The financial and health burden of diabetic ambulatory care sensitive hospitalisations in Mexico

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Abstract

Objective. To estimate the financial and health burden of diabetic ambulatory care sensitive hospitalisations (ACSH) in Mexico during 2001-2011. **Materials and methods.** We identified ACSH due to diabetic complications in general hospitals run by local health ministries and estimated their financial cost using diagnostic related groups. The health burden estimation assumes that patients would not have experienced complications if they had received appropriate primary care and computes the associated Disability-Adjusted Life Years (DALYs). **Results.** The financial cost of diabetic ACSH increased by 125% in real terms and their health burden in 2010 accounted for 4.2% of total DALYs associated with diabetes in Mexico. **Conclusion.** Avoiding preventable hospitalisations could free resources within the health system for other health purposes. In addition, patients with ACSH suffer preventable losses of health that should be considered when assessing the performance of any primary care intervention.

Keywords: ambulatory care sensitive hospitalisations; primary care; diabetes; Mexico

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Resumen

Objetivos. Estimar la carga financiera y de salud de las hospitalizaciones relacionadas con diabetes sensibles a la atención ambulatoria (HSAA) en México durante 2001-2011. **Material y métodos.** Se identificaron HSAA relacionadas con complicaciones diabéticas en hospitales generales operados por los servicios estatales de salud y se estimó su costo financiero utilizando grupos relacionados por diagnóstico. Para estimar la carga de salud se supuso que los pacientes no hubieran sufrido complicaciones diabéticas si hubieran recibido atención primaria adecuada y se calcularon los años de vida ajustados por discapacidad (AVAD). **Resultados.** El costo financiero de las HSAA diabéticas aumentó 125% en términos reales y la carga de salud en 2010 representó 4.2% del total de AVAD asociados con la diabetes en México. **Conclusiones.** Evitar hospitalizaciones prevenibles libera recursos dentro del sistema de salud. Adicionalmente, pacientes con HSAA sufren pérdidas de salud prevenibles que deben tomarse en cuenta al evaluar el desempeño de la atención primaria.

Palabras clave: hospitalizaciones sensibles a la atención ambulatoria; atención primaria; diabetes; México

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Timely, effective and high-quality primary care services can prevent the development or exacerbation of some 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.[1,2] While the financial implications of ACSHs have been studied before for some countries, the preventable losses of health as a consequence of ACSHs have not received attention in the literature. This paper estimates the financial cost of ACSHs in public general hospitals in Mexico and proposes a way to quantify the health burden associated with them.

Although the literature on ACSHs is extensive, few studies have considered the cost they represent to the health system. Culler and colleagues estimated that Medicare cost savings from eliminating all potentially preventable hospitalisations could have reached 9% of the programme's spending during 1991.[3] Analysing nursing home data from New York State, Grabowski and colleagues found that ACSHs made up 23% of total spending on nursing home hospitalisations.[4] Kim focused on uncontrolled diabetes in the U.S. during 2004 and estimated that approximately 32% of hospital admissions that were primarily a result of diabetes were due to uncontrolled diabetes with a cost amounting to 2.8 billion dollars.[5] McFarlane and colleagues estimated that "*the total economic burden for hospitalisations*" for diabetes and hypertension represented 1.2% of the recurrent budget for the regional health authorities of Jamaica in 2010-2011.[6] No study appears to have estimated the health burden of suffering ACSHs.

Worldwide, most ACSHs are associated with chronic diseases; in Mexico, previous studies show that diabetes is the most important cause of ACSH.[2,7,8] The prevalence of diabetes has risen dramatically during recent decades and its high costs and serious health consequences have made it a public health priority.[9,10] This paper focuses on the costs of five diabetic complications assumed to be avoidable through timely and effective primary care.

The economic burden of diabetes in Mexico has been analysed in several studies.[10-12] In the most recent report, Barraza-Lloréns and colleagues (2015) estimated that in 2013 this burden, including direct and indirect costs, was MXN$362 859.8 million accounting for 2.25% of GDP. Direct costs were estimated as MXN$179 495.3 million of which medical care for the main diabetic complications represented 87%.

The health burden of diabetes in 2010 was estimated as 1 614 486 DALYs, representing the first and the fourth cause of DALYs for females and males, respectively.[13] Clearly diabetes imposes an important pressure on both public finance and population health in Mexico, one which is expected to increase with the continuing rise in the prevalence of diabetes.[9] While primary care does not necessarily prevent the development of diabetes, appropriate management can prevent the main complications of the disease. The aim of this paper is, therefore, to identify the avoidable component of these burdens as an effort to contribute to understanding and improving the efficiency with which healthcare resources are used in Mexico.

