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Abstract

Ambulatory care sensitive hospitalisations (ACSH) have been widely used to study the quality and effectiveness of primary care. Using data from 248 general hospitals in Mexico during 2001-2011 we identify 926,769 ACSHs in 188 health jurisdictions before and during the health insurance expansion that took place in this period, and estimate a fixed effects model to explain the association of the jurisdiction ACSH rate with patient and community factors. National ACSH rate increased by 50%, but trends and magnitude varied at the jurisdiction and state level. We find strong associations of the ACSH rate with socioeconomic conditions, health care supply and health insurance coverage even after controlling for potential endogeneity in the rolling out of the insurance programme. We argue that the traditional focus on the increase/decrease of the ACSH rate might not be a valid indicator to assess the effectiveness of primary care in a health insurance expansion setting, but that the ACSH rate is useful when compared between and within states once the variation in insurance coverage is taken into account as it allows the identification of differences in the provision of primary care. The high heterogeneity found in the ACSH rates suggests important state and jurisdiction differences in the quality and effectiveness of primary care in Mexico.

Keywords: Mexico; ambulatory care sensitive hospitalisations; primary care; quality; instrumental variables.

I. Introduction

Timely, effective and high-quality primary care services can prevent the development or exacerbation of certain health conditions which may lead to hospitalisations. These avoidable hospitalisations - ambulatory care sensitive hospitalisations (ACSHs) - have been widely used to study the access to, quality and effectiveness of primary care services, typically in high-income countries **(Agency for Healthcare Research and Quality, 2013; Ansari, 2007; Caminal, Starfield, Sánchez, Casanova, & Morales, 2004; Finegan, Gao, Pasquale, & Campbell, 2010).** This paper analyses ACSHs before and during the health insurance expansion in Mexico, thus adding to studies of the behaviour of ACSHs in countries where efforts to expand the primary care coverage have been made **(Macinko et al., 2011; Saha, Solotaroff, Oster, & Bindman, 2007)**.

The Mexican healthcare system comprises a public and a private sector. The public sector is divided into two segments: workers in the formal labour market and their dependents (insured population) covered by social security institutions financed mostly by payroll taxes; and, non-salaried workers, unemployed, self-employed and informal sector workers (uninsured population) receiving health care offered by non-social security institutions financed mainly by the federal government from general revenues. Social security institutions provide complete medical care, including prescribed drugs, without any copayment. On the other hand, until 2003, the uninsured population needed to pay utilisation fees out-of-pocket (with the possibility of incurring catastrophic expenditures) in order to receive basic ambulatory care at rural clinics and a more complete set of interventions in the biggest cities. Users of

the private health services belong both to the insured and to the uninsured population; they receive medical care in heterogeneous private hospitals and medical clinics financed mainly with out-of-pocket expenditure, but also through private insurance companies.

In 2003, Mexico conducted a major health reform that gradually offered, through the *Seguro Popular* (*SP*) programme operated by the 32 state health ministries, free access to an explicit package of health care interventions to more than 50 million population not covered by any other public insurance scheme (described as uninsured). By 2012, the package included 284 interventions covering almost 100% of the primary level demand and 85% of the hospitalisation and surgery demands **(Comision Nacional de Protección Social en Salud, 2012)**. Since the reform, Mexico has made substantial advances in terms of health insurance coverage and financial protection **(Knaul et al., 2012).** With almost half of the Mexican population affiliated to *SP* and the rest being covered by the public social security institutions, Mexico declared universal health coverage in 2012.

While a fall in the ACSH rate might be expected following the reform, given the increase in the funding for the provision of primary care, opposing forces may prevent this fall. First, even when new resources were transferred from the federation to the states, the rules for budget allocation within the states (i.e. health jurisdictions, hospitals, primary care centres) seem to have remained unchanged hindering major changes in the way primary care is delivered. Second, as a result of the increase in coverage, the workload of primary care providers boomed. Since primary care providers are salaried and are not responsible for health outcomes or for further health care expenses, they do not necessarily have adequate incentives to provide appropriate care (under the assumption that providing high-quality health

care services is both time consuming and costly, at least in terms of effort). Therefore, primary care workers might provide poor quality services, refer patients to specialists or hospitalise them in order to manage the increasing demand for primary care services. Third, accessing hospital care via the emergency services is still relatively easy. Fourth, it could be difficult to avoid hospitalisations for patients with limited access to appropriate care before the implementation of the reform, thereby when the reform lowered barriers to health care their condition might have worsened to the point that the hospitalisation might not be avoidable anymore. The increase/decrease of the ACSH rate would still be a valid effectiveness and quality indicator if the first three forces are present, but not necessarily if the latter is also preventing a fall in this indicator, since ensuring the provision of appropriate care to the previously uninsured was outside the control of the primary care team.

Therefore, the two main objectives of this paper are 1) to identify the ACSH rate in health jurisdictions focusing on the differences in the magnitude and trend of ACSHs between and within states before and during the health insurance expansion in Mexico; and, 2) to explore the association of this indicator with aggregated patient and community factors. In doing this it is acknowledged that the traditional focus on changes in the ACSH rate as an indicator of the effectiveness of primary care services may not be valid when health insurance coverage is expanding.

II. Literature Review

ACSHs have been studied using different approaches leading to different results and, thus, literature findings are still not conclusive. Previous efforts have focused mainly on describing the trends of ACSHs throughout different periods of time **(Ashton et al., 1999; Kozak, Hall, & Owings, 2001; Stranges & Stocks, 2010)** and

on using econometric methods to identify associations of several variables with these hospitalisations. Research on ACSHs has used three different units of analysis: individuals, hospitals, and small geographic areas; the chosen approach being mainly driven by data availability. In most ACSH studies, the authors associate the increase or high levels of the ACSH rate with poor primary care.

Econometric analysis of ACSHs has been addressed using ordinary least squares **(Finegan et al., 2010; Laditka, Laditka, & Probst, 2005)**, logistic regressions **(Culler, Parchman, & Przybylski, 1998; Saha et al., 2007; Weissman, Gatsonis, & Epstein, 1992)**, and panel data models **(Dusheiko, Doran, Gravelle, Fullwood, & Roland, 2011)**. When defining the model specification, Culler et al. and Finegan et al. followed Andersen's behavioural model and proposed that variation in this kind of hospital utilisation is a function of an individual's predisposing, enabling, and need characteristics **(Andersen & Davidson, 2007).**

Literature has reached consensus on the importance of the association between socioeconomic conditions and ACSHs. Most of the studies controlling by socioeconomic status show that a higher income level is associated with a lower ACSH rate **(Bindman et al., 1995; Blustein, Hanson, & Shea, 1998; Epstein, 2001; Finegan et al., 2010)**. Contrary to this finding, with the introduction of two variables controlling for the effect of income, Laditka et al. (2005) did not find a significant effect for the proportion of low-income households and the county ACSH rate, but showed that the proportion of high-income households has a positive and significant effect; Culler et al. (1998) did not find a significant association between ACSHs and income level, but possibly the effect of income was captured by the variable measuring social vulnerability that had a positive effect on the probability of having at least one ACSH.

