obesity and drug use and an increasingly market-driven healthcare, Australian health systems are struggling to deliver their services efficiently. These challenges are complicated by workforce shortages, geographical dispersion, changing demographics and technological innovation.

As the demand for health services increases, the health system faces pressure to simultaneously address patient needs and contain costs (Segal, 1998). In this situation, it is tempting to search for easy or immediate solutions, such as the acquisition of additional funds or an increase in the number of hospital beds. However, most researchers and health policy-makers will acknowledge that increasing access to acute hospital services, particularly for individuals with chronic and complex conditions, is not sufficient to address the cause of the problem (de Beor, Wijker & Haes, 1997).

One area that could be addressed is that of hospital admissions arising from the acute exacerbation of a chronic condition. These hospital admissions are considered to be symptomatic of a less than optimal health system (Billings, Anderson & Newman, 1996). A disproportionate number of avoidable hospital admissions occur in relation to chronic conditions, usually due to an acute exacerbation of one or more symptoms and often as a result of the absence of preventative measures or timely access to primary health care services (Basu, Friedman & Burstin, 2002; Laditka & Laditka, 2006; Page, Ambrose, Glover & Hetzel, 2007). Avoidable hospital admissions are defined as admissions that might ordinarily have been controlled or avoided (Guo, MacDowell). Using this definition, researchers have reported consistent rates of avoidable admissions of up to 10% of total hospital admissions (Cloutier-Fisher, Penning, Zheng & Druyts, 2006; Glover, 2007). In Australia, this figure equates to more than half a million admissions that could be potentially avoided in a single calendar year (Page et al., 2007). When one considers the cost of these avoidable admissions, there is a clear need to better understand the factors that predict hospitalization in individuals with chronic disease. From this information, it is possible to develop future initiatives that can address the multi-factorial nature of health service utilization and hospital admission.

The unsustainable situation currently being faced in most hospital systems has prompted a renewed focus on health system reform, with an increasing emphasis on the promotion of well-being and maintenance of good health,

rather than on a crisis-oriented disease-focused model of service provision (Frank, 1987; Siler-Wells, 1987).

Despite the interest in avoidable hospital admissions, empirical models of hospital avoidance remain under-developed. An extensive body of research exists around avoidable hospitalization in chronic disease, but the knowledge in this area remains confusing and contradictory. This situation is further complicated by the presence of heterogeneous outcomes, methodologies and populations that restrict the synthesis of information and increase the likelihood of a disparate evidence-base. Surprisingly, there have been minimal attempts to undertake a comprehensive and systematic review of the evidence to identify a parsimonious set of predictors of hospitalization in the chronic disease population. Identifying the key modifiable determinants of avoidable hospitalization could potentially reduce the demand on our strained health system. This type of analysis can contribute to the development of preventative approaches to disease management and improve our understanding of the chronic disease process (Altman, 2001). The present study will address this gap in the literature by conducting a comprehensive review of the factors related to avoidable admissions in chronic disease in order to develop a coherent framework from which to interpret findings.

Method

Study selection

A systematic search for published studies was conducted using a number of electronic databases, including MEDLINE (1966 - 2008), CINAHL (1982-2008), Health and Society, and Meditext as well as databases specific to indigenous health issues (Indigenous Australia, Family-ATSIS, MAIS-ATSIS) to identify the factors associated with avoidable hospital admissions for adults with chronic disease. The search strategy utilised a combination of terms that related to avoidable admissions and (a) predictive factors, (b) hospitalization and (c) the most prevalent chronic disease conditions identified by the National Chronic Disease Strategy (Queensland Health, 2007):

> (determinant* OR factor* OR predictor*) AND (hospital* OR (re)admission OR avoidable OR preventable OR unnecessary OR ambulatory) AND (chronic disease OR asthma OR depression OR diabetes OR COPD OR heart failure).

Unpublished or 'grey' literature, although potentially useful in reviews, was excluded from the scope of this review because of reservations about its quality and extensive costs associated with its acquisition (Cook, Guyatt, Ryan, Clifton, Buckingham, Willan et al., 1993; McAuley, Pham, Tugwell & Moher, 2000). Two investigators independently examined the studies for inclusion in the narrative review, and any disagreements were resolved by discussion. Investigators were not blinded to journal titles, authors or affiliations. Studies were selected for the review if they were original journal articles that related to the measurement of factors that predicted

hospitalization, or the risk of hospitalization, among people with chronic disease.

The combination of search terms yielded 1915 titles and abstracts. On the basis of title or abstract, a large number of these (n=1787) studies were excluded if chronic disease was not the primary diagnosis of the study participants, or if the study focused primarily on the paediatric population, a surgical intervention, an acute episode in the absence of disease chronicity, illicit drug or alcohol dependency, a foreseen and pre-planned admission, a non-English speaking population, or a non-community dwelling population. Studies were also excluded if they contained insufficient data to determine outcome, or if they duplication other published results (repeated publication). Length of stay following hospital admission and its associated predictors were not the focus of this review. Full text review of the remaining studies (n=128) was conducted, and following further scrutiny, an additional 49 studies were excluded according to the same pre-determined exclusion criteria.

The selected studies were then classified according to study type and as guided by the levels of evidence established by the Oxford Centre for Evidence Based Medicine. In the present study, Level 1 evidence was broadly classified as systematic reviews, Level 2 was considered randomised controlled trials, Level 3 was classified as either (a) prospective cohort or (b) retrospective cohort studies, and Level 4 related to retrospective database reviews, or population audits.

The data extracted from each study included first author and date, country of origin, sample size (n), study type, study design, predictor variables, and negative or positive association with outcome (including significance level if available).

Results

A total of 82 articles were included in final review (see Figure 1 for summary flow diagram of the review process). Although an extensive database search was undertaken to locate all relevant studies, it is possible that the search strategy did not identify some studies potentially useful to this review. Appendix A summarises information regarding the studies. The studies consisted of systematic reviews (n=4, 4%), randomised controlled trials (n=6, 7%), prospective (cohort and cross-sectional) studies (n=33, 40%), retrospective studies (n=3, 4%) with a larger proportion reflecting retrospective file review or population studies of large databases (n=18, 21%). These classification levels are summarised in Table 1 along with disease specific categories.

Studies originated from the United States of America, United Kingdom, Canada, Netherlands, Germany, Spain, Australia, Japan, and New Zealand. Some excluded studies were retained for additional description in the narrative review.

Table 1: Summary of study type and disease categories (n=82)

Chronic Disease category	*Systematic reviews*	*RCTs*	*Observational studies*		*Audit and database reviews*
			P	*R*	
COPD	2	3	9	1	4
Asthma	0	0	10	1	7
CHF	1	2	7	0	1
Depression	1	0	0	0	2
Diabetes	0	0	3	1	4
Chronic disease/ ACS	0	1	4	0	18
Total	***4***	***6***	***33***	***3***	***36***

NOTE: P=prospective studies, R=retrospective studies.

Summary of Predictors

From the 82 studies reviewed, 31 unique factors were identified as being key determinants of avoidable hospitalization, with some consisting of multiple variables. A narrative review was conducted and the predictor variables were categorised according to the level of the factor, namely individual, health service system or environmental factors. For the narrative review, some individual predictors (e.g., bio-medical factors) were grouped for ease of reporting. In interpreting the findings, it is important to note that although the presence of some conditions may predict avoidable hospitalization in people with chronic disease, the absence of the same characteristic may not necessarily predict the opposite outcome, namely, prevention of hospitalization.

