Preventable hospitalizations among adult Medicaid beneficiaries with concurrent substance use disorders ☆

Kit Sang Leung [a,*], Joe Parks [a,b], James Topolski [a]

[a] MIMH,University of Missouri — St. Louis, 4633 World Parkway Circle, St. Louis, MO 63134-3115, USA
[b] Missouri Department of Social Services, 615 Howerton Court, PO Box 6500, Jefferson City, MO 65102-6500, USA

ARTICLE INFO

ABSTRACT

Objective. We aim to examine the relationships between substance use disorders and preventable hospitalizations for Ambulatory Care Sensitive Conditions among adult Medicaid beneficiaries.

Methods. Cross-sectional analysis using de-identified Medicaid claims data in 2012 from 177,568 beneficiaries in Missouri was conducted. Logistic regression models were estimated for the associations of substance use disorder status with Ambulatory Care Sensitive Conditions, demographics, chronic physical and mental illnesses. Zero-inflated negative binomial regressions assessed substance use disorders, hospitalization for Ambulatory Care Sensitive Conditions, and length of hospital stay for Ambulatory Care Sensitive Conditions adjusting for co-morbid physical illnesses, mental illnesses and demographics.

Results. Over 12% of the sample had been diagnosed for substance use disorder. Beneficiaries with substance use disorder were more likely than Nonsubstance use disorder beneficiaries to have admissions for chronic conditions including short/long-term complications of diabetes, uncontrolled diabetes, hypertension, chronic obstructive pulmonary disease/asthma, but not for acute conditions. While substance use disorder beneficiaries were more likely than Nonsubstance use disorder beneficiaries to be hospitalized for any Ambulatory Care Sensitive Conditions; there were no statistical differences between the two groups in terms of length of hospital stays.

Conclusions. Substance use disorder is statistically associated with hospitalizations for most Ambulatory Care Sensitive Conditions but not with length of hospital stay for Ambulatory Care Sensitive Conditions, after adjusting for covariates. The significant associations between substance use disorder and Ambulatory Care Sensitive Condition admissions suggest unmet primary health care needs for substance use disorder beneficiaries and a need for integrated primary/behavioral healthcare.

Introduction

Drug users often face multiple, concurrent physical and mental health problems (Morgenstern et al., 2008; Lynskey and Strang, 2013; Degenhardt and Hall, 2012; Degenhardt et al., 2013). Although drug users are more in need of health care services because of poor general health compared with the general population, they are less likely to receive the same quality of health care as their non-drug use counterparts (Deehan et al., 1998a,b,c; Ahern et al., 2007). Several contributory factors have been identified for this disparity in health care services between drug-users and non-users, including poor treatment compliance (Brener et al., 2010; Cohen et al., 2004), inability to access desired assistance (Druss and von Esenwein, 2006; Santos et al., 2013; McCoy et al., 2001), stigmatization of drug users by medical personnel at health care facilities (Neale et al., 2007, 2008; Henderson et al., 2008), and disadvantaged socioeconomic status (Rice, 1991; McBride et al., 2005). Consequently, drug users may not have adequate access to proper care when they get sick. Even when proper care is accessible, they may still be reluctant to seek professional treatments because of negative experiences from past services. The delay of proper and timely treatment could therefore lead to deterioration of an existing illness which in turn may result in hospital admissions.

Research indicated that hospitalizations for certain health conditions such as complications of diabetes, hypertension, chronic obstructive pulmonary disease (COPD), asthma, and some other problems are potentially preventable if proper and timely care is provided (Ansari et al., 2006; Agency for Healthcare Research and Quality, 2014; Bindman et al., 1995). Because admissions for these health problems,

also termed as Ambulatory Care Sensitive Conditions (ACSCs), are considered preventable, rates of ACSC hospitalization are frequently used as the indicator of the quality of outpatient services and the measure of access to primary care (Bindman et al., 1995; Basu et al., 2014). Apparently, both patients and the health care system may greatly benefit from reducing hospitalizations for ACSCs. However, there is a gap in the research literature when it comes to understanding the relationships between substance use disorders (SUDs) and admission for ACSCs.

While many studies have shown that SUD is associated with preventable conditions/ACSCs (Sumino et al., 2014; Sumino and Cabana, 2013; Caponnetto et al., 2013; Clark et al., 2009; Gore et al., 2010; Maruyama et al., 2013; Coffey et al., 2012), the relationships between ACSC admissions and substance use/dependency are relatively under-explored. In a systematic qualitative review of studies on preventable hospitalization in chronic diseases, Muenchberger and Kendall found that over one-third of the reviewed studies focused on health status, socioeconomic status, or general demographics, whereas substance abuse/dependency was examined by less than 5% (Muenchberger and Kendall, 2010). Several recent studies have indirectly explored these issues; however, they focused mainly on other specific populations, such as patients with co-occurring mood disorders (Daratha et al., 2012), veterans (Gao et al., 2014; Yoon et al., 2012), or patients with a specific medical diagnosis such as diabetes (Leung et al., 2011; Druss et al., 2012), where substance users were treated as a sub-group in these studies.