Materials and methods

The analysis uses hospital discharge data for the period 2001-2011 from general hospitals run by local health ministries.[14] Data on diagnosis and medical procedures, among other variables, were recorded for each discharge, but it is not possible to link patient episodes since unique ID numbers are not available.

Hospitalisations of patients 20 years or older due to five complications of diabetes (retinopathy, kidney failure, neuropathy and diabetic foot) were identified through the ICD-10 code of the main diagnosis in each case. If a patient experienced an amputation procedure and his main hospitalisation diagnosis was any of the ICD-10 codes reported in table I, it was classified as a diabetic amputation and also considered in this analysis.

The economic burden of ACSHs is formed by the value of the resources needed to provide this type of care instead of using them in other interventions and by the effects of an ACSH on the participation and performance in the labour market of those suffering them. This study focuses only on the first component using the financial cost of the hospital care received. The health burden of an ACSH could be represented by the effects on the disability suffered by patients with ACSHs that would not have been hospitalised if they had received appropriate primary care.

The hospital discharges database does not include cost data that could be used to estimate inpatient day costs; hence, this study uses the Diagnostic Related Group (DRG) system from the Mexican Institute of Social Security (IMSS) to estimate the financial costs of ACSH due to diabetic complications in general hospitals run by local health ministries.[15] Thus, costs in IMSS hospitals are assumed similar to those operated by local health ministries. Arredondo and De Icaza estimated, however, that IMSS average diabetic hospitalisations costs are 1.8 times the costs of the Ministry of Health.[9] They indicate that the difference in costs can be mainly explained by differences in case management protocols, in productivity standards, in quality standards and in cost of inputs. Consequently, this study uses the full

Table I
DIABETIC ICD-10 CODES AND DRG CLASSIFICATION

	ICD-10 of Diabetic Complications	*DRG*	*IMSS DRG 2013 Cost (MXN)*
Kidney Failure	E10.2, E11.2, E12.2, E13.2, E14.2	698 – Other kidney and urinary tract diagnostics with major complications	71 066
Retinopathy	E10.3, E11.3, E12.3, E13.3, E14.3	125 – Other eye disorders	22 820
Neuropathy	E10.4, E11.4, E12.4, E13.4, E14.4	074 – Cranial and peripheral nerve disorders with no major complications	37 494
Diabetic Foot	E10.5, E11.5, E12.5, E13.5, E14.5	301 – Peripheral vascular disorders	46 057
Amputation	Any Diabetic code + CIE-9CM: 84.1, 84.10, 84.11, 84.14, 84.15, 84.17, 84.19	Low limb amputation secondary to diabetic foot	58 831

All Diabetic Hospitalisations ICD-10 Codes

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

Source: References 2 and 15. IMSS, Cédulas Médico-Económicas. México DF, 2014

IMSS-DRG cost to estimate the upper bound of the ACSH financial costs in local health ministries, but also presents the results using 56% of the IMSS-DRG costs (as suggested by Arredondo and De Icaza). Since IMSS-DRG data are only available for 2013, the assumption is that IMSS-DRG costs only changed due to inflation during the study period.

Some of the ICD-10 codes analysed can be classified in more than one DRG; the decision of which DRG to use in each case was based on the DRG that included all the ICD-10 codes related to the complication. The costs of the DRGs selected were taken from the IMSS Medical-Economic Forms. Since diabetic amputations are defined as those hospitalisations where the main cause was any diabetic ICD-10 code where the patient suffered an amputation, only the cost of the surgical procedure was considered since this intervention represents additional costs not previously accounted for. The latter cost was obtained from a joint effort in 2012 to produce maximum referral tariffs by the four main health care institutions in Mexico.[16] Table I shows the DRG classification and costs for all the ICD-10 codes considered in this analysis.

It is important to note that IMSS-DRG costs are currently used by IMSS as a reference and do not necessarily represent what IMSS hospitals are really expending on each treatment. In addition, IMSS-DRG costs do not consider rural-urban nor big-small city price differentials. Despite these drawbacks of using IMSS-DRG costs as proxy of hospital care costs in local health ministries, they are still considered the best available costing data to conduct this study.