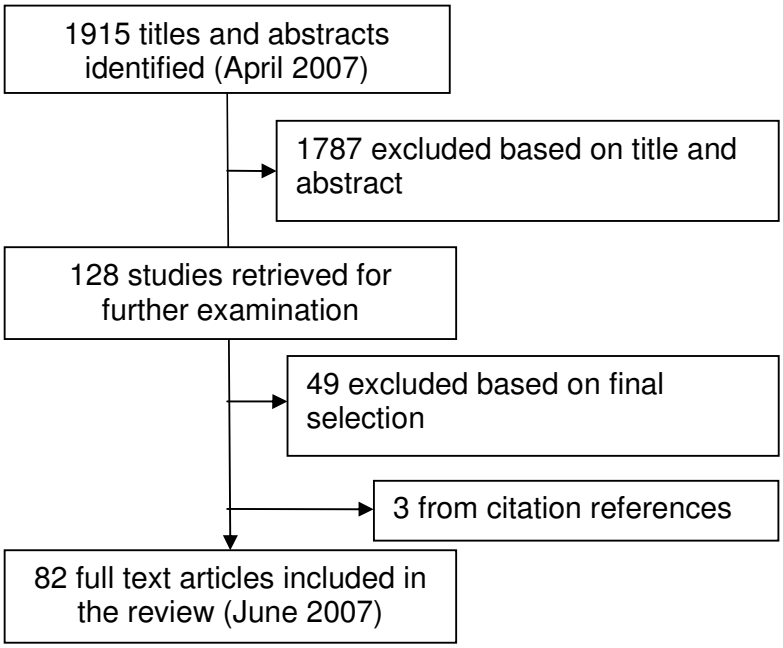

Figure 1: Flow diagram of systematic review process

Individual-Level Factors

Age

The age at onset of the disease was significantly related to hospitalization in a over one third of the studies selected (n=28, 34%), and age was the most frequent predictor studied. There was a clear trend towards hospitalization with increasing age, with many studies (78%) reporting a significant greater likelihood for older people to be hospitalized, particularly those over the age of 65 years (Miravitlles et al., 2006; O'Malley et al., 2007). The strength of the association between age and hospitalization was captured by Chen and colleagues (2006), who reported that adults over the age of 65 years were up

to twenty-five times more likely to be hospitalized for their chronic condition (i.e., asthma) than those aged between 15 and 44 years.

However, bi-modal effects of age was reported in the research, where peaks in hospitalization occurred for specific age groups. According to Lin et al., (2002), both younger and older age groups were more likely to experience avoidable hospitalizations than those aged between 35 and 55 years. This finding was supported by Guo et al. (2001) who identified a U-shape distribution across age and hospitalization, where both older (>64 years) and younger patients (<19 years) were at higher risk of avoidable hospitalization. Specifically, younger people with access to Medicaid, who lived in urban areas of lower median income and who possessed a “college” education were more likely to be hospitalized for avoidable conditions.

The combined influence of age and gender was a common finding (Rizza et al., 2007). In a study conducted by Rizza et al. (2007), older males were most likely to be hospitalized for avoidable reasons. Using multivariate analysis, Diette et al. (2002) found that age was not an independent predictor of hospitalization for asthma. Gadoury et al. (2005) distinguished between “older” and “younger” groups in terms of their risk for hospitalization. However, the age in years that defined these groups could not be clearly determined. As O’Malley et al. (2007) concluded, hospitalization is most likely at the beginning and end of life and is, therefore, an intuitively reasonable finding. Nevertheless, in a multivariate analysis conducted by Diette et al. (2002), older age was no longer significantly associated with hospitalization for

asthma, after controlling for severity, health status, comorbidity, smoking and demographic variables.

Gender

The influence of gender on hospital admission was included in numerous studies (n=21, 26%), with both significant (n=16) and non-significant (n=5) outcomes reported. When found to be significant (Lin et al., 2002; Ng et al., 2004, Brameld et al. 2006), the impact of gender in some studies was considerable. In a retrospective study, Ng et al. (2004) reported that males were more than five times more likely to be hospitalized as a result of COPD than females. In contrast, other studies have found the females were more likely to be hospitalized for asthma (Diette et al., 2002), the authors suggesting that exposure to higher levels of psychosocial and environmental stressors may explain this relationship (Robbins et al., 2006). Robbins et al. 2006 found differing effects of gender depending on age. For instance in their retrospective cohort study, they found that gender was significantly related to hospitalization for females with diabetes less than 35 years of age, whereas males more than 55 years of age with the same condition were more likely to be hospitalized.

The findings in relation to gender may be attributed to its interactions with multiple other predictors. For instance, in a number of studies, the influence of gender was found to increase when associated with the effects of age and/or race (Rizza et al., 2007; Robbins et al., 2006; Trawick et al., 2001). For instance, Trawick et al. found that high-risk female patients were admitted for

asthma twice as often as high-risk male patients and were older. In contrast, rates of hospitalization for diabetes increased for older males and younger females (Robbins et al., 2006). Similarly, Savoie et al. (2004) in their systematic review, reported that female gender was significantly associated with hospitalization in depression than males, though results were conservative at $p<.05$. Brameld et al. (2006) confirmed that the relationship between gender and hospitalization depended on the specific chronic disease. In her review of hospital admission data, Brameld and colleagues (2006) found that males demonstrated a greater risk of admission for ischemic heart disease and peripheral vascular disease, but the gender differential was negligible in cases of COPD. Thus, the influence of gender on hospitalization ought to be considered in combination with age and disease type.

Socioeconomic status

Socioeconomic status (including the combined effect of education and income) was found to be a strong predictor of hospitalization in nearly half of the studies selected (n=23, 39%). A number of studies reporting on income (n=16) or education (n=9) alone identified a significant association with avoidable hospitalization (75% of studies reporting income, and 50% of studies reporting education). There was an inverse relationship between these factors and hospitalization, where the less income earned, the higher the risk of hospitalization for potentially avoidable conditions. Similarly, Prescott et al. (1999) noted that people with COPD who had low socioeconomic status (combined education and household income) were three times more likely to be admitted to hospital for their condition than those

with a moderate or high socioeconomic index. In their study, Prescott and colleagues reported that age differences exacerbated the impact of education and household income, in that the impact of socioeconomic status was most relevant for people below 65 years of age (Prescott et al., 1999). However, the impact of this variable may be compounded by the increased incidence of disease and limited access to healthcare, both of which are related to low socioeconomic status.

Using a broad indicator of social disadvantage, Brameld et al. (2006) confirmed socio-economic influence on hospitalization. Specifically, Brameld et al. (2006) found that individuals with low levels of socio-economic status incurred more hospital admissions for avoidable conditions. In this instance, socio-economic status was judged according to the Census Collection District Index of Relative Disadvantage, which included qualifications, income, unemployment, type of job, home ownership, single parent families, marital status, car ownership, school leaving age, Aboriginal and Torres Strait Islander descent, number of families per household and English proficiency (Brameld et al., 2006; Australian Bureau of Statistics, 1996 Census of population and housing. Socio-economic indexes for areas Canberra - Australia, ABS 1998). Claudio's et al. (1999) research supported the influential role of socioeconomic factors (i.e., low median family income) on hospitalization in people with asthma, where asthma hospitalization rates were concentrated in poor neighbourhoods, presumably because people in these areas did not have adequate access to primary health care.

In terms of broader environmental concerns, Booth and Hux (2003) reported that individuals who live in overall low-income neighbourhoods were 40% more likely to incur a hospitalization for acute exacerbation of diabetes, even adjusting for other variables of age, gender, rurality, co-morbidity, frequency of visits, continuity of care, physician speciality and geographic region. In a prospective population study conducted by Taylor et al. (2006), similar evidence was found to support the influence of neighbourhood socio-economic status on individual hospitalization rates. The authors identified that low socio-economic individuals residing in high socio-economic status neighbourhoods were more vulnerable to hospitalization, perhaps due to less disposable income for health care, medications, memberships in gyms and healthy food (Taylor et al., 2006). Individuals with low socio-economic status had higher risk factors, lower cardiovascular disease knowledge, and more illness days than moderate and high socio-economic status individuals.

Booth and Hux (2003) reported that individuals in the lowest income quintile were 44% more likely to be hospitalized than those in the highest quintile (16.4% vs 11.4%), an effect that was most evident in 45 to 64 year-olds (OR, 1.76; CI(95%)1.69-1.82). Despite the complicated nature of socio-economic status, this effect persisted even after adjusting for age, sex, urban versus rural residence, co-morbidity, frequency of physician visits, continuity of care, physician specialty, and geographic region (adjusted OR, 1.09; CI(95%) 1.08-1.10). Unemployment was also found to significantly relate to hospitalization, with all of two studies reporting significant effect on outcome. Thus, even though socio-economic status may be inherently linked with other variables, it remains an important consideration in the prediction of hospitalization.