In the US, it is estimated that 13% of adult Medicaid beneficiaries have been diagnosed for substance use disorders within a 12-month time period (Busch et al., 2013), totaling over three million people in 2011 (Kaiser Family Foundation, 2014; United State Census Bureau, 2014; Centers for Medicare and Medicaid Services, 2011). If Medicaid expansion in the United States has been implemented in all states in 2014, an addition of over 2.5 million uninsured adults with a current SUD might become Medicaid eligible (Substance Abuse and Mental Health Services Administration, 2013). With the increasing number of SUD patients enrolled in the health care system, the lack of information about drug use disorders and hospitalization for ACSCs may hamper the development of cost effective programs for this population. To understand better the SUD–ACSC relationships among adult Medicaid beneficiaries, the present study examined hospitalizations for ACSCs among adult Medicaid beneficiaries in Missouri who had a concurrent SUD in a 12-month time period. We believe that this is the first exploratory study with a primary focus on drug use disorders and preventable hospitalization in a statewide low-income population.

Methods

Data source

This study was a cross-sectional analysis utilizing a de-identified Medicaid data extract provided by the Missouri Medicaid Agency (MoHealthNet). The dataset consisted of de-identified claims information, including duration of Medicaid eligibility, diagnoses, dates of services, inpatient and discharge information, residential location indicators, as well as general demographics in 2012. Study protocols were approved by the Institutional Review Board at the University of Missouri — St. Louis and by MoHealthNet.

Study sample

In 2012, nearly a million (n = 987,163) people were enrolled in the Missouri Medicaid program. We excluded those who were younger than 18 years old (n = 540,068) and/or having a total of more than 30 days without Medicaid coverage (n = 132,570). Due to the potentially incomplete claims data for those who were also enrolled in Medicare, an additional 136,957 people who were both Medicaid and Medicare dually eligible (duals) were excluded. After further excluding

cases with missing data, there were 177,568 adult Medicaid beneficiaries in the final sample.

Measures

In the data extract, each claim was associated with up to five ICD-9-CM diagnoses. A positive diagnosis (yes/no) for a target disorder was identified if any of the five ICD-9-CM codes in the claims data met the code set for the target disorders during the reporting period. To determine SUDs, ICD-9-CM codes for dependence on or abuse of alcohol, opiates, sedatives, cocaine, cannabis, amphetamine, hallucinogens, and other substances were examined (2910–2929, 30300–3059). Beneficiaries were identified as 'SUD' cases if they were diagnosed for any of these SUDs in the 12-month time period and otherwise labeled as 'NonSUD'. For ACSC admissions, a list of thirteen Prevention Quality Indicators (PQIs) developed by the Agency for Healthcare Research and Quality (AHRQ) were used to identify ACSC admissions, which include diabetes, COPD/asthma, hypertension, heart failure, angina, appendicitis, dehydration, bacterial pneumonia, and urinary tract infection (URI), (AHRQ, 2014). Nine of them were grouped together to form the chronic conditions (see Table 3). The principal diagnosis for an episode of hospitalization was determined by the first discharge diagnosis in the claims data. Additionally, we examined the total number of inpatient days related to any ACSCs and chronic ACSCs.

Statistical analysis

Bivariate associations between SUD status and categorical demographic variables; SUD and illnesses (ACSCs with physical and mental illnesses) were examined using odds ratios and chi-square tests. Crude odds ratios (ORs), adjusted odds ratios (aORs) and 95% confidence interval (95% CI) for the associations between admissions for individual ACSCs and SUD were estimated using logistic regression models. Furthermore, zero-inflated negative binomial regression (ZINB) was used to estimate the relationship of SUD, with the length of hospital stay regarding ACSCs and chronic ACSCs. Zero-inflated negative binomial regression is suitable for modeling data with overdispersed count variables and excessive structured zeros commonly observed in insurance, biomedical, and health science studies (Ismail and Zamani, 2013; Phang and Loh, 2013). For multivariate analyses, co-morbid chronic physical illnesses, mental illnesses, and socio-demographic variables such as age group, gender, race/ethnicity, and residential location were used for statistical adjustments. Specific chronic physical illnesses included heart failure, hypertension, diabetes, COPD/asthma, and an overall comorbidity measure defined as the total number of physical illnesses (n = 26) in the claims data (Elixhauser et al., 1998). Mental illnesses included schizophrenia (295xx); bipolar-disorder (2960); other mental illnesses such as major depression, episodic mood disorders, anxiety, dissociative and somatoform disorders, acute reaction to stress, and other nonpsychotic mental illnesses (2962x, 2963x, 2969–2988, 300xx, 301–3026, 3071, 30751–30753, 3083–3149); and pervasive developmental disorders/intellectual disabilities (29900–2998, 317xx–319xx). Codes for mental illnesses were based on the code sets used by the Missouri Department of Mental Health to identify clients for the statewide Health Care Home Initiative. Regression analyses on ACSC admissions and length of hospitalizations were conducted among cases with the corresponding diagnoses. For example, admissions for uncontrolled diabetes were analyzed for those who have diabetes. We used a 4-category variable (metropolitan, micropolitan, small town, and rural) based on beneficiaries' residential zip codes to define residential location (Rural Health Research Center, 2014). All statistical tests were two-sided, with alpha = 0.05. SAS statistical software, version 9.3 (SAS Institute Inc., Cary, NC) was used for all statistical analyses and the GENMOD procedure for the two-part modeling.