Dusheiko et al. (2011) found that moving 10% of registered diabetic patients from poor to good glycaemic control was associated with a 14% decrease in the rate of emergency admissions for short term complications. Shi and Samuels (1999) showed that individuals without a primary care physician in South Carolina were more likely to be admitted for an ACSH.

Saha et al. (2007) is one of the few studies that have examined the change of ACSHs after increasing access to care. They found that the ACSH rate rose after expanding Medicaid coverage in Oregon, USA. They discussed several explanations for this increase such as easier access to inpatient care, potential decrease in the patients' threshold for seeking care and in the physicians' threshold for admitting them, sufficient health decline for those lacking timely receipt of care while uninsured, and data-related biases. Macinko et al. (2011) analysed ACSHs after the rolling out of a community-based primary care programme in Brazil and found that the ACSH rate declined by about a third in 1999-2007.

The current study contributes to this literature by analysing the behaviour of the ACSH rate for a large population located in areas experiencing different and increasing health insurance coverage rates and examines changes in the ACSH rate as this coverage expands. Furthermore, it challenges the traditional analysis of the increase/decrease of the ACSH rate to measure the effectiveness of primary care services in a health insurance expansion context and explores an alternative interpretation of this indicator that could help to identify areas with primary care systems performing less well than others.

III. Methods

This paper follows Finegan et al. (2010) approach to estimate the association between avoidable hospitalisations and health jurisdiction characteristics that predispose care-seeking; enable patients to obtain care; and provide a proxy for the need of health services.

The model estimated is

$$Y_{it} = X_{it}\beta + W_{it}\gamma + Z_{it}\varphi + H_{it}\delta + \varepsilon_{it}, \qquad i = 1, \dots, N; t = 1, \dots, T \qquad (\mathrm{E}.1)$$

where Y_{it} is the vector showing the ACSH rate per 10,000 uninsured in health jurisdiction i in year t; X, W and Z are vectors of aggregated characteristics that predispose, enable and influence the need of patients to obtain care. H is the vector of hospital supply controls (number of hospital beds and outpatient consultancy rooms per 10,000 uninsured in each jurisdiction). X includes age group, proportion of females, and proportion of indigenous population. W includes social gap index (SGI), proportion of the population living in rural localities, and *Seguro Popular* (*SP*) jurisdiction coverage rate. Three dummy variables were created to capture the effect of SGI: very low, low and medium SGI with high and very high SGI forming the reference group. *SP* coverage rate is the percentage of the population of the jurisdiction with no social security affiliated to *SP* (only those not covered by social security institutions are entitled to register as *SP* beneficiaries). A quadratic relationship between the ACSH rate and the *SP* coverage rate will be tested to explore if a decrease or a levelling-off in the ACSH rate is observed as jurisdictions reach higher *SP* coverage levels. Z includes the state diabetes and hypertension prevalence rates, state general practice (GP) consultation rate, and the proportion of patients hospitalised in a different jurisdiction from where they are registered. State-level data were used when jurisdiction-level data were unavailable. All variables

other than *SP* coverage rate and SGI are mean-centred and expressed per 10,000 population. $\beta, \gamma, \varphi,$ and δ capture the effect of $X, W, Z,$ and H, respectively. Finally, $\varepsilon_{it} = \alpha_i + u_{it}$ is the disturbance of jurisdiction i composed of an unobservable individual specific component α_i and of an error component u_{it}, independent across time and across jurisdictions.

In Mexico, the provision of health care by public non-social security institutions is decentralised to the state level. Within states the administrative units in charge of the management and operation of primary care are health jurisdictions accountable to state health ministries. Taking into account that health jurisdictions are at the heart of primary care provision in Mexico, two units of analysis were chosen for this study: health jurisdictions with at least one general hospital in their territory (hospital jurisdictions) and health jurisdictions where hospitalised patients reside (origin jurisdictions). While jurisdictions manage and operate primary care in their territories, they do not necessarily administer hospital budgets as these may be defined directly by state health ministries.

Both perspectives are relevant and have important advantages and disadvantages. On the one hand, it is interesting to analyse the ACSH rate by hospital jurisdiction since they are the administrative units where health resources were used to provide this type of avoidable care that could otherwise had been used to provide more cost-effective services. However, this perspective omits jurisdictions with no general hospitals and overlooks that jurisdictions where ACSHs take place are not always responsible for providing primary care services to the people suffering them. The latter drawback is tackled by analysing ACSHs by origin jurisdictions; the major disadvantage of this perspective is that not all these jurisdictions have comparable controls for hospital supply since not all of them have a general hospital in their

territory. Since it is not clear which perspective is superior this study analyses ACSHs from both perspectives and compares them. To deal with the issue that some origin jurisdictions did not have general hospitals in their territory, two separate analysis were run. First, origin jurisdictions with no general hospitals were excluded; in the second, all origin jurisdictions were analysed even if they had no general hospital in their territory. To control for hospital supply in the latter a dummy variable was included indicating if a general hospital was within 50 km and less than one hour drive from the most populated municipality in the jurisdiction. The use of two units of analysis provides the opportunity to examine the robustness of any findings.

The original idea was to consider the hierarchical structure of the Mexican Health System to estimate a multilevel or hierarchical model that would allow account to be taken not only of the correlation between jurisdictions in the same state to obtain correct standard errors, but also disentangling of the jurisdiction effect from the state effect to analyse both effects separately. However, multilevel models only lead to consistent estimates when the individual specific components are not correlated with the covariates. This assumption was tested and rejected by the Hausman test and by finding significant differences between the fixed effects (FE) and the random effects estimates which is asymptotically equivalent to the Hausman test **(Rabe-Hesketh & Skrondal, 2012).** For this reason, a FE model with jurisdictions as the unit of analysis and clustered at the state level was preferred.