Race and ethnicity

The role of race and ethnicity in predicting avoidable hospitalization was included in almost one quarter of the studies (n=18, 23%), with significant associations between ethnicity and hospitalization reported in many of these studies (n=13). Hanania et al. (1997) found that up to one half of acutely ill asthmatics hospitalized during their study were of ethnic background. However, these findings were qualified as the authors concluded that there was no greater tendency for these groups to use hospital care than ambulatory care, particularly when socioeconomic status was taken into account. They concluded that it was difficult to distinguish between ethnic or racial origin and lower socioeconomic status, which also predicted the use of hospital resources. They also pointed out the fact that not all ethnic groups behaved in similar ways in terms of healthcare utilization. Finally, the authors noted that their study may have obviated the access issues experienced by ethnic groups, thus clouding the findings (i.e., the study provided culturally sensitive services in both ambulatory and hospital settings).

Although variables, such as socioeconomic status and service access, are likely to confound the relationship between race and hospitalization, several small-area analyses have found higher asthma hospitalization rates among African-Americans, even after statistically controlling for income (Carr et al., 1992; Eisner et al., 2001). Eisner et al. (2001) concluded that increased risk of hospitalization for asthma among African-Americans was not entirely explained by income, education or health care access. Eisner and his

colleagues (2001) found that African-American and Hispanic people were up to ten times more likely to be hospitalized compared to white, non-Hispanic persons ((OR 10.2; CI(95%) 1.8 – 58.4, and OR 4.0; CI(95%) 0.9-18.0 respectively)).

Similarly, Laditka and Laditka (2006) conducted a large population-based study into hospitalization rates for African-American and Hispanics compared to the white, non-Hispanic population. They reported that being either African-American or Hispanic not only resulted in greater risk of hospitalization for both males and females of any age, but that the general risk for ambulatory conditions (e.g., asthma, diabetes and hypertension) was also significantly increased.

Studies conducted in Indigenous communities have also found that hospitalization rates are higher for this population. For instance, Riddell (2005) found that Maori hospitalization rates were four to five times higher than those of non-Maori aged 45 to 64 years, and twice of those of non-Maori aged 65 years and older. Condon et al. (2001) found similar statistics in relation to Australian indigenous communities in Northern Territory, with some indication that rates have risen significantly over time. Specifically, in 1979, hospitalisation rates were slightly less for Aboriginal males than for non-Aboriginal males and only 10% higher for Aboriginal females than for non-Aboriginal females. However, by 1996, Aboriginal males used public hospitals at 1.8 times the rate of non-Aboriginal males but still died at three times the rate of Australian males. Aboriginal females used public hospitals at 2.2 times

the rate of non-Aboriginal females, but died at 3.1 times the rate of Australian females. This review has found that although hospitalization may occur at different rates across different cultures, there is general support for the impact of race on hospitalization.

Social support

A limited number of studies (n=4, 5%) reported on the important role of social support in avoidable hospitalization. Results of a prospective analysis by Rodrigues-Artalejo et al. (2006) found significant effects for social isolation, in that heart failure patients with limited social contact were more likely to experience an emergency hospital readmission. However, in this case, social support was determined by whether or not the person was married, living with others, if they had contact with family members and were home alone for less than 2 hours per day. The authors suggested that people who lived alone, with no frequent contact with family, and were unmarried were also at greater risk of hospitalization. Using a broader definition of social support, a systematic review conducted by Luttik et al. (2005) found that social support predicted hospital admissions for people with heart failure. Luttik et al. noted that social support could take many forms, but highlighted the role of significant others (e.g., partner) in preventing readmissions. In a general population study not specific to chronic disease, Aliyu et al. (2003) found that elderly people living with non-relatives were three times more likely to be admitted to hospital than those living with spouses (OR 2.90, CI(95%) 1.44-5.82). In a related area, caregiver mental health status (i.e., presence of stress and depression) was also linked to increased hospitalization risk in

people with congestive heart failure, as reported in a prospective cohort study by Schwarz et al. (2003).

Living arrangements

A small number of studies reported on the association between living arrangements and hospitalization (n=6, 7%). Studies defined living arrangements in a number of ways, including cohabitation, total number of people residing in the household, household crowing or living alone. Eisner et al. (2000) reported that married individuals or those who were cohabiting were not significantly more at risk of hospitalization than those unmarried or not cohabiting. According to Rizza et al. (2007) additional persons in the household was also not significantly related to hospitalization. However, household crowding did seem to have a significant effect ($p<.0001$) on hospitalization according to Morris. Similarly, Saxena et al., (2006) reported that living alone was significantly ($p<.05$) related to hospitalization particularly for elderly people with chronic diseases, but this finding was refuted by another study (Stewart et al., 1998) who reported that living alone was not significantly related to hospitalization ($p=.07$). Overall, results indicated that living arrangements were not significantly related to hospitalization risk for chronic conditions.

Bio-medical markers and treatment

Bio-medical markers were frequent and significant predictors of hospitalization for chronic disease (n=24, 30%). These factors were usually condition specific, and most often included FEV (Forced Expiratory Volume), dyspnea,

hypertension, body mass index, and blood pressure (systolic). Other clinical indicators that predicted hospitalization included chronic mucus hyper-secretion (Yohannes et al., 2001), glycosylated haemoglobin level, hypertension (Moss, 1999), high blood urea nitrogen (Smith et al., 2000), airflow obstruction (Ong et al., 2005), and nephropathy (Pagano et al., 2007). Treatment and therapy indicators (n=10, 12%) were also mentioned as predictors of hospitalization in chronic disease, and most often included insulin treatments, home oxygen therapy and steroid treatment. Infectious processes (including flu outbreaks) as reported in three studies (7%) was considered a potential risk factor for hospitalization in people already compromised with a chronic condition.

Medication

A total of five studies (6%) identified medication use specifically as a predictive factor in hospitalization for avoidable conditions. A significant association was found between the number of medications prescribed and hospitalization rates. Saxena et al. (2006) argued that respiratory drugs, diabetes drugs, cardiovascular drugs increased the likelihood of hospitalization. According to these findings, medication use was more likely associated with the complexity of the illness and the treatment of co-morbid conditions, in that both an increase in number and severity of co-morbid conditions, and the associated medication use, significantly increased the risk of hospitalization (Saxena, 2006). Non-compliance to medication was also highlighted as a risk factor for hospitalization in those with chronic illness, as reported by Chin et al. (1997).

Health status

Multiple studies (n=27, 33%) identified the important role of health status (including physical and mental health) and health quality of life in the prevention of hospitalization. In fact, current health status (incorporating physical and mental health) was the second most frequent indicator of hospitalization reported. Rodriguez-Artalejo et al. (2005) examined the influential role of health related quality of life in predicting hospital readmission for patients with heart failure. Overall, a worse health related quality of life score (as measured by the SF-36) was associated with hospital admission. Higher scores on the physical functioning scale (HR 1.65; CI(95%) 1.11-2.44), general health scale (HR 1.73, 95% CI (95%) 1.19-2.52) and mental health (HR 1.65; CI(95%) 1.10-2.47) significantly predicted hospital admission for this group (Rodriguez-Artalejo et al., 2005). Lower health status, more frequent asthma symptoms (Diette et al., 2002), walking distance capacity, activity related health status (Emtner et al., 2006) and level of physical activity (Pitta et al., 2006) were also associated with hospitalization in a number of studies.