Results

Beneficiaries' characteristics

A total of 177,568 non-dual adult Medicaid beneficiaries were included in the analysis. Table 1 presents beneficiaries' characteristics and the prevalence of mental/physical illnesses. The majority of the sample was female (72%), Caucasian (69%), younger than 40 years old (63%), and living in metropolitan areas (61%). Over 12% of the sample have been diagnosed for SUD (n = 21,661, Table 1). All older-age groups except the oldest group were more likely to have SUD compared with the youngest-age group (Table 1). Caucasians were more likely to have SUD compared with African American and 'other race'. Furthermore, males were more likely than females to have SUD, and beneficiaries living in metropolitan also have significantly higher odds of having SUD compared with those living in other areas.

For comorbid physical and mental illnesses, SUD beneficiaries were more likely than NonSUD beneficiaries to have a diagnosis for hypertension and COPD/asthma, bipolar disorders, major depression, schizophrenia, and non-psychotic mental illnesses. SUD beneficiaries also have a higher overall comorbidity burden as indicated by more comorbid physical illnesses (Wilcoxon test, p < 0.0001).

For beneficiaries with SUD, the most common SUDs were dependence on/abuse of alcohol, cannabis, opiates, and amphetamines. Multiple SUD was common — excluding nicotine, 36% of the SUD beneficiaries were diagnosed for dependence on/abuse of two or more classes of substances (Table 2).

Table 1
Associations between beneficiaries' demographic characteristics, chronic physical illnesses, and mental illnesses, 2012, Missouri, US.

	SUD N = 21,661 (12.2% of the sample)			
	n	% of SUD	Crude OR	95% CI
Age group				
18–29	6084	8.12	1	Referent
30–39	5255	14.14	1.86	1.79–1.94
40–49	4933	18.37	2.55	2.44–2.65
50–59	4516	16.82	2.29	2.19–2.38
60+	873	7.40	0.90	0.84–0.97
Race/ethnicity				
Caucasian	15,529	12.67	1	Referent
African American	5543	11.68	0.91	0.88–0.94
Others	589	7.80	0.58	0.54–0.64
Gender				
Female	12,579	9.78	1	Referent
Male	9085	18.56	2.10	2.04–2.17
Residential location				
Metropolitan	13,840	12.84	1	Referent
Micropolitan	3088	11.66	0.75	0.72–0.79
Small town	2678	11.67	0.89	0.86–0.94
Rural	1992	9.99	0.89	0.86–0.93
Chronic physical illnesses				
Hypertension	5787	18.21	1.82	1.76–1.88
COPD/asthma	8734	12.89	1.85	1.79–1.92
Diabetes	1272	12.54	1.01	0.95–1.07
Heart failure	729	17.08	1.50	0.38–1.63
Mental illnesses				
Bipolar disorders	6990	34.68	5.17	4.99–5.34
Major depression	6756	31.60	4.38	4.24–4.53
Developmental/intellectual disorders	313	5.24	0.39	0.35–0.44
Schizophrenia	3329	33.78	4.16	3.98–4.35
Other mental disorders	15,472	22.60	4.86	4.71–5.01
Overall comorbidity [mean (SD)]				
SUD	2.04	(2.15)		
NonSUD	1.24	(1.75)		

Table 2
SUD type and poly-substance use among beneficiaries with SUDs, 2012, Missouri, US.

	SUD N = 21,661	
	n	%
SUD type		
Alcohol	9155	42.26
Other substances	7021	32.41
Cannabis	5745	26.52
Opiates	4247	19.61
Amphetamine	2386	11.02
Cocaine	2032	9.38
Sedatives	913	4.21
Hallucinogens	77	0.36
Nicotine	12,283	56.71
Multiple SUDs (except for nicotine)		
5 + SUDs	465	2.00
4 SUDs	779	3.60
3 SUDs	1829	8.44
2 SUDs	4747	21.91
1 SUD	13,841	63.90

SUD and hospital admissions for ACSCs

Multivariate logistic regressions were estimated for the associations of SUD with different ACSC admissions, adjusting for covariates. Due to the low prevalence, perforated appendix, angina without procedure, and lower-extremity amputation were not submitted to the multivariate analysis. After taking into account the effects of other covariates, there were significant associations between SUD and hospital admissions due to diabetes with short/long-term complications, uncontrolled diabetes, hypertension, and COPD (Table 3). None of the admissions for acute ACSCs were statistically associated with SUD. Although SUD was statistically associated with admissions for URI in the univariate analyses, the significant association diminished after adjusting for other covariates.