The variable "*Seguro Popular* jurisdiction coverage" in E.1 is potentially endogenous since jurisdictions in states with better-organised healthcare systems (and better provision of primary care services that could potentially influence their ACSH rate), might also manage to affiliate the uninsured population to the *SP* programme at a faster pace. In the linear case, a way to deal with this issue is the use of instrumental

variables (IV). Therefore, the *SP* coverage is instrumented by the years that *SP* had been operating in the state where each health jurisdiction is located. *SP* specifically targeted poor families in both urban and rural areas of Mexico without access to any other form of private or public coverage and it was rolled out gradually during 2001-2005; the process of incorporation to *SP* entailed political decisions at the state and federal level, but there is no evidence that such decisions were linked to the quality of primary care in each state or jurisdiction nor to their ACSH rate **(Sosa-Rubi, Galarraga, & Harris, 2009; Torres & Knaul, 2003).** Therefore, it is reasonable to think that the years that *SP* had been operating in the state only affects the jurisdiction ACSH rate through the *SP* jurisdiction coverage rate in each year. Sosa-Rubi et al (2009) also used incorporation to *SP* as an instrument with the difference that they defined three dummy variables indicating the year when each state was officially incorporated to *SP*.

With the intention of analysing the dynamics of the data, lagged values of the ACSH rate were introduced in the model in order to obtain the Arellano-Bond estimator. However, the restrictions imposed by this alternative specification proved not to be valid. Dummy variables for each year in 2001-2011 were used instead as regressors to control for the time effect. All models were estimated using both hospital and origin jurisdictions as units of analysis and were conducted using STATA 13 **(StataCorp, 2013).**

IV. Data

The analysis uses hospital discharge data for the period 2001-2011 from general hospitals run by state health ministries **(Secretaria de Salud, 2013b).** Data on diagnosis, age, gender, insurance status, state and municipality of the patient are

recorded for each discharge, but it is not possible to keep track of each patient since unique id patient numbers are not available.

Hospitalisations of patients 20 years or older were classified as ACSHs if the main diagnosis contained one of 300 ICD-10 codes across 21 conditions identified by previous studies (Agency for Healthcare Research and Quality, 2013; Caminal et al.; 2004; Epstein, 2001; Finegan et al., 2010; Weissman, 1992). While the primary care services covered by *SP* can prevent hospitalisations for these conditions, *SP* does not cover hospital care for all of them (see Appendix). Services not covered by *SP* are subject to utilisation fees.

This study identified 926,769 ACSHs from a total of 10.6 million hospital discharges during 2001-2011 in more than 248 general hospitals (new hospitals were added throughout the period: 287 hospitals were observed in 2011) within 188 health jurisdictions in the 32 states of Mexico. These data was complemented with variables from different sources, shown in Table I, to form the final database. Data for SGI and diabetes/hypertension prevalence rates were only available at three points in time (2000, 2005, and 2010 for the former and 2000, 2006, and 2012 for the latter). The first observation was assigned as the value for 2001-2003; the second as the value for 2004-2007; and the third as the value for 2008-2011.

[TABLE I]

Figure 1 presents the overall composition of ACSHs for the period 2001-2011. Diabetes and hypertension represent more than half of all ACSHs. Figure 2 shows the dramatic 50% increase in the national ACSH rate per 10,000 uninsured population (target population of health jurisdictions), reaching 19.7 in 2011. During the same period total hospitalisations in the health jurisdictions analysed increased

by 42.5%. Measured as the proportion of total hospitalisations, ACSHs rose by 3.8% overall, after an initial increase of 10.3% during 2001-2005 followed by a decline of 5.9% in 2005-2011.

[FIGURE 1]

[FIGURE 2]

Table II shows the descriptive statistics for the 188 health jurisdictions included in the hospital jurisdiction analysis (home to approximately 53.2 million uninsured Mexicans). For some jurisdictions the *SP* coverage rate has values over 100%. However, this is not surprising since previous studies have documented multiple coverage among *SP* beneficiaries **(Fundación Mexicana para la Salud, 2012).** The high proportion of jurisdictions with very low SGI may reflect that only health jurisdictions with at least one general hospital were analysed and usually general hospitals tend to be located in jurisdictions with better socioeconomic conditions than the ones without a general hospital, but also that the jurisdictional SGI was obtained as a weighted average of the SGI of all the municipalities in the jurisdiction. Forty four jurisdictions were excluded from the hospital jurisdiction analysis. The reasons for excluding them were either because they did not have a general hospital in their territory or because general hospitals in the jurisdiction changed their classification during the period studied and in one case because the general hospital in the jurisdiction was inside a prison. In general, the excluded jurisdictions are less populous and have higher rate of uninsured population, lower *SP* coverage rate, higher percentage of rural population, and higher SGI indices. When changing the unit of analysis from origin jurisdictions to hospital jurisdictions, there is no loss in the number of hospitalisations only in the number of jurisdictions: origin jurisdictions with no general hospitals are not included in the hospital jurisdiction analysis but patients

with ACSHs coming from these jurisdictions are classified in jurisdictions where the hospitalisation occurred.

[TABLE II]

V. Results

Table III reports the main results of the models described above. The FE and the IV model from the origin jurisdictions perspective are not reported, but they are available from the authors upon request. The estimates are robust for different specifications and a likelihood ratio test indicates that model 4 is preferred to model 1 ($\chi^2_{(10)}$ statistic = 32.48). As expected, since chronic conditions are the most prevalent causes of ACSHs, the younger age groups have a negative association with ACSHs while this relation is positive for the older age groups. With the exception of the proportion of the population living in rural localities, enabling factors show a strong association with the ACSH rate: the higher the jurisdiction SGI and the higher the *SP* jurisdiction coverage rate, the higher the ACSH jurisdiction rate. A quadratic relationship between the ACSH rate and the *SP* coverage rate was discarded in model 2. It is worth noting that the strongest association is between SGI and the ACSH rate. The estimated coefficient for *SP* coverage changed only slightly after an explicit control for the effect of time is introduced (model 4); in the models where origin jurisdictions are the unit of analysis (models 5 and 6) the estimated coefficients are within the 95 per cent confidence interval for those estimated in model 4. The individual estimates for each year dummy variable in models 4-6 are not reported in Table III but they show an increasing association, for example in model 4 it goes from 1.2 in 2003 to 3.3 in 2009 (although not always significantly different from 2001, the reference year).

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[TABLE III]

An important relationship between hospital supply in health jurisdictions and ACSH rate was also found; having one consultancy room more than the mean per 10,000 uninsured is associated with more than 4 additional ACSHs per 10,000 uninsured. One unit deviation from the mean of hospital beds per 10,000 uninsured is associated with an additional 2.9 ACSHs per 10,000 uninsured. The latter remains significant and with a similar magnitude in model 5. Regarding the coefficient of consultancy rooms, it remained significantly different from zero in all the models where it was included. It can be observed that in model 6 having a general hospital less than 50 km and one hour drive away has the highest association with the ACSH rate. Model 6 does not include the same hospital supply controls previously used because these were perfectly correlated for the jurisdictions with no general hospitals and the availability of a general hospital within 50 km seems to be a more relevant supply variable in this case.