Gudmundsson et al. (2005) found that higher scores on the disease-specific St George's Respiratory Questionnaire (SGRQ), indicating lower health status, predicted hospital admission within the next 12 months among people with chronic obstructive pulmonary disease. The SGRQ contained three components of health-related quality of life, namely perceived severity of symptoms, restriction of activity and impact of condition on one's life. Other

variables including age, sex and pulmonary function did not predict hospitalization in this study. In categorizing the influence of health status, Gudmundsson et al. (2005) found no association between the symptom scale and re-hospitalization (HR (95% CI) for a 4 unit increase 1.01 (0.98–1.05)), but a significantly increased risk of hospitalization was found both for the impact (1.04 (1.01–1.07)) and the activity scales (1.07 (1.03–1.11)). Thus, the consequences of a chronic condition for a person's life may be more important than the actual condition in predicting hospitalization (Gudmundsson et al., 2005). Similarly, in a study conducted by Sprenkle et al. (2004) not all components of the SF36 (health-related quality of life measure) were predictive of hospitalization. In this study, significant associations were found between the physical health summary score and hospitalization, but no significant associations were found with the mental health summary score. After correcting for potential confounding factors through multivariate regression, the physical score independently predicted hospitalization. Those with low self-reported physical health scores were almost twice as likely to be admitted to hospital than those with high physical scores (OR= 1.82, CI(95%) 1.51-2.19) (Sprenkle et al. , 2004).

Several studies reported a link between mental health functioning and hospitalization risk (n=8), although the findings were mixed According to Gudmundsson et al. (2005), there was a significant interaction between health status and psychological status in relation to the risk of re-admission ($p<0.002$). Specifically, for people with low health status, a higher anxiety score was related to increased risk of hospitalization. Thus, although

psychological status may not be a prominent predictor of hospitalization, it is an important factor for consideration, particularly in patients with COPD. As Gudmundsson et al. (2005) noted, the symptoms of COPD are likely to cause anxiety in patients with COPD, exacerbating the impact of the condition and complicating this finding. Further, it was reported by Gudmundsson et al. that people who experience anxiety are often more likely to smoke, which may further aggravate their respiratory symptoms. In this regard, Godfredsen et al. (2002) reported that individuals who ceased cigarette smoking halved their odds of being admitted to hospital for a chronic disease exacerbation (OR=0.57; CI(95%), .33-.00). Interestingly, in the same study, a reduction in smoking was not significantly associated with decreased hospitalization risk, suggesting that a complete cessation is the more important health behaviour rather than reduction. However, in general, the effects of smoking were not significant predictor of hospitalization risk, with a number of studies reporting no association between smoking and hospitalization risk (Eisner et al., 2000; Kessler et al., 1998; Moss et al., 1999).

The complexity of mental health issues was confirmed by Rost (1998), who suggested that rurality exacerbated the risk of hospitalisation for people with mental health issues. She reported that depressed rural individuals were three times more likely to be admitted for physical problems (p=.02).

Co-morbidity

Co-morbidity was consistently associated with avoidable hospitalization in the studies reviewed (n=18, 22%), in all but two studies. The risk of hospitalization

appeared to increase exponentially for every additional co-morbid chronic condition. Niewoehner et al. (2007) reported that the presence of one or more cardiovascular conditions was predictive of hospitalization, whereas Brameld et al. (2006) found that people with 3 or 4 co-morbid conditions were at least twice as likely to be hospitalized than those with only one condition (RR=2.17; CI(95%), 1.99-2.36). This rate increased to three times the risk with the presence of 5 or more co-morbid conditions (RR=3.14; CI(95%), 2.77-3.55). Miravitlles et al. (2006) similarly found that COPD patients with co-morbidities were nearly twice as likely to be admitted compared to those without co-morbid conditions of cardiac insufficiency, ischemic heart disease or diabetes. Using multivariate modelling, Miravitlles et al. estimated that ambulatory patients with COPD had a greater probability (54%) of being admitted to hospital within one year if they had diabetes or cardiac-related co-morbidity.

Population studies provided further evidence of the impact of co-morbidity on hospitalization risk. In a large nationally representative random sample of aged people (>70 years), Wolff et al. (2002) calculated that individuals with three chronic conditions were 37 times more likely to be hospitalized. This risk increased almost threefold with the addition of at least one other chronic disease, and those with four or more chronic conditions were 99 times at risk of experiencing an avoidable hospitalization (Wolff et al., 2002). In another study of a nationally representative sample, Niefeld et al. (2003) reported that co-morbidities increased the likelihood of avoidable admissions among people aged over 65 years with type 2 Diabetes.

In addition to the number and type of co-morbidity, severity of co-morbidity was also positively associated with risk of hospitalization (O'Malley et al., 2007). In this study, people who had COPD and a severe co-morbid condition were twice as likely to be hospitalized as people without severe co-morbidities. Thus, hospitalization risk appears to depend on the complexity of the individual's condition, both in terms of the disease profile and the severity.

In a large retrospective database review conducted by Ahern et al. (2007), a number of comorbid conditions significantly increased the risk of hospitalization for people with diabetes. Most significantly related to risk were conditions of hypertension, cancer, lung disease, and some demographic factors of (older) age, gender, income and insurance cover, where younger females were at less risk of hospitalization (Ahern et al., 2007).

Health Service System Factors

Prior hospitalization

Prior hospitalization was found to be a significant predictor of hospitalization among people with chronic disease. This finding was reported in several studies (n=11, 13%). Prior hospitalization was usually measured as any admissions to hospital within the last 12 months, and did not necessarily include emergency department visits, although this was also a significant predictor of outcome in all studies reporting this factor (n=5). O'Malley et al. (2007) found that people with COPD who had been hospitalized for this condition on a previous occasion were at more than six times greater risk

(OR=6.12; CI(95%), 5.66-6.61) of hospitalization than those with COPD who had not been previously hospitalized. Similarly, Eisner et al. (2000) reported that people with asthma who reported a recent hospitalization for their condition were eleven times more likely to be hospitalized in future (OR=11.6, CI(95%), 5.3-25.2).

Prior hospitalization was linked to a cluster of predictors, including less well controlled asthma, high levels of symptoms, poorer lung functioning, and a greater need for regular oral corticosteroids (Adams, Smith & Ruffin, 2000). Length of stay following admission, was mentioned in three studies (4%), and was found to be a somewhat reliable indicator of future hospitalization risk with 66% of studies reporting a significant association. Emergency department visits were also frequently associated with increased risk of hospitalization. In a multivariate analysis, Smith et al. (2000) found that only increased emergency room visits and increased hospitalizations in the prior 6 months predicted future hospitalization when all other variables were controlled. Other predictors linked to access to emergency care included the presence of COPD and high blood urea nitrogen scores (an indicator of disease severity), poorer mental health and satisfaction with care access.

This pattern of findings suggests that hospitalization may be associated with the presence of higher levels of disease severity with overt symptoms such as breathing obstruction, mental vulnerability and a previous satisfying experience in emergency care. As Smith et al. (2000) noted, it would be inappropriate to reduce satisfaction with access to emergency care as a

method for reducing readmission rates. However, providing safe options within the primary care sector may be an alternative response. In this regard, Adams et al. (2000) found that the presence of a written Asthma Action Plan and the use of problem-focused coping strategies were associated with reduced likelihood of hospitalization.

Availability of health services

Availability of health services was related to hospitalization in a number of studies (n=9, 11%), and included physician availability as well as hospital bed availability. In regard to physician availability, Basu et al. (2002) confirmed a negative association between primary care physicians per capita and the likelihood of hospital admissions for ambulatory conditions. They concluded that fewer General Practitioners resulted in a greater number of people being forced to seek treatment as an inpatient when such treatment could have been offered in the community.

Parchman et al. (1994) also found a relationship between the availability of primary care providers and hospitalization, suggesting that the admission rate for avoidable conditions was associated with the total number of physicians available per capita. He found that, when combined with per capita income, the number of General Practitioners available per 10 000 population explained over 50% of the variance in hospitalization rates. Regression analysis indicated that after controlling for income, variations in the number of General Practitioners in an area continued to explain hospitalization rates. An increase of one General Practitioner per 10 000 population resulted in a reduction of

almost three (OR=2.75, CI(95%), 4.79-0.69) admissions per 100,000 population. The availability of general internists and general paediatricians was not significantly associated with admissions, indicating the importance of the primary care setting (Parchman et al., 1994).