SUD and length of hospital stay

The zero-inflated negative binomial regressions were estimated for the relationships between SUD and length of hospital stay due to any ACSCs or chronic ACSCs. After adjusting for covariates, the zero-inflated parts of the ZINB regressions showed that SUD beneficiaries were more likely than NonSUD beneficiaries to have admissions for any ACSCs and chronic ACSCs (Tables 4 & 5). Analysis of the count values showed that SUD was not statistically associated with length of hospital stay for any ACSCs or chronic ACSCs. The findings from the ZINB regressions suggest that, when both SUD and NonSUD beneficiaries went to seek help because of their physical illnesses, SUD beneficiaries were more likely than NonSUD beneficiaries to be admitted for ACSCs. Furthermore, because of the relatively large sample size, the non-significant associations between SUD and length of hospital stay clearly suggest that once SUD beneficiaries were admitted for any ACSCs or chronic ACSCs, their length of hospital stay did not differ significantly from that of their NonSUD counterparts.

Discussions

The findings indicated that SUD beneficiaries not only had higher likelihood of having hypertension, COPD/asthma, bipolar disorders, schizophrenia, major depression, non-psychotic mental illnesses, and a higher overall comorbidity burden compared to beneficiaries without SUDs, they were also more likely to have hospital admissions for most of the ACSCs, as well as the chronic ACSC cluster, even after adjusting for covariates such as age, gender, ethnicity, residential area, and comorbid physical and mental illnesses. As mentioned, a possible reason for

Table 3
ACSC admission rates and associations with SUD, 2012, Missouri, US.

PQI# ACSC		SUD		NonSUD		Total	%[a]	Crude OR	95% CI	aOR[b]	95% CI
		n	%[a]	n	%[a]						
Chronic conditions											
1	Diabetes short-term complications	105	8.25	251	2.75	356	3.43	3.18	2.51–4.02	2.02	1.53–2.68
3	Diabetes long-term complications	109	8.57	313	3.43	422	4.06	2.64	2.10–3.31	1.59	1.22–2.01
14	Uncontrolled diabetes	35	2.75	92	1.01	127	1.22	2.78	1.87–4.11	1.79	1.15–2.77
16	Lower-extremity amputation among patients with diabetes	5	0.39	29	0.32	34	0.33	1.24	0.48–3.20	–	–
5	COPD or asthma in older adults	285	9.04	804	6.32	1089	6.86	1.47	1.28–1.70	1.22	1.04–1.43
15	Asthma in younger adults	32	2.69	119	2.02	151	2.14	1.34	0.90–1.99	0.98	0.63–1.54
7	Hypertension	63	1.09	158	0.61	221	0.70	1.80	1.34–2.41	1.47	1.05–2.03
8	Heart failure	105	14.40	445	12.58	550	12.89	1.17	0.93–1.47	0.90	0.70–1.17
13	Angina without surgery	9	3.07	30	2.39	39	2.52	1.29	0.61–2.75	–	–
Acute conditions											
2	Perforated appendix	6	37.50	35	41.18	41	40.59	0.86	0.29–2.58	–	–
10	Dehydration	56	7.12	164	6.96	220	7.00	1.03	0.75–1.41	0.94	0.66–1.34
11	Bacterial pneumonia	210	19.74	659	17.77	869	18.21	1.14	0.96–1.35	1.03	0.85–1.25
12	Urinary tract infection	101	3.79	360	2.39	461	2.60	1.61	1.29–2.02	1.16	0.90–1.50

[a] ACSC admission rates were computed for the corresponding diagnosis. For instance, the number of SUD cases with diabetes, n = 1272 (see Table 1), was used as the denominator and the admission rate for diabetes with short-term complications (PQI1) among SUD cases was (105/1272) × 100% = 8.25%.

[b] aORs obtained from multivariate logistic regressions were adjusted for gender, age, race/ethnicity, residential location, SMI, non-psychotic mental illnesses, developmental disorders, nicotine use disorders, chronic medical diagnoses (COPD/asthma, heart failure, hypertension, and diabetes), and the overall claim based comorbidity.

admission for ACSCs is the delay of proper care (Bindman et al., 1995; Ansari et al., 2006; AHRQ, 2014). Because availability and accessibility of primary care services for ACSCs should not differ between these two populations under the current policy on Medicaid coverage, the elevated risk of ACSC admissions among SUD beneficiaries should be less affected by access of care, but rather that they are hesitant to seek help or being treated differently. Substance users may experience stigmatization from medical personnel at primary care facilities, such as a

medical physician's tendency to provide inferior services (Deehan et al., 1998a,b,1998c; Ahern et al., 2007). Consequently, those who have negative experiences about their primary care providers may hesitate to seek help until their health problem becomes more serious. Alternatively, substance users may prefer outpatient facilities such as community mental health centers (CMHCs) as their principal point of contact. However, physical health monitoring and services provided at mental health centers are historically inadequate, which often result

Table 4
Associations between SUD and hospitalization for chronic ACSCs among beneficiaries with chronic illnesses, 2012, Missouri, US.