Table III displays a positive association between the rate of hospitalised patients coming from different jurisdictions and the ACSH rate. This variable controls for the proportion of patients seeking care in a different jurisdiction from the one in which they live for a condition that should have been managed at the primary level that will be expected to take place, preferably, in their registered area of residence. The association for this variable is significant from the two perspectives used, but the magnitude in models 1-4 is almost twice that of models 5 and 6.

This analysis reports a lack of a significant association between the ACSH rate at the jurisdiction level and utilisation of primary care services measured through GP consultations per 10,000 uninsured at the state level.

Table IV shows the first stage of the 2SLS reported in column (3) in Table III. Years of *SP* operation in the state seem to be a strong instrument for *SP* jurisdiction coverage rate since its effect on the coverage rate is not only significant at the 1% level but it also has one of the highest estimated coefficients. The strength of the instrument is supported by a high R^2 in the regression of *SP* jurisdiction coverage rate on its instruments and also by the weak identification test where the null hypothesis that the instrument is weak is rejected at the 1% level. Also in Table IV, the endogeneity test for *SP* jurisdiction coverage rate does not reject the null hypothesis of treating this variable as exogenous, supporting the assumption in Table III columns (4-6) that *SP* jurisdiction rate is an exogenous variable.

As an additional robustness check, the same analysis was conducted only for the diabetes ACSHs subgroup (not reported). While the magnitude of the estimated coefficients is considerably lower, the sign and significance of the findings prevail (with the exception of the SGI variables whose coefficients were not different from zero in models 1-3 and only significant for the medium SGI category in models 4-6).

[TABLE IV]

The increase in the ACSH rate and its positive association with the *SP* coverage rate should be interpreted carefully. It is important to stress that this study analyses data from a period where *SP* was in a gradual, continuous, and heterogeneous expansion across the country, and, consequently, access to both primary and hospital care improved for more than 50 million previously uninsured people. In general, states show an increase in their ACSH rate at an earlier stage of the *SP* coverage expansion, but the ACSH rate did not follow the same trend in all states as *SP* continued to expand. Hence, states can be classified into those with a decreasing or

stable ACSH trend after reaching *SP* coverage levels above 50%; states with increasing ACSH trend irrespective of the *SP* coverage level; states with apparent stable ACSH rate throughout the period; and states without a clear ACSH trend. Table V shows how states can be classified in these four categories and Figure 3 presents one example of each group indicating the year when each of these states reached and/or passed the 0%, 20%, 50% and 80% *SP* coverage thresholds. High heterogeneity was also found for jurisdictions within states.

[TABLE V]

[FIGURE 3]

VI. Discussion

The increase in health insurance coverage experienced in Mexico after the Health Reform of 2003 did not lead to a decrease in the ACSH rate, but rather the ACSH rate boomed in the following decade. The analysis conducted suggests that this increase was driven by the expansion in health insurance coverage, at least during the initial expansion stage, as *SP* reached people with chronic conditions without sufficient access to appropriate health care services prior to the coverage expansion whose poorly controlled condition hindered the ability of primary care to avoid ACSHs. Therefore, the increase in ACSHs does not necessarily imply that the primary care services provided is ineffective or of low-quality. Focusing on the increase/decrease of the ACSH rate may not be an appropriate way to measure the effectiveness of primary care services in the Mexican post-reform context. Rather it shows the immediate consequences of years of limited access to primary care that have health and financial implications over both patients and providers that are worth exploring in further studies. This is not the first study to find an increase in the ACSH

rate after an expansion in health coverage, Saha et al. (2007) observed a similar trend in preventable hospitalisations after the expansion of Medicaid coverage in Oregon.

The use of this indicator becomes relevant in the Mexican setting when ACSH rates are compared across states because after taking into account differences in the *SP* coverage rate among states and among jurisdictions, there are still unexplained differences in the ACSH rate that may be due to differences in primary care performance. This argument is supported not only by the different trends in ACSH rate during the period studied, but also by the different reactions of the ACSH rate after high *SP* coverage levels are reached. The differences observed in the ACSH rates between and within states reflect serious structural differences in management and primary care infrastructure across states that might have been worsened by the decentralisation processes of the 1980's and 1990's and that the Reform of 2003 has been unable to reduce as it did with the inter-state health-financing gap **(Autrique-Echeveste, 2012)**. Once *SP* coverage rates converge across the country, as a result of achieving universal health coverage in 2012, monitoring and comparing the ACSH rate across states, jurisdictions and facilities as well as complementing this information with primary care utilisation data will provide a clearer picture of the quality of care provided by the state health ministries.

The associations found for age and socioeconomic status are consistent with previous research: the higher the proportion of older population and the poorer socio-economic conditions, the higher is the ACSH jurisdiction rate **(Culler et al., 1998; Finegan et al., 2010; Shi & Samuels, 1999).** It was also found that hospital supply is strongly linked to the ACSH rate; when this result is interpreted jointly with the positive coefficient of the rate of patients coming from different jurisdictions, it

suggests that jurisdictions with greater availability of general hospital services attract cases that should be solved at the primary care level.

The lack of association between GP consultations at the state level and the jurisdiction ACSH rate could result from differences in access to and provision of primary care services within states. This explanation of the apparently insignificant association with the ACSH jurisdiction rate could be confirmed by better utilisation data at the jurisdiction level. Finegan et al. (2010) also found no significant association of this factor with the ACSH rate, they argue that effectiveness of primary care is not equivalent to the number of visits *per se* and that GP visits should be complemented with new effective therapies.

This study has some limitations. First, it is possible that data limitations biased the results. Using state level data as a proxy for the data at the jurisdiction level is not ideal and might have led to severe biases in the estimated coefficients of primary care utilisation and condition prevalence rates. A second limitation is that the analysis is subject to the environmental fallacy, since information is only available for individuals being hospitalised and individuals not being hospitalised for any reason (either because they did not need it or because they were not able to access to it) are not considered. This problem will remain without a survey of primary care and hospital utilisation, and future studies will continue to be unable to uncover the real problems of access, quality and effectiveness of health care. Third, this paper only analyses ACSHs in general hospitals run by state health ministries without considering those occurring in smaller public and private hospitals. This decision was made due to the high heterogeneity present in the hospital services offered by smaller hospitals. Even when heterogeneity is still present in general hospitals a comparison among them seems to be more appropriate since in order to be

classified as general hospitals they need to meet minimum standards for the number of services offered. Fourth, as with any other study using administrative data, it is vulnerable to coding and measurement errors. However, these data are not used to reimburse hospitals, meaning that hospitals do not have strong incentives for upcoding; thus, the assumption that errors follow a normal distribution and do not introduce significant bias is plausible.