In a prospective study conducted by Rizza et al. (2007), measures of accessibility and satisfaction with primary care health services and the number of clients per primary care physician were significantly related to avoidable hospitalizations ($p<.001$). These findings remained significant even after controlling for other factors known to influence hospital admission, such as socio-demographics and propensity to seek care.

An important interaction between the hospital and primary care sectors in predicting hospitalization was noted by Morris et al. (1994). These researchers concluded that higher rates of hospital admission were found in counties with more hospital beds and fewer physicians per capita. In their spatial analysis of hospital admissions, they found that a cluster of factors, including smoking, low education, low per capita income, and household crowding, were all associated with elevated hospitalization rates for respiratory-related conditions. However, higher rates of hospitalization were consistently associated with more hospital beds per capita and fewer general physicians per capita. Morris et al. (1994) concluded that predictors of hospital admission rates fell into two general categories: (1) increased disease incidence and/or severity or (2) variability in medical care. They concluded that hospitalization was likely to reflect inadequate access to medical care in

the community. In contrast, an abundance of hospital beds may precipitate a lower threshold for admitting people to hospitals.

Similarly, access to health insurance coverage facilitated access to hospital care. O'Malley et al. (2007) found that following expansion of insurance eligibility in one US state, previously uninsured people demonstrated a significantly greater rate of hospitalization than those who had previously been insured. O'Malley et al. speculated that the presence of health insurance may increase thresholds for seeking hospital care, and for admitting people to hospital. However, the increased rate of hospitalizations among newly insured people may simply reflect pent up demand for health care and conditions that had previously been left unattended.

Integrated services and coordinated care

The coordination or integration of primary care services emerged as a consistent predictor of hospitalization in the chronic disease population, with all 10 studies (12%) reporting significant findings. Casas et al. (2006) reported that delivery of an integrated care intervention reduced exacerbation episodes requiring hospitalization in people with COPD. It was suggested that the effectiveness of an integrated care intervention was associated with enhanced self-management together with increased access to health care professionals, thus improving symptom management and early detection (Casas et al., 2006).

In a two year population study not included in the selected papers but retained for this narrative, conducted by Gill and Manious (1998), continuity of care was significantly associated with the prevention of avoidable hospitalizations. In a large sample (n=13 495), it was found that care continuity was significantly ($p<.01$) related to a decreased risk of hospitalization. This trend was still evident even after controlling for the effect of number of visits (OR=0.49%; CI(95%), 0.41-0.59) and demographic variables (OR=0.56; CI (95%), 0.46-0.69). This finding suggests that encouraging people to concentrate their care with a single provider may lead to lower hospitalization rates. A number of conclusions were offered in relation to the predictive value of continuity of care. It was suggested that care continuity is underpinned by a complex decision-making process. Physicians who see their patients more often were more likely to have in-depth knowledge of current and previous medical conditions, early recognition of emerging problems, close monitoring of any decline in presentation and particular interest in the success of any outpatient regimes (Gill & Mainous, 1998). In addition, people reported higher satisfaction with the level of care provided by their same physician, perhaps reflecting greater degree of confidence in their physician and commitment to manage symptoms at home (Gill & Mainous, 1998; Becker, Drachman & Kirscht, 1974).

Reduction in hospital admissions was associated with receipt of a managed care program. In this context, care planning processes were enhanced through a multidisciplinary approach, as Rea et al. (2004) reported that multidisciplinary involvement in providing community care was beneficial in

reducing the likelihood of hospital admission in COPD. O'Malley et al. (2007) reported that people whose usual physicians derived more than 50% of their practice revenue from managed care had lower rates of hospitalization, and practitioners with a higher proportion of managed care patients were likely to be more familiar with the process of delivering coordinated services and may have had a more supportive infrastructure in place for patients. Indeed, physicians who reported more difficulty securing ancillary services reported higher rates of hospitalization (O'Malley et al. 2007). Given that most managed care patients receive some form of multi-disciplinary health care, these ancillary services may have contributed to hospital avoidance. Better access to preventative services such as home oxygen, smoking cessation counsellors, and outpatient COPD management programs also decreased the need for hospitalization (O'Malley et al., 2007; Gadoury et al., 2005; Hanania et al., 1997).

Physician characteristics

Reported in two studies only (2%), physician decision-making processes appeared to make a meaningful contribution to the risk of hospitalization according to the findings of one of these studies (O'Malley et al., 2007). In terms of decision-making skills, O'Malley et al. (2007) highlighted the importance of medical practitioner experience. For people with COPD, general practitioners with practice experience exceeding 10 years were able to significantly reduce the likelihood of hospitalisation. Although practitioner experience is clearly important, this finding also suggests that physicians with

less than 10 years experience may benefit form more targeted quality improvement efforts (O'Malley et al., 2007).

There was some evidence to suggest that guidelines for clinical practice may lower the risk of hospitalization for COPD (O'Malley et al., 2007). Although guidelines may be less helpful in guiding the care of patients with complex or multiple conditions, the risk of hospitalization for COPD was lower among people whose usual medical practitioner rated guidelines as important to their practice (O'Malley et al., 2007). In comparison, those whose general practitioner reported that guidelines had relatively little impact on their clinical practice were more likely to be hospitalized (AHR 0.88, CI(95%) 0.80–0.96). This finding remained significant even after controlling for a range of socio-demographic factors that might be associated with hospitalization. However, the association between use of guidelines and lower COPD hospitalization risk was only found for physicians who had been in practice for 10 years or less ($p= 0.03$) (O'Malley et al., 2007). Thus, physicians with more experience were associated with less risk of hospitalization for people with COPD unless junior physicians used guidelines. Given that this study was based on a longitudinal cohort of over 500,000 people with COPD, it provides a reliable source of information about how physical characteristics can influence outcomes.

Additionally, Kamaromy et al. (1996) reported that although variations in practitioner style (i.e., decision to admit patient to hospital based on degree of illness and social characteristics likely to impact on outpatient care) were

evident across medical service areas in California, there was no overall predictive effect for practitioner style on hospitalization risk once community socio-economic factors were taken into account. Despite this, they found that physicians hospitalized almost 60% of the presented clinical vignettes. Emergency physicians had higher admission scores than practitioners working in large community practices. Medical practitioners who practiced in more socially disadvantaged areas had higher admission scores, especially if more than 10% of their client group were uninsured. The findings highlighted that practitioners were responsive to the socio-demographic concerns of patients (especially those from low-income communities), and were likely to consider the social vulnerabilities of patients arising from insufficient financial or self-care resources when determining patient hospitalization. Thus, practitioners use both clinical and social information to guide their decisions about hospital admission and the process may be confounded by the physician's social justice orientation. It could be concluded that strategies to change physician behaviour, such as guidelines or reviews may not be effective in reducing hospitalization rates in the absence of attention to social inequities.

Indeed, the likelihood of hospitalization for COPD was greater in practices where a higher proportion of revenue came from the government-sponsored Medicaid program (O'Malley et al., 2007). This finding may reflect the impact of socio-economic status and the social justice response of physicians. However, it is also possible that for practices with a high proportion of Medicaid patients, the lower overall rate of reimbursement for services may

result in fewer resources to invest in care processes, such as education or self-management support that could help prevent hospitalization.

Self-management Supports

The impact of self-management on avoidable hospitalization was reported in a small number of studies (n=7, 9%). Similar to continuity of care, findings across almost all studies reported that an increased focus on self-management for patients resulted in less likelihood of avoidable hospital admission. In their prospective study of people with asthma, Hanania et al. (1997) identified a sub-group who depended primarily on crisis-oriented care for the management of their asthma (e.g., hospitalization). These people were more likely to have lower income and to live alone, but most importantly, they were less knowledgeable about asthma and its management and were less likely to have a predetermined crisis plan. In this same study (Hanania et al. 1997), only 33% of those using hospital facilities could describe accurately the effects of inhaled corticosteroids and had received significantly fewer asthma education sessions (9% vs 100%; $p<0.001$), asthma pamphlets and books to read (39% vs 67%; $p<0.01$) than those who used community resources to manage their asthma. Hospital-users were less likely to own a peak flow metre and were less likely to have had objective measurement of airflow during the preceding year (18% vs 43% and 50% vs 97%, respectively; $p<0.01$). Importantly, there were no differences between the two groups in age, gender, ethnic origin, illness severity or possible economic barriers to ambulatory care (e.g., health insurance).