Covariates	Part 1: binary model[a]			Part 2: negative binomial model[b]		
	Est.	aOR	95% CI	Est.	SE	95% CI
Intercept	−4.86	0.01	0.01–0.01	0.87	0.09	0.71–1.04
Non-SUD	Referent		–	Referent	–	–
SUD	0.28	1.33	1.19–1.48	−0.02	0.04	−0.10–0.06
Age group						
18–29	Referent	–	–	Referent	–	–
30–39	0.05	1.05	0.87–1.27	0.02	0.08	−0.13–0.18
40–49	0.001	1.00	0.84–1.19	−0.10	0.07	−0.24–0.04
50–59	−0.09	0.92	0.78–1.09	−0.18	0.07	−0.32–−0.05
60 +	−0.14	0.87	0.72–1.05	−0.20	0.08	−0.36–−0.05
Gender						
Female	Referent	–	–	Referent	–	–
Male	0.07	1.08	0.98–1.18	0.13	0.04	0.06–0.20
Race/ethnicity						
Caucasian	Referent	–	–	Referent	–	–
African American	0.42	1.53	1.38–1.69	0.09	0.04	0.01–0.17
Others	0.11	1.11	0.90–1.37	−0.03	0.09	−0.20–0.14
Residential location						
Metropolitan	Referent	–	–	Referent	–	–
Micropolitan	−0.18	0.84	0.74–0.96	−0.08	0.06	−0.18–0.03
Small town	−0.12	0.88	0.77–1.01	−0.002	0.06	−0.11–0.12
Rural	−0.22	0.80	0.69–0.93	−0.08	0.06	−0.20–0.05
Chronic physical illnesses						
Diabetes	1.01	2.73	2.48–3.01	0.20	0.04	0.12–0.28
Hypertension	−0.11	0.90	0.82–0.99	−0.01	0.04	−0.09–0.07
Heart failure	1.10	3.01	2.70–3.35	0.12	0.04	0.04–0.20
COPD/asthma	0.78	2.18	1.99–2.40	0.04	0.04	−0.04–0.12
Overall comorbidity	0.26	1.30	1.27–1.32	0.14	0.01	0.12–0.15
Serious mental illnesses	−0.34	0.71	0.65–0.79	0.002	0.04	−0.08–0.08
Non-psychotic mental illnesses	0.15	1.16	1.05–1.28	0.17	0.04	0.09–0.25
Developmental/intellectual mental disorders	−0.75	0.47	0.32–0.70	−0.46	0.17	−0.80–−0.12
Nicotine use disorders	0.45	1.56	1.43–1.71	0.09	0.04	0.12–0.28

[a] Part 1 (zero-inflated part) modeled the likelihood of hospitalization for chronic ACSCs in terms of odds ratios.

[b] Part 2 modeled the length of hospital stay for chronic ACSCs.

Table 5
Associations between SUD and hospitalization for any ACSCs, 2012, Missouri, US.

Covariates	Part 1: binary model[a]			Part 2: negative binomial model[b]		
	Est.	aOR	95% CI	Est.	SE	95% CI
Intercept	−4.33	0.01	0.01–0.02	0.94	0.06	0.83–1.05
Non-SUD	Referent	–	–	Referent	–	–
SUD	0.21	1.24	1.13–1.35	0.01	0.03	−0.05–0.08
Age group						
18–29	Referent	–	–	Referent	–	–
30–39	0.12	1.12	0.98–1.29	−0.03	0.06	−0.15–0.08
40–49	0.05	1.05	0.92–1.19	−0.06	0.05	−0.16–0.05
50–59	0.04	1.04	0.92–1.18	−0.11	0.05	−0.21–−0.01
60 +	0.16	1.17	1.02–1.35	−0.04	0.06	−0.15–0.07
Gender						
Female	Referent	–	–	Referent	–	–
Male	0.001	1.00	0.93–1.08	0.14	0.03	0.09–0.20
Race/ethnicity						
Caucasian	Referent	–	–	Referent	–	–
African American	0.17	1.18	1.09–1.29	0.08	0.03	0.02–0.15
Others	0.06	1.06	0.90–1.25	−0.003	0.07	−0.13–0.13
Residential location						
Metropolitan	Referent	–	–	Referent	–	–
Micropolitan	−0.18	0.84	0.76–0.93	−0.02	0.04	−0.10–0.07
Small town	−0.13	0.88	0.79–0.98	0.03	0.04	−0.05–0.11
Rural	−0.26	0.77	0.68–0.87	−0.07	0.05	−0.16–0.03
Chronic physical illnesses						
Diabetes	0.51	1.67	1.54–1.81	0.18	0.03	0.12–0.24
Hypertension	−0.21	0.81	0.75–0.88	−0.05	0.03	−0.11–0.01
Heart failure	0.74	2.11	1.91–2.32	0.13	0.03	0.06–0.19
COPD/asthma	0.55	1.73	1.61–1.86	0.05	0.03	−0.01–0.11
Overall comorbidity	0.33	1.39	1.36–1.41	0.13	0.01	0.11–0.14
Serious mental illnesses	−0.19	0.83	0.76–0.90	−0.01	0.03	−0.08–0.05
Non-psychotic mental illnesses	0.16	1.18	1.09–1.28	0.15	0.03	0.08–0.21
Developmental/intellectual mental disorders	−0.06	0.94	0.75–1.18	−0.05	0.09	−0.24–0.13
Nicotine use disorders	0.40	1.48	1.38–1.60	0.05	0.03	−0.01–0.10