To conclude, it is important to note that despite significant associations between several predisposing, enabling, need and hospital supply factors and the health jurisdiction ACSH rate, an important proportion of the variation in the rate could not be explained with the proposed model. From the dispersion shown in Table III (rho) we can infer that the main source of this unexplained variation is the high heterogeneity at the health jurisdiction level; from the figures shown above we can also conclude that the trends vary substantially from state to state. Therefore, this paper suggests that some states and jurisdictions are performing less well than others. As long as large differences in the ACSH rate are not explained, the potential role of the ineffectiveness of primary care and the provision of low-quality services in Mexico cannot be disregarded.

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Tables and Figures

Table I

Variable Description

Variable	Description	Source
ACSH rate per 10,000 uninsured	(Discharges, for patients ages 20 and older, with one of the 300 ICD-10 codes considered preventable as main diagnosis in general hospitals of the jurisdiction i / total population without social security in jurisdiction i) X 10,000	(Secretaria de Salud, 2013b)
different JURIS rate	(number of patients residing in other jurisdictions but hospitalised in hospitals of the jurisdiction i / total population without social security in jurisdiction i) X 10,000	
Seguro Popular (SP) coverage rate	(number of *SP* beneficiaries in jurisdiction i / total population without social security in jurisdiction i) * 100	(Comision Nacional de Protección Social en Salud, 2011; Secretaria de Salud, 2013b)
social gap index	weighted measurement that summarises four social deprivation indicators (education, health, household services and housing spaces) into a single index whose purpose is to arrange units according to their social deprivation	(Consejo Nacional de Evaluación de la Política de Desarrollo Social, 2012)
state diabetes prevalence per 10,000 population	(diabetic population in state / total population in state) * 10,000	(Gutiérrez et al., 2012; Olaiz-Fernández et al., 2006; Olaiz et al., 2003)
state hypertension prevalence per 10,000	(hypertensive population in state / total population in state) * 10,000	
state GP consultation rate	(general practice consultancies for population without social security in state / total population without social security in state) * 10,000	(Secretaria de Salud, 2014)
beds rate	(number of hospital beds in jurisdiction i / total population without social security in	(Secretaria de Salud, 2013a)

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consultancy room rate	jurisdiction i) * 10,000 (number of consultancy rooms in general hospitals of the jurisdiction i / total population without social security in jurisdiction i) * 10,000	
rural population	(population from the jurisdiction i residing in localities with less than 2,500 population / total population without social security in jurisdiction i) * 100	(Consejo Nacional de Población, 2012, 2013)
indigenous population	(indigenous population in the jurisdiction i / total population without social security in jurisdiction i) * 10,000	(Comision Nacional para el Desarrollo de los Pueblos Indigenas, 2010)

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Table II

Descriptive Statistics

Hospital Jurisdictions

Variable	Mean	SD	Min	Max
Pop with no Social Security	274,541	197,784	12,383	1,156,468
ACSCH rate*	23.8	18.6	0.1	173.2
Female rate*	5,020	165.9	4,509	5,422
Age group 20-29*	1,788	199.8	1,228	2,346
Age group 30-39*	1,442	205.4	955	2,119
Age group 40-49*	1,031	146.4	720	1,852
Age group 50-59*	639	105.7	390	1,321
Age group 60-69*	392	103.0	167	861
Age group older than 70*	325	118.6	95	900
Seguro Popular coverage	39.5	36.2	0.0	135.9
Rural	32.9	22.7	0.0	89.0
Indigenous population*	1,066	1,800	8	9,873
Very Low SGI	0.60	0.49	0.0	1.00
Low SGI	0.20	0.40	0.0	1.00
Medium SGI	0.15	0.36	0.0	1.00
High & Very high SGI	0.05	0.23	0.0	1.00
Different JURIS rate*	36.8	68.0	0.0	577.1
GP consultation rate*	14,700	4,438	7,874	28,899
Beds rate*	4.1	2.7	0.5	21.8
Consultancy room rate*	1	1	0	7
Diabetes state prevalence	730	188.2	330	1,230
Hypertension state prevalence	1,454	285.9	810	2200

SGI: Social Gap Index; JURIS: heath jurisdiction.
*Rate per 10,000 population with no Social Security

Table III

Fixed Effects Models for ACSH rate

Variable	(1) Fixed Effects	(2) Squared *SP* coverage	(3) Instrumental Variables	(4) Year Dummies	(5) Origin JURIS ‡	(6) Origin JURIS ALL ††
Predisposing Factors						
*Age group*ᵗ						
20-29	-0.0113*	-0.0104	-0.0113*	-0.0113	-0.0062	-0.0078
	[0.0065]	[0.0064]	[0.0064]	[0.0069]	[0.0075]	[0.0072]
30-39	-0.0361	-0.0366*	-0.0359*	-0.0363*	-0.0455**	-0.0486***
	[0.0213]	[0.0214]	[0.0211]	[0.0211]	[0.0211]	[0.0159]
50-59	-0.0854**	-0.0809**	-0.0848**	-0.0878**	-0.0913**	-0.0812**
	[0.0396]	[0.0367]	[0.0389]	[0.0356]	[0.0357]	[0.0338]
60-69	0.1299**	0.1282**	0.1294**	0.1311**	0.1328**	0.1158**
	[0.0625]	[0.0604]	[0.0617]	[0.0632]	[0.0650]	[0.0516]
Enabling Factors						
SP coverage rate	0.1120***	0.0771***	0.1149***	0.1032**	0.0945**	0.0818**
	[0.0134]	[0.0250]	[0.0112]	[0.0384]	[0.0380]	[0.0319]
SP coverage squared	-	0.0004	-	-	-	-
	-	[0.0003]	-	-	-	-
Very Low SGI	-4.6277*	-4.4177*	-5.0143**	-5.6046**	-5.8559**	-5.6433**
	[2.4950]	[2.3677]	[2.1993]	[2.6133]	[2.5468]	[2.7448]
Low SGI	-3.9843	-3.6716	-4.2730**	-4.9460*	-4.8286*	-3.9788
	[2.4419]	[2.1985]	[2.1441]	[2.4284]	[2.4100]	[2.5275]
Medium SGI	-3.5744**	-3.4013**	-3.6939**	-3.9934**	-4.0069**	-3.7426***
	[1.6962]	[1.5833]	[1.6449]	[1.7285]	[1.6898]	[1.2430]
Need Factors						
*Different JURIS rate*ᵗ	0.0794***	0.0773***	0.0797***	0.0802***	0.0447*	0.0473***
	[0.0264]	[0.0265]	[0.0258]	[0.0263]	[0.0235]	[0.0118]
*GP consultation rate*ᵗ	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0001
	[0.0003]	[0.0003]	[0.0003]	[0.0003]	[0.0003]	[0.0003]
Hospital Characteristics						
*Beds rate*ᵗ	2.8704***	2.8752***	2.8694***	2.8506***	2.4110**	-
	[0.9168]	[0.9087]	[0.8949]	[0.9169]	[0.9050]	-
*Consultancy room rate*ᵗ	4.4102*	4.2387*	4.4243**	4.4061*	4.9915**	-
	[2.1718]	[2.1514]	[2.1164]	[2.1754]	[2.3004]	-
General hospital closer than 50 km	-	-	-	-	-	8.9905**
	-	-	-	-	-	[3.7231]
Constant	23.8121***	23.8876***	24.0061***	23.7982***	22.4107***	11.9163***
	[1.8034]	[1.8313]	[1.9401~]	[1.8162]	[1.8341]	[2.6101]
$\widehat{SD}$						
sigma_u	12.9899	13.0656	13.0812	13.2639	14.0671	16.6586
sigma_e	6.7512	6.7416	6.7518	6.7166	6.7561	7.0619
rho	0.7873	0.7897	0.7896	0.7959	0.8126	0.8477
N	1961	1961	1961	1961	2020	2552
R^2	0.3823	0.3844	0.3822	0.3925	0.355	0.2504
ll	-6418.1214	-6414.7698	-6418.301	-6401.879	-6606.063	-8472.4623