Hanania et al. (1997) found that almost 80% of those who attended a community-based Asthma management centre had a predetermined crisis plan that set out the actions they would take in the event of an exacerbation. Similarly, Adams et al. (2000) identified lower levels of hospitalization among those who had written Asthma Action Plans, reported using problem-focused coping in response to their asthma symptoms and desired a level of autonomy in relation to their healthcare. These findings highlight the importance of a strong community support network in assisting people to develop and implement self-management plans.

Indeed, in a randomized controlled study, Stewart et al. (1998) reported a significant association between hospitalization among people with congestive heart failure and home-based interventions. Specifically, those who received home-based support incurred less hospitalization than those who received usual care (i.e., less than 3 over the study period compared to 5 under usual care). People who received the home-based interventions were also less likely to be admitted to the emergency department ($p=.05$).

Gadoury and colleagues (2005) reported on the predictive value of self-management skills in people with chronic disease. The authors reported a significant reduction in the rate of hospitalizations between people who underwent a self-management training program and those who did not. Further, this reduction was maintained at two year follow up. Although hospitalization is not often used as an outcome indicator of self-management education, there are findings that disease-specific education can improve

specific clinical indicators in diabetes, COPD and asthma (Steed et al., 2003). Given the likelihood that these indicators increase the risk of acute episodes if ignored, it is possible that self-management training may contribute to hospital avoidance. In support of this possibility, O'Malley et al. (2007) found that the extent to which a physician reported ease in accessing self-management resources, such as health counsellors, management programs and community-based treatments, was associated with reduced risk of hospitalization for COPD.

Environmental Factors

Atmospheric conditions

Atmospheric conditions (including air quality, atmospheric temperature, air pollutants) were predictive of hospitalization, but were only reported in a small number of studies (n=6, 8%). In a large sample study conducted over 4 years, Chen et al. (2006) found that seasonal variation in hospitalization rates (i.e., highest in spring months) was significantly associated with the presence of air pollutants (levels of ozone, carbon monoxide, sulphur dioxide and nitrogen dioxide respectively). Variation was negatively correlated with climactic factors (i.e., low temperature, reduced hours of sun exposure and low barometric pressure). Morris et al. (1994) also found that hospital admissions for acute respiratory infection increased with increasing average annual temperature, whereas hospital admissions for COPD decreased, presumably due to the effects of dry, cold air on the airways and greater exposure to respiratory irritants during the winter. Although seasonal variation was mostly associated

with respiratory conditions, other studies have found effects of pollutants on hospitalization for heart failure (Dominici et al., 2006). In this study, small increases in atmospheric particles resulted in a 1.28% increase in risk per 10-µg/m3 increase in pollutants in same-day (CI (95%), 0.78%-1.78%). These findings highlight the need for early warning systems and pollutant monitoring devices to support individuals to manage their conditions more effectively.

Geographical factors

A small number of studies (n=11, 13%) reported significant relationships between hospitalization and geographical factors. Factors included distance from home to hospital (n=2), topographical barriers to access (n=2), and rurality/urbanization (n=7). Physical accessibility emerged as a predictor of hospitalization, but was associated with an unexpected pattern. For instance, Lin, Allan and Penning (2002) reported that, in three regions in Canada, overall hospitalization rates declined as distance from a hospital increased. This finding suggests that residents located closer to a hospital may be either sicker or are more willing to seek hospital care than those residing a greater distance away. Alternatively, living close to a hospital may encourage utilization of hospital resources or people who anticipate more frequent hospital care may choose to live near a hospital. The lowest avoidable hospitalization rates appeared for those who resided between 35 and 50 kilometres from hospital. Residence beyond 50 kilometres from hospital was associated with higher rates of avoidable admission, presumably because these distant communities lacked primary care services. Although people with low-incomes were more likely to be hospitalized for avoidable conditions, this

effect did not account for the distance effects. This curvilinear relationship may explain why distance to hospital was not a consistent predictor (Rizza et al., 2007).

Physical barriers, such as crossing, hills, lakes or inlets changed the effect of distance. For instance, a mountain or river crossing increased the likelihood of an avoidable hospitalization for people in these communities, presumably because small communities or areas made remote by geographical features are likely to lack ambulatory services and primary care facilities. Thus, the risk of hospitalization is increased. Other studies have confirmed the influence of remoteness (i.e., distance by road to service centres, Brameld et al., 2006) and rurality (Booth et al., 2003; Tong et al., 1999) on the risk of hospitalization for chronic disease. For instance, Brameld et al. (2006) found that the risk of admission was lowest in more accessible locations and highest in remote locations. Individuals residing in rural areas were more likely to be hospitalized for their chronic condition, again presumably due to the absence of primary care facilities in the area. In the study conducted by Booth et al. (2003), it was found that individuals living in a rural setting had an increased rate of avoidable hospitalization. However, urban dwellers had higher recurrence rates (2.0 vs 1.8; $p<.001$ for emergency visits and 1.9 vs 1.8; $p=.004$ for hospitalizations). This finding confirms the possibility that although more people in rural areas may need hospitalization for an avoidable exacerbation of their condition, those living closer to a hospital may actually use emergency departments and hospitals more regularly.

In contrast to the positive effect of rurality, Morris and Munasinghe (1994) found that population density, which may reflect the degree of urbanization, had no appreciable impact on hospital admission rates for COPD. Although the overall effects of urbanization were also non-significant in the study conducted by Ramos et al. (2006), population size and density, amount of vehicular traffic per day and total number of roads and highways was positively associated with hospitalization in specific areas. Ramos et al. (2006) noted that higher urbanization and hospitalization both appeared to be associated with being female, having lower socioeconomic status and being older than 35 years of age. However, hospitalization initially decreased with lower levels of urbanization, indicating the potential protective effects of a traffic-free environment. Further decline in urbanization was associated with increased avoidable hospitalization rates as found in the studies of rurality.

The complex interaction between socio-economic status, residential area and hospitalization must be considered in any analysis of hospital usage. This interaction is highlighted by those studies that have used a population level indicator of socio-economic status. For instance, Booth and Hux (2003) found that individuals who resided in low-income neighbourhoods were more than 40% more likely to be hospitalized for an acute complication of diabetes. People with diabetes from low-income neighbourhoods experienced excessive numbers of complications that should have been prevented by optimal ambulatory care. These low-income neighbourhoods are also often home to large groups of people from ethnic minority or Aboriginal and Torres Strait Islander backgrounds, which may increase the extent of avoidable

hospitalization in the region. Further, there are likely to be fewer services per capita in these areas and limited capacity to use those services, resulting in a circular effect on hospitalization that is distinct from the issue of distance. Clearly, the combined effect of person-place interaction must be addressed through a regional settings-based response that seeks to balance the tensions between multiple factors. A summary of all significant and non-significant findings for each predictor are displayed in Figure 1 below.