[a] Part 1 (zero-inflated part) modeled the likelihood of hospitalization for any ACSCs in terms of odds ratios.
[b] Part 2 modeled the length of hospital stay for any ACSCs.

in delay of proper treatment (Druss and von Esenwein, 2006; Miller et al., 2003). More importantly, since the rate of ACSC admission is an indicator of access to high quality primary care, our findings suggest that the disparity in health care services between substance users and non-users also exists among the Medicaid population.

Furthermore, although SUD beneficiaries were more likely to be admitted for ACSCs, there was no statistical difference between SUD and NonSUD beneficiaries in terms of length of hospital stay for ACSCs. Because the length of hospital stay could be an indicator of seriousness of illnesses (Ahern et al., 2007), these results suggested that when SUD beneficiaries got admitted for ACSCs, their conditions might not be more severe than their NonSUD counterparts. These findings are somewhat unexpected. One possible explanation is that, due to the unhealthy life-style, SUD beneficiaries are more susceptible to physical illnesses and hence an increased likelihood of ACSC admissions (Kasl and Cobb, 1966a,b). However, once an individual gets sick, the decision to seek help depends more on the perceived severity of illness and the perceived benefits of treatment, which may not be influenced directly by their SUD status (Mackian et al., 2003, 2004). Future studies which include assessments on patients' health beliefs and perceptions may help to clarify these issues.

Several limitations should be noted. First, potential changes in the target behavior (i.e., ACSC admissions) in response to policy changes cannot be captured and inferred because of the cross-sectional nature of the study. Second, the generalizability of the findings obtained from a single state (Missouri) in the US to other states and other low income populations is limited. Nevertheless, given the lack of information about preventable hospitalizations among drug users, the present study may serves as the first step towards more comprehensive studies. Third, Medicaid claims data typically do not contain information unrelated to day-to-day administrative operations; it was impossible to examine the relationships between admissions and other endogenous factors

such as health belief and perceptions which may impact health behaviors and the risk of ACSC admissions. Fourth, despite the statistically significance, some of the findings have adjusted ORs close to 1.0 with narrow confidence intervals, suggesting that the associations between SUD and ACSCs were relatively weak. Finally, because of a lack of consensus on the set of ACSCs, results obtained in this study may not be comparable with those in other studies, especially when aggregated measures such as the chronic cluster are involved.

Conclusions

This study demonstrated that SUD is independently associated with hospitalizations for most of the chronic conditions (5/7), but not with the length of hospital stay due to ACSCs, among adult Medicaid beneficiaries in Missouri. Effects of SUD have been found to contribute independently to ACSC admissions, over and above the effects of other variables, including comorbid mental illnesses. Of particular relevance to policy makers and health care providers is that the significant association between SUD and ACSC admissions implicates the existence of unmet primary health care needs for SUD beneficiaries. These could be the results of inadequate primary care service in the mental health care settings, or inadequate mental health service in primary care settings, or both. In addition to enhancing training for physicians and health care professionals to enable cross-disciplinary services, the integration of primary care and mental health services may be an alternative solution (Druss and von Esenwein, 2006; National Association of State Mental Health Program Directors, 2005; Schuffman et al., 2009; Woltmann et al., 2012). Further research on the effects of integrated service on preventable hospitalizations among Medicaid SUD beneficiaries or other drug user populations is warranted.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

References

Agency for Healthcare Research and Quality Prevention Quality Indicators Overview. Available at: http://www.qualityindicators.ahrq.gov/Modules/pqi_resources.aspx (Accessed: 2014).

Ahern, J., Stuber, J., Galea, S., 2007. Stigma, discrimination and the health of illicit drug users. Drug Alcohol Depend. 88, 188–196.

Ansari, Z., Laditka, J.N., Laditka, S.B., 2006. Access to health care and hospitalization for ambulatory care sensitive conditions. Med. Care Res. Rev. 63, 719–741.

Basu, J., Mobley, L.R., Thumula, V., 2014. The small area predictors of ambulatory care sensitive hospitalizations: a comparison of changes over time. Soc. Work Public Health 29, 176–188.