State cluster standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. ᵗ Mean-centred rate per 10,000 population with no Social Security. In (3) SP coverage rate is instrumented by the years of SP operation in the state where each jurisdiction is located. ~The SE for the constant in (3) is not clustered. Non-significant associations unreported: proportion of female population, age groups 40-49 and older than 70, indigenous condition, rural rate, diabetes and hypertension prevalence, and in (4) year dummies. ‡ Model 5 uses origin health jurisdictions as unit of analysis. All jurisdictions without general hospitals were excluded. †† Model 6 includes all origin health jurisdictions whether they have a general hospital in their territory or not. A dummy that indicates if a general hospital is within 50 km and less than one hour driving from the biggest municipality in the jurisdiction was included to control for health care supply instead of number of hospital beds and consultancy rooms.

Table IV

First Stage: *Seguro Popular* coverage on instruments

Variable	Coeff.
Female rate	0.04***
Age group	
20-29	-0.02***
30-39	-0.02
40-49	0.09***
50-59	-0.25***
60-69	0.08**
Older than 70	0.06**
Indigenous	0.00
Rural	0.24
Very Low SGI	19.32***
Low SGI	10.52***
Medium SGI	5.16**
Diabetes	-0.04***
Hypertension	0.02***
Different JURIS rate	-0.02
GP consultation rate	0.00
Beds rate[t]	-0.01
Consultancy room rate[t]	1.35
Years of SP operation	**10.46*** **
Constant	-14.54**
N	1961
R^2	0.89
Weak identification test (Kleibergen-Paap rk Wald F statistic):	1,637.91
Stock-Yogo weak ID test critical values:	
10% maximal IV size	16.38
15% maximal IV size	8.96
20% maximal IV size	6.66
25% maximal IV size	5.53
Endogeneity test (*SP coverage rate)*: Chi-sq(1) P-val = 0.484	0.490

* p<0.10, ** p<0.05, *** p<0.01.

Table V

Classification state ACSH index

Category	States
Decreasing or relatively stable trend after reaching 50% *Seguro Popular* coverage rate	**Aguascalientes**, Colima, Distrito Federal, Durango, Guanajuato , Jalisco, Nayarit, Querétaro, Quintana Roo, Tabasco, Veracruz
Increasing trend throughout the period irrespective of the *Seguro* Popular coverage level	Coahuila, **Chiapas**, Guerrero, Hidalgo, Estado de México, Michoacán, Nuevo León, Oaxaca, Puebla, Sinaloa, Yucatán
Relatively stable throughout the period	Baja California, Baja California Sur, Morelos, **Tamaulipas**, Zacatecas
No clear trend	Campeche, Chihuahua, **San Luis Potosí**, Sonora, Tlaxcala