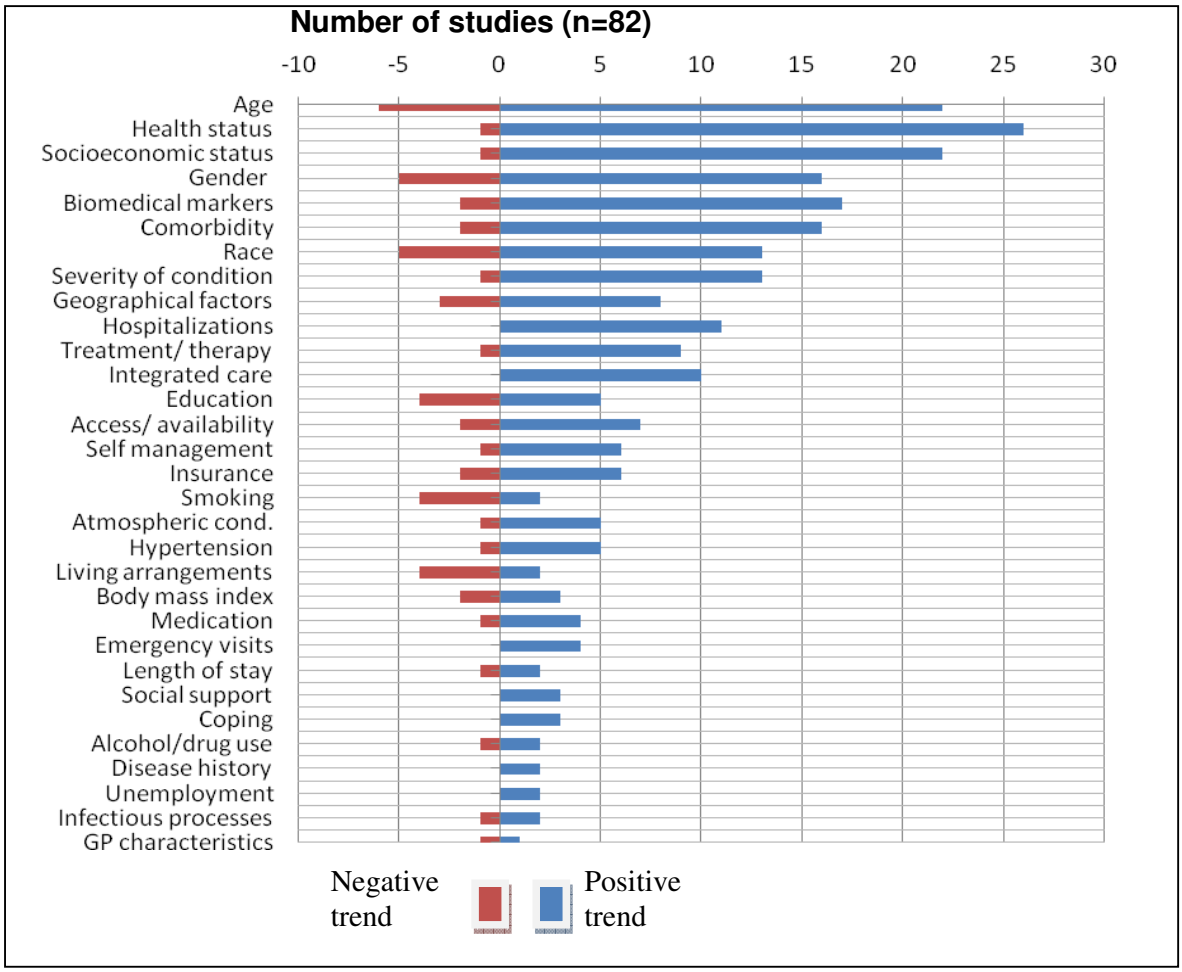

Figure 1: Trends of significance for major predictor clusters

Discussion

Equitable access to health services remains a significant challenge for contemporary health systems that can be partially addressed through a comprehensive understanding of complex processes such as avoidable hospitalization. This review has highlighted a possible framework by which avoidable hospital admissions can be understood. In particular, hospitalization is the result of a complex interplay of factors at all levels (i.e., person-related factors, physician factors, health system, geographical and environmental factors). It is clear that hospitalization is not a consequence of any single factor in isolation and, accordingly, warrants a complex and multi-faceted response. It is also interesting to note that the most studied predictors of age, gender and race are the least modifiable, yet continue to be a focus in prognostic health research. Non-significant results were also less likely to be reported in individual studies. Although it was not possible to statistically calculate publication bias in the present study, a graphical depiction of the positive and negative results for the predictors does suggest the presence of a publication bias.

Although traditional person-related factors (i.e., age, gender, marital status, socioeconomic status and race) were significantly associated with hospitalization, their significance was often dependent on a combination of other factors such as disease type, disease duration and the number and nature of co-occurring illnesses. Findings in relation to race and co-morbidity were relatively consistent across the selected studies. The presence of co-morbid conditions increased the likelihood of admission, up to one hundred times in one study (Wolff et al., 2002). Not only was the number of co-

morbidities relevant, but the influence of severity of co-morbidity and type of co-occurring condition were equally important. In summary, avoidable hospitalization may be associated with people (especially those >65 years of age) who are mentally vulnerable, from ethnic backgrounds, who have higher levels of disease severity and/or more co-morbid conditions, with overt symptoms such as breathing obstruction.

Although these individual and illness variables are important in predicting hospitalization, their role may be influenced by their interaction with broader factors, such as physician decision-making, previous experiences of hospital, geographic location, an emergency plan for problem-solving and an orientation towards self-management or autonomy in health care. The opportunity to influence outcome through these variables is minimal. A similar conclusion was reported more than thirty years ago by Dirks and colleagues who noted the importance of considering broader psycho-social factors alongside bio-medical factors in understanding health outcomes (Dirks, Horton, Kinsman, Fross & Jones, 1978).

The review has highlighted the important influence of potentially modifiable health service system factors, such as self-management supports, physician qualities (i.e., experience, use of guidelines) and continuity of care (i.e., care plans, management plans, emergency action plans, integrated services). The complex and subjective nature of clinical decision making in relation to hospitalization is complicated by the influence of physician-related factors, such as, physician experience, practice location, practice resources and the

availability of preventative measures (i.e., self-management supports) (Fleming, D'Agostino & Selker, 1991). This process is further complicated by the influence of a range of non-clinical factors, such as hospital bed availability, per capita income in the region, the scope of outpatient practice and outpatient workload (Rosenblatt & Moscovice, 1984).

Other factors of increasing interest in this review included environmental and geographical considerations in the location of health services. Geographical and environmental factors were consistently mentioned as risk factors related to avoidable hospitalization in the chronic disease population, particularly in relation to the distance to health services, and practical challenges associated with accessing those services. This is an important finding as it reinforces the need for localized services that can respond to the needs of a particular area. It further highlights the importance of population projections and region-based health systems planning for the future.

The determinants of health model developed by Schulz and Northbridge (2004) can be used to explain the current findings (see Figure 2). Specifically, the model describes three key domains that are fundamental to health and map onto the structure, process and outcome qualities of a health system (Schuster, McGlynn & Brook, 1998)—(1) the *structure* of the natural environment or place (including topography, climate, and water supply), macro-social or community factors (including historical conditions, political and economic status, and human rights), and inequalities (including those related to the distribution of wealth, employment opportunities, and political

influence). These fundamental factors influence outcomes via two intermediate factors, namely the built environment (including land use, transportation systems, and buildings) and the social context (including community investment, public and fiscal policies, and civic participation); (2) the intermediate factors then impact on the proximate *process*-oriented factors that are thought to directly influence health, such as stressors (including financial insecurity, environmental toxins) and social integration (including the shape of social networks and the resources available within networks); (3) the *outcomes* of this complex mediated process are both health and well-being (e.g., hope/despair, life satisfaction, and happiness). By way of definition, fundamental factors are those that relate to philosophy, policy and place-based initiatives, Intermediate are those that include infrastructure and social resources, Proximate relates to inter-personal factors that are influences by interaction with others, and Health and well-being factors are personal factors that are largely self-determined. These levels interact to either dismantle or emphasize the disparities in health and promote or hinder wellbeing. The model highlights the inherent tensions that result when certain conditions are not met, such as equal distribution of resources and opportunities, capacity of the community to respond, and meaningful participation by the individual (Schulz & Northridge, 2004).