Bindman, A.B., Grumbach, K., Osmond, D., Komaromy, M., Vranizan, K., Lurie, N., Billings, J., Stewart, A., 1995. Preventable hospitalizations and access to health care. JAMA 274, 305–311.

Brener, L, von, H.W., von, H.C., Resnick, I., Treloar, C., 2010. Perceptions of discriminatory treatment by staff as predictors of drug treatment completion: utility of a mixed methods approach. Drug Alcohol Rev. 29, 491–497.

Busch, S.H., Meara, E., Huskamp, H.A., Barry, C.L., 2013. Characteristics of adults with substance use disorders expected to be eligible for Medicaid under the ACA. Psychiatr. Serv. 64, 520–526.

Caponnetto, P., Auditore, R., Russo, C., et al., 2013. "Dangerous relationships": asthma and substance abuse. J. Addict. Dis. 32, 158–167.

Centers for Medicare & Medicaid Services, 2011. Actuarial Report: On the Financial Lookout for Medicaid. United States Department of Health & Human Services (10-1-2014).

Clark, R.E., Weir, S., Ouellette, R.A., Zhang, J., Baxter, J.D., 2009. Beyond health plans: behavioral health disorders and quality of diabetes and asthma care for Medicaid beneficiaries. Med. Care 47, 545–552.

Coffey, R.M., Misra, A., Barrett, M., Andrews, R.M., Mutter, R., Moy, E., 2012. Congestive heart failure: who is likely to be readmitted? Med. Care Res. Rev. 69, 602–616.

Cohen, M.H., Cook, J.A., Grey, D., et al., 2004. Medically eligible women who do not use HAART: the importance of abuse, drug use, and race. Am. J. Public Health 94, 1147–1151.

Daratha, K.B., Barbosa-Leiker, C., Burley, H., et al., 2012. Co-occurring mood disorders among hospitalized patients and risk for subsequent medical hospitalization. Gen. Hosp. Psychiatry 34, 500–505.

Deehan, A., Marshall, E.J., Strang, J., 1998a. Tackling alcohol misuse: opportunities and obstacles in primary care. Br. J. Gen. Pract. 48, 1779–1782.

Deehan, A., Templeton, L., Taylor, C., Drummond, C., Strang, J., 1998b. How do general practitioners manage alcohol-misusing patients? Results from a national survey of GPs in England and Wales. Drug Alcohol Rev. 17, 259–266.

Deehan, A., Templeton, L., Taylor, C., Drummond, C., Strang, J., 1998c. Low detection rates, negative attitudes and the failure to meet the "Health of the Nation" alcohol targets: findings from a national survey of GPs in England and Wales. Drug Alcohol Rev. 17, 249–258.

Degenhardt, L., Hall, W., 2012. Extent of illicit drug use and dependence, and their contribution to the global burden of disease. Lancet 379, 55–70.

Degenhardt, L., Whiteford, H.A., Ferrari, A.J., et al., 2013. Global burden of disease attributable to illicit drug use and dependence: findings from the Global Burden of Disease Study 2010. Lancet 382, 1564–1574.

Druss, B.G., von Esenwein, S.A., 2006. Improving general medical care for persons with mental and addictive disorders: systematic review. Gen. Hosp. Psychiatry 28, 145–153.

Druss, B.G., Zhao, L., Cummings, J.R., Shim, R.S., Rust, G.S., Marcus, S.C., 2012. Mental comorbidity and quality of diabetes care under Medicaid: a 50-state analysis. Med. Care 50, 428–433.

Elixhauser, A., Steiner, C., Harris, D.R., Coffey, R.M., 1998. Comorbidity measures for use with administrative data. Med. Care 36, 8–27.

Gao, J., Moran, E., Li, Y.F., Almenoff, P.L., 2014. Predicting potentially avoidable hospitalizations. Med. Care 52, 164–171.

Gore, J.M., Peterson, E., Amin, A., et al., 2010. Predictors of 90-day readmission among patients with acute severe hypertension. The cross-sectional observational Studying the Treatment of Acute hyperTension (STAT) study. Am. Heart J. 160, 521–527.

Henderson, S., Stacey, C.L., Dohan, D., 2008. Social stigma and the dilemmas of providing care to substance users in a safety-net emergency department. J. Health Care Poor Underserved 19, 1336–1349.

Ismail, N., Zamani, H., 2013. Estimation of Claim Count Data Using Negative Binomial, Generalized Poisson, Zero-inflated Negative Binomial and Zero-inflated Generalized Poisson Regression Models. Casualty Actuarial Society E-Forum Spring.

Kaiser Family Foundation Medicaid Enrollment: June 2011 Data Snapshot. Available at: www.kff.org (Accessed: 2014).

Kasl, S.V., Cobb, S., 1966a. Health behavior, illness behavior, and sick role behavior. I. Health and illness behavior. Arch. Environ. Health 12, 246–266.