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Figure 1

Composition of Ambulatory Care Sensitive Hospitalisations, 2001-2011

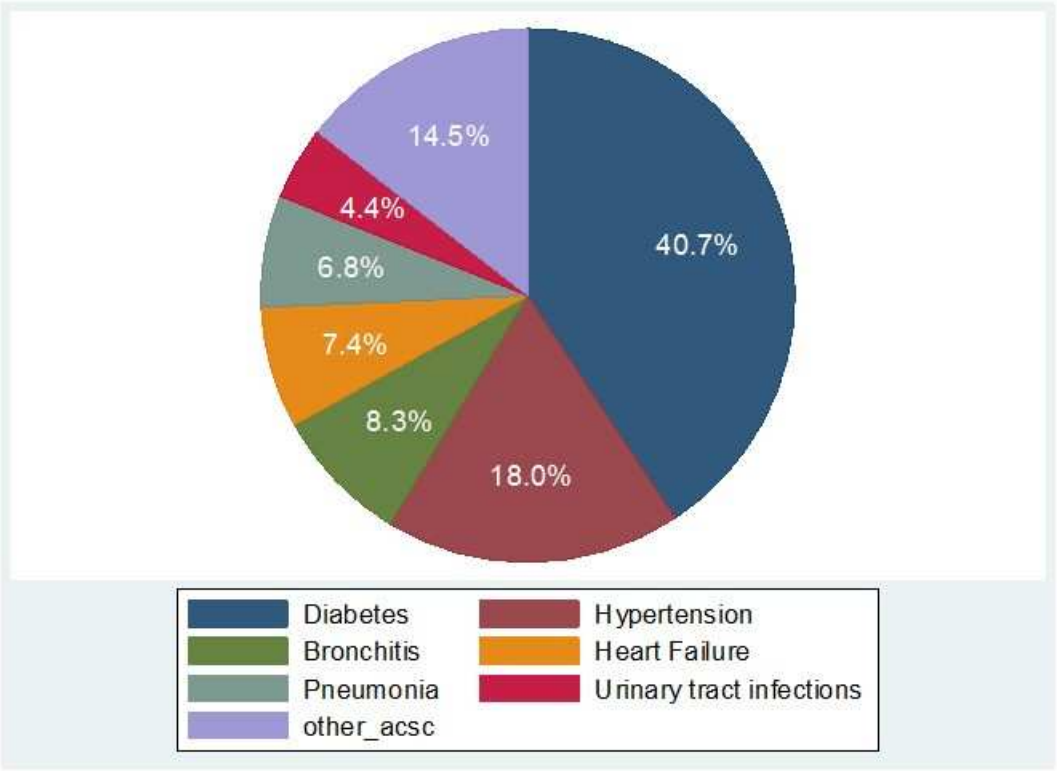

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Figure 2

Ambulatory Care Sensitive Hospitalisation national rate, 2001-2011

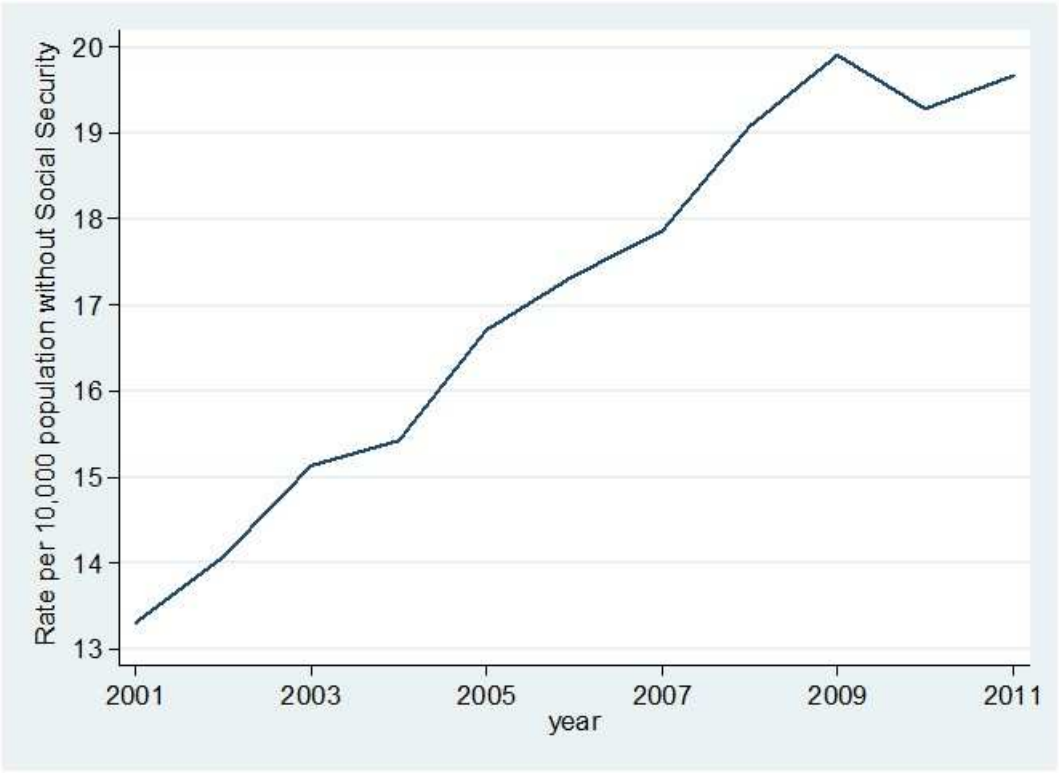

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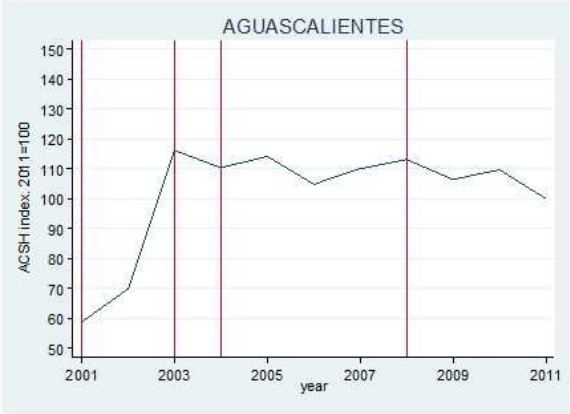
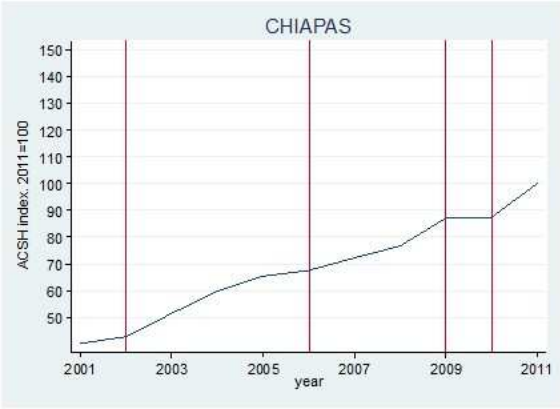
Figure 3
Ambulatory Care Sensitive Hospitalisations (ACSH) by State with *Seguro Popular* coverage thresholds, 2001-2011

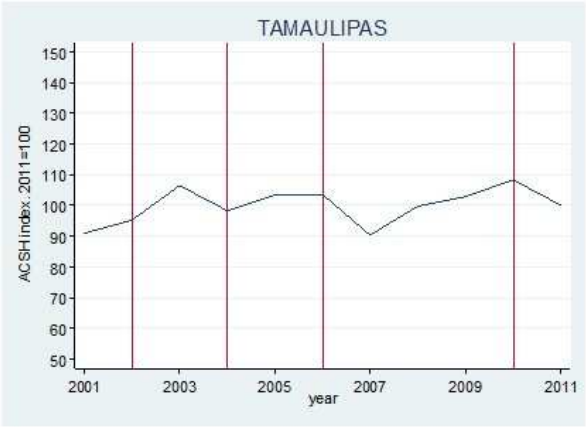
A) Decreasing/ stable ACSH trend after reaching 50% *Seguro Popular* coverage rate



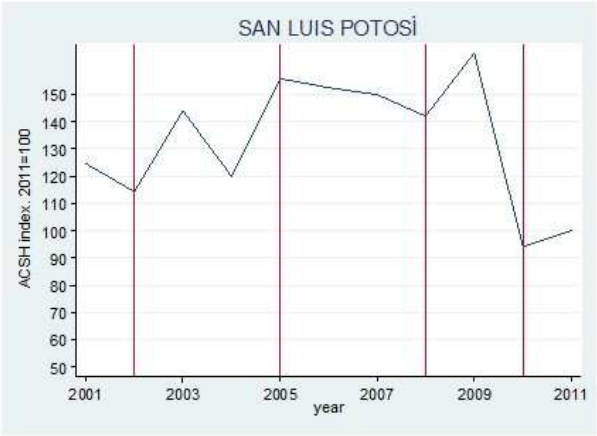
B) Increasing ACSH trend throughout the period irrespective of the *Seguro Popular* coverage level



C) Relatively stable ACSH rate throughout the period



D) Not clear ACSH trend



Notes:

(1) The ACSH rate is presented as proportion of the value of the ACSH rate in 2011 that is equal to 100.
(2) Lines in the graphs show the year when the chosen states reached and/or crossed the *Seguro Popular* coverage thresholds of 0%, 20%, 50% and 80%, respectively.