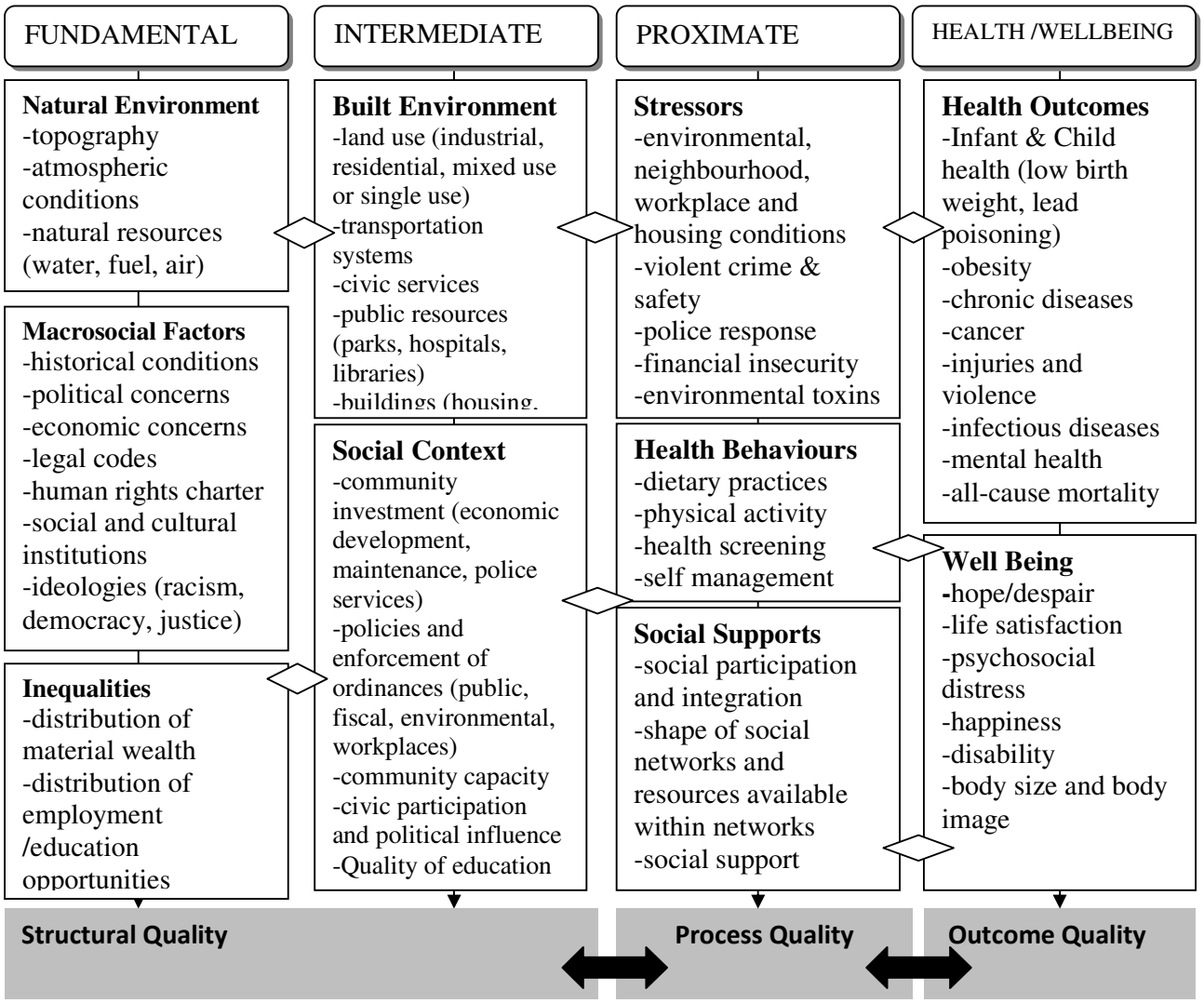

Figure 2: Social Determinants of Health model (Schulz & Northridge, 2004)

By mapping the current findings onto the Schulz and Northridge (2004) model (see Table 3 below), it becomes apparent that evidence is mostly available at the individual and interpersonal levels, and least for intermediate (i.e., built environment, service system, resource availability, community context) and environmental levels (i.e., natural environment, distribution of resources, values and philosophies). It is these broader determinants of health that offer the foundation for a potential solution to avoidable hospitalizations (i.e., man-

made systems that support equitable access to services, investment in community and natural social connections, opportunities for civic participation, public and fiscal policies that support a strong primary health care system). These strategies must be placed on top of a system that supports the proximate factors identified in the model (i.e., stressors, social supports and health behaviours) and the fundamental inequalities that underpin the model. According to this model, findings from this review confirmed that much of the research investigating hospitalization in chronic disease is largely focussed on personal (individual health and well being) or inter-personal (proximal) factors in hospitalization and associated risk. There is also a trend in the existing literature to focus on stressors rather than supports that can buffer effects of competing variables, or help to overcome limitations.

However, the existing research relating to supports is largely person oriented, and under-emphasises the potential role of a settings-based approach in alleviating the pressure on health systems and optimising health care. It is tempting to focus the attention on the responsibility of the individual when considering preventative approaches to avoidable hospitalisation. However, the broader involvement of the health service system and public health initiatives should not be underestimated in promoting equitable access to health care. Indeed, strategies such as integrated care have multiple and long term benefits, in that it optimises health service delivery and coordination at the same time as promoting a preventative approach to managing complex comorbidities (Ahern et al., 2007). As indicated by the determinants of health

model proposed by Schulz and Northridge (2004), strategies for the future will benefit by a focus on intermediate and fundamental factors.

The findings of the current review have emphasized the interplay between the individual, his or her physical condition and the social and physical environment. The availability of resources and services at each level and the imposition of stressors or agents of harm at each level can alter the outcome. When the balance between supports and stressors is managed for individuals and for specific areas/populations, a quality health system is produced. In terms of hospital avoidance, the aim of any health system should be to minimize stressors that deplete from health and wellbeing, reduce social inequities in health access and maximise population-wide supports or resources that can keep people healthy.

Limitations of the current study

The current study was limited to published studies, and as such, did not incorporate unpublished literature that may have contained valid results or conflicting findings. Only English language papers were reviewed, and non-English studies could equally have been of benefit. It is also possible that we have missed other published studies due to primary reliance on specific electronic database searches, though extensive efforts were made to broaden the search and follow up with citation searching. Due to wide variation in study design and statistical indicators, a formal meta analysis was not conducted.

Table 3: Factor matrix of significant predictors reported in the studies (n=82)

Risks to avoidable hospitalization	*Individual Health and Well-being* n (%)	*Interpersonal-Proximal* n (%)	*Service System-Intermediate* n (%)	*Environmental-Fundamental* n (%)
Stressors *(increased risk)*				
Age	22/28 (78%)			
Socio-economic status	22/23 (96%)			
Gender	16/21 (76%)			
Bio-medical markers	17/19 (89%)			
Non-white race	13/18 (72%)			
Co-morbidity	16/18 (88%)			
Severity of condition	13/14 (93%)			
Lower education	5/9 (55%)			
Smoking	2/6 (33%)			
Hypertension	5/6 (83%)			
Body mass index (obesity)	3/5 (79%)			
Infectious processes	2/3 (66%)			
Unemployment	2/2 (**100**%)			
Disease history	2/2 (**100**%)			
Treatment and therapy		9/10 (90%)		
Previous hospitalization		11/11 (**100**%)		
General health status		6/6 (**100**%)		
Physical health status		13/14 (93%)		
Mental health status		7/7 (**100**%)		
Emergency dept. visits		4/4 (**100**%)		
Medication		4/5 (80%)		
Length of stay		2/3 (66%)		
Access/ availability			7/9 (78%)	
Geographical topography				3/4 (75%)
Rurality			4/4 (**100**%)	
Urbanisation			2/3 (66%)	
Atmospheric conditions				5/6 (83%)
Supports *(decreased risk)*				
Treatment and therapy	9/10 (90%)			
Autonomy/coping	3/3 (**100**%)			
Social support		3/3 (100%)		
Living arrangements		4/6 (66%)		
Insurance		6/8 (75%)		
Integrated care		10/10 (**100**%)		
Self-management		6/7 (86%)		
GP characteristics		1/2 (50%)		
Strategies *for the future*				
Centralised systems				
Place-based approaches				
Increased community capacity				
Positive health policies (including reducing social inequities)				
Accessible transportation systems				

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