Kasl, S.V., Cobb, S., 1966b. Health behavior, illness behavior, and sick-role behavior. II. Sick-role behavior. Arch. Environ. Health 12, 531–541.

Leung, G., Zhang, J., Lin, W.C., Clark, R.E., 2011. Behavioral disorders and diabetes-related outcomes among Massachusetts Medicare and Medicaid beneficiaries. Psychiatr. Serv. 62, 659–665.

Lynskey, M.T., Strang, J., 2013. The global burden of drug use and mental disorders. Lancet 382, 1540–1542.

Mackian, S., Elliott, H., Busby, H., Popay, J., 2003. 'Everywhere and nowhere': locating and understanding the 'new' public health. Health Place 9, 219–229.

Mackian, S., Bedri, N., Lovel, H., 2004. Up the garden path and over the edge: where might health-seeking behaviour take us? Health Policy Plan. 19, 137–146.

Maruyama, A., Macdonald, S., Borycki, E., Zhao, J., 2013. Hypertension, chronic obstructive pulmonary disease, diabetes and depression among older methadone maintenance patients in British Columbia. Drug Alcohol Rev. 32, 412–418.

McBride, D.C., Drumm, R.D., Terry-McElrath, Y., Chitwood, D.D., 2005. Back to basics: the role of health insurance in getting a physical exam. Soc. Work Health Care 42, 93–106.

McCoy, C.B., Metsch, L.R., Chitwood, D.D., Miles, C., 2001. Drug use and barriers to use of health care services. Subst. Use Misuse 36, 789–806.

Miller, C.L., Druss, B.G., Dombrowski, E.A., Rosenheck, R.A., 2003. Barriers to primary medical care at a community mental health center. Psychiatr. Serv. 54, 1158–1160.

Morgenstern, J., Hogue, A., Dasaro, C., Kuerbis, A., Dauber, S., 2008. Characteristics of individuals screening positive for substance use in a welfare setting: implications for welfare and substance-use disorders treatment systems. J. Stud. Alcohol Drugs 69, 561–570.

Muenchberger, H., Kendall, E., 2010. Predictors of preventable hospitalization in chronic disease: priorities for change. J. Public Health Policy 31, 150–163.

National Association of State Mental Health Program Directors, 2005. Integrating Behavioral Health and Primary Care Services: Opportunities and Challenges for State Mental Health Authorities. National Association of State Mental Health Program Directors (NASMHPD) Medical Directors Council, 66 Canal Center Plaza, Suite 302, Alexandria VA 22314.

Neale, J., Robertson, M., Bloor, M., 2007. 'Treatment experienced' and 'treatment naive' drug agency clients compared. Int. J. Drug Policy 18, 486–493.

Neale, J., Tompkins, C., Sheard, L., 2008. Barriers to accessing generic health and social care services: a qualitative study of injecting drug users. Health Soc. Care Community 16, 147–154.

Phang, Y., Loh, E., 2013. Zero inflated models for overdispersed count data. Int. J. Math. Comput. Nat. Phys. Eng. 7, 817–819.

Rice, D.P., 1991. Ethics and equity in U.S. health care: the data. Int. J. Health Serv. 21, 637–651.

Rural Health Research Center, University of Washington Rural-Urban Commuting Area Codes (RUCAs). Available at: http://depts.washington.edu/uwruca/ (Accessed: 6-19-2014).

Santos, C.M., Andrade, T., Bastos, F.I., et al., 2013. Patterns, determinants and barriers of health and social service utilization among young urban crack users in Brazil. BMC Health Serv. Res. 13, 536.

Schuffman, D., Druss, B.G., Parks, J.J., 2009. State mental health policy: mending Missouri's safety net: transforming systems of care by integrating primary and behavioral health care. Psychiatr. Serv. 60, 585–588.

Substance Abuse and Mental Health Services Administration, 2013. Medicaid handbook: interface with behavioral health services. HHS Publication No. SMA-13-4773. Substance Abuse and Mental Health Services Administration, Rockville, MD.

Sumino, K., Cabana, M.D., 2013. Medication adherence in asthma patients. Curr. Opin. Pulm. Med. 19, 49–53.

Sumino, K., O'Brian, K., Bartle, B., Au, D.H., Castro, M., Lee, T.A., 2014. Coexisting chronic conditions associated with mortality and morbidity in adult patients with asthma. J. Asthma 51, 306–314.

United State Census Bureau U.S. and World Population Clock. Available at: http://www.census.gov/popclock/ (Accessed: 2014).

Woltmann, E., Grogan-Kaylor, A., Perron, B., Georges, H., Kilbourne, A.M., Bauer, M.S., 2012. Comparative effectiveness of collaborative chronic care models for mental health conditions across primary, specialty, and behavioral health care settings: systematic review and meta-analysis. Am. J. Psychiatry 169, 790–804.

Yoon, J., Yano, E.M., Altman, L., et al., 2012. Reducing costs of acute care for ambulatory care-sensitive medical conditions: the central roles of comorbid mental illness. Med. Care 50, 705–713.