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APPENDIX

Ambulatory Care Sensitive Conditions included in the analysis[1]

No.	Condition	Hospital care covered by *Seguro Popular*
1	Immunisation and preventable infectious diseases	
2	Congenital syphilis	
3	Tuberculosis	
4	Diabetes mellitus	X*
5	Disorders of hydro-electrolyte metabolism	
6	Anaemia	
7	Convulsions and epilepsy	X
8	Diseases of the upper respiratory tract	X
9	Hypertension	X**
10	Heart Failure	
11	Pneumonia	X
12	Bronchitis and chronic obstructive pulmonary disease	X
13	Asthma	
14	Bleeding or perforating ulcer	X
15	Appendicitis with complication	X
16	Disease of the skin and subcutaneous tissue	
17	Gastroenteritis	
18	Urinary tract infections	X
19	Pelvic inflammatory disease	
20	Hypoglycaemia	
21	Gallstone ileus	X

Source: Authors with data from Comisión Nacional de Protección Social en Salud (2012).

* Hospitalisation for diabetes with kidney failure is not covered by *Seguro Popular*.

** Treatment for acute myocardial infarction is only covered for those under 60.

[1] ICD-10 codes considered for each condition are available here [INSERT LINK TO ONLINE FILE A].

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Research Highlights

- We analyse the avoidable hospitalisation (ACSH) rate in Mexico during 2001-2011.
- The ACSH rate in Mexico boomed after health insurance expansion.
- ACSH rate may not be a valid effectiveness indicator when health coverage expands.
- ACSH rate may identify differences in primary care between and within states.
- The heterogeneity found in the ACSH rates suggests regional differences in quality.

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SUPPLEMENTARY FILE A

Ambulatory Care Sensitive Conditions included in the analysis[1]

ICD-10 Coding		
No.	**Condition**	**ICD-10 codes**
1	Immunisation and preventable infectious diseases	A36.0, A36.1, A36.2, A36.3, A36.8, A36.9, A37.0, A37.0, A37.1, A37.8, A37.9, A35X, A80.0, A80.1, A80.2, A80.3, A80.4, A80.9, B26.0, B26.1, B26.2, B26.3, B26.8, B26.9, B05.0, B05.1, B05.2, B05.3, B05.4, B05.8, B05.9, G00.0, I00X, I01.0, I01.1, I01.2, I01.8, I01.9
2	Congenital syphilis	A50.0, A50.1, A50.2, A50.3, A50.4, A50.5, A50.6, A50.7, A50.9
3	Tuberculosis	A15.0, A15.1, A15.2, A15.3, A15.6, A15.4, A15.5, A15.7, A15.8, A15.9, A17.0, A17.1, A17.8, A17.9, A18.0, A18.1, A18.4, A19.0, A19.1, A19.2, A19.8, A19.9
4	Diabetes mellitus	E10.9, E11.9, E12.9, E13.9, E14.9, E10.0, E10.1, E10.6, E10.7, E10.8, E11.0, E11.1, E11.6, E11.7, E11.8, E12.0, E12.1, E12.6, E12.7, E12.8, E13.0, E13.1, E13.6, E13.7, E13.8, E14.0, E14.1, E14.6, E14.7, E14.8, E10.5, E11.5, E12.5, E13.5, E14.5, E10.3, E11.3, E12.3, E13.3, E14.3, E10.2, E11.2, E12.2, E13.2, E14.2, E10.4, E11.4, E12.4, E13.4, E14.4
5	Disorders of hydro-electrolyte metabolism	E86X, E87.6
6	Anaemia	D50.0, D50.1, D50.8, D50.9
7	Convulsions and epilepsy	G40.0, G40.1, G40.2, G40.3, G40.4, G40.8, G40.9, R56.0, R56.8
8	Diseases of the upper respiratory tract	H66.0, H66.1, H66.2, H66.3, H66.4, H66.9, H67.8, J02.0, J02.8, J02.9, J31.2, J03.0, J03.8, J03.9, J06.0, J06.9, J36X

[1] The studies considered in the design of the ACSCH list used in this paper were Weissman (1992), Epstein (2001), Caminal et al (2004), Finegan et al (2010), and Agency for Healthcare Research and Quality (2013).

No.	Condition	ICD-10 codes
9	Hypertension	I10X, I11.9, I12.0, I12.9, I13.0, I13.1, I13.2, I13.9, I15.0, I15.1, I15.2, I15.8, I15.9, I21.0, I21.1, I21.2, I21.3, I21.4, I21.9, I25.2, I24.0, I24.1, I24.8, I24.9, I25.1, I25.3, I25.4, I25.5, I25.6, I25.8, I28.9, I20.0, I20.1, I20.8, I20.9, I60.0, I60.1, I60.2, I60.3, I60.4, I60.5, I60.6, I60.7, I60.8, I60.9, I61.0, I61.1, I61.2, I61.3, I61.4, I61.5, I61.6, I61.8, I61.9, I67.4
10	Heart Failure	I50.0, I50.1, I50.9, I11.0, J18X
11	Pneumonia	J13X, J14X, J15.3, J15.4, J15.7, J15.9, J15.9, J15.9, J16.0, J16.8, J18.0, J18.9
12	Bronchitis and chronic obstructive pulmonary disease	J20.0, J20.1, J20.2, J20.3, J20.4, J20.5, J20.6, J20.7, J20.8, J20.9, J41.0, J41.1, J41.8, J43.0, J43.1, J43.2, J43.8, J43.9, J47X, J44.0, J44.1, J44.8, J44.9
13	Asthma	J45.0, J45.1, J45.8, J45.9,
14	Bleeding or perforating ulcer	K25.0, K25.2, K25.4, K25.6, K26.0, K26.2, K26.4, K26.6, K27.0, K27.1, K27.2, K27.4, K27.5, K27.6
15	Appendicitis with complication	K35.0, K35.1
16	Disease of the skin and subcutaneous tissue	L03.0, L03.1, L03.2, L03.3, L03.8, L03.9, L04.0, L04.1, L04.2, L04.3, L04.8, L04.9, L08.0, L08.1, L08.8, L08.9
17	Gastroenteritis	K52.8, K52.9
18	Urinary tract infections	N11.0, N11.1, N15.1, N36.9, N39.0
19	Pelvic inflammatory disease	N70.0, B70.1, N70.9, N73.0, N73.1, N73.2, N73.3, N73.4, N73.5, N73.6, N73.8, N73.9
20	Hypoglycaemia	E16.2
21	Gallstone ileus	K56.3