The estimation of the health burden assumes that patients would not have experienced complications if they had received appropriate primary care and computes the associated Disability-Adjusted Life Years (DALYs). Disability weights for diabetic foot, neuropathy, kidney failure – stage IV, amputation of toe, amputation of one leg, and amputation of both legs were taken from the Global Burden of Disease Study 2010.[17] The weight for retinopathy-blindness was taken from the Global Burden of Disease 2004 Update, since the 2010 version did not report a weight for this condition.[18] Due to lack of detail concerning the severity of the condition from hospitalised patients (e.g. degree of kidney failure or seriousness of retinopathy) and the absence of disability weights for different severity levels, only one level of disability (equal to the available weight in each case) is considered for patients whose main hospitalisation diagnosis was kidney failure, retinopathy, neuropathy and diabetic foot. This clearly overestimates the DALYs associated with these conditions and, thus, should be interpreted as the upper bound of the health burden of ACSHs resulting from diabetic complications. WHO data on the life expectancy at age with the lowest mortality observed worldwide are used to compute the Years of Life Lost (YLL) and Years Lived with Disability (YLD).[13,19]

Some hospitalised patients whose main diagnosis was kidney failure, neuropathy, retinopathy and diabetic foot also suffered amputations. Hence, to avoid double counting of deaths while computing YLL it was necessary to define the variable "net amputation" indicating those diabetic amputations in which the main hospitalisation cause was none of the other

complications analysed; therefore, amputation YLL are based on net amputations. However, when computing YLD the total number of people suffering amputations was used, since amputations will contribute to their disability; in this case, patients with diabetic foot without amputations (net diabetic foot) were used to compute diabetic foot YLD.

Results

Table II shows the composition of ACSHs due to diabetic complications during 2001-2011. A total of 195 778 hospitalisations met the described criteria and account for 52% of total diabetic ACSHs and 21% of total ACSHs identified by Lugo-Palacios and Cairns.[2] Total ACSHs due to diabetic complications increased by more than 130% over the period. While kidney failure and amputation discharges seemed to reach a plateau after 2008, hospitalisations for diabetic foot increased throughout the whole period (by 163% overall).

Financial costs

Table III shows the estimated financial costs of ACSHs as a result of diabetic complications. Scenario 1 uses the full IMSS-DRG costs as proxy for local health ministries' hospital care costs; Scenario 2 uses adjusted costs as described previously.

Financial costs of ACSH due to diabetic complications increased 125% in real terms during 2001-2011. Measured as cost per person with no social security (major demanders of the services provided by the analysed hospitals), the costs in scenario 1 increased by 95.4% from 11.04 MXN in 2001 to 21.6 MXN in 2011. Diabetic foot hospitalisation costs exhibit a continuous increasing trend throughout the period growing by more than 160% and surpassed kidney failure hospitalisations from 2010 onwards as the most important contributor to the cost of ACSHs from diabetic complications; by 2011 diabetic foot hospitalisation costs were more than 80 times the retinopathy costs and more than 30 the neuropathy costs.

Health burden

The estimated DALYs associated with diabetic complications ACSH are presented in table IV. Overall, DALYs increased by 112% in 2001-2011. Kidney failure is the complication with the highest health burden. In 2011, DALYs associated with diabetic amputation (the complication with the second highest health burden) represented only 29% of the kidney failure DALYs.

During the study period, the difference between the health burden caused by kidney failure and the burden associated with the rest of the complications increased. However, YLL and YLD show different trends during this period (the disaggregation of DALYs in YLL and YLD is available upon request). On the one hand, the difference between kidney failure YLL and the second cause of YLL, diabetic foot, rose 161% with this gap broadening in the last three years due to a continuous increase in kidney failure YLL and a stable trend in diabetic foot YLL. On the other hand, the difference between kidney failure YLD and the second cause of

Table II
Diabetic ACSHs in Mexico 2001-2011. Hospital Discharges

Complication	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*Total*
Kidney failure	3 682	4 045	4 330	4 332	4 900	5 142	5 835	7 006	6 987	6 640	6 563	59 462
Retinopathy	130	140	128	96	175	221	174	175	158	138	292	1 827
Neuropathy	274	318	279	362	407	412	353	429	466	422	432	4 154
Diabetic foot	4 520	5 140	5 717	6 056	6 815	7 468	8 243	9 461	10 139	11 352	11 883	86 794
Amputation*	2 215	2 386	2 897	3 092‡	3 505	3 863	4 110	4 831	4 941	5 806	5 895	43 541
Total	10 821	12 029	13 351	13 938	15 802	17 106	18 715	21 902	22 691	24 358	25 065	195 778

Source: Authors using data from Sistema Nacional de Información en Salud[14]

Notes:
* Some diabetic patients suffered more than one amputation. In that case, they are counted as different surgical procedures, but only contributed with one discharge to their hospitalisation type (for example, one patient with diabetic foot had two different amputations, they are counted as two amputations procedures but only one diabetic foot discharge)
‡ In 2004, only 129 amputations were reported. However, this number is not consistent with the observed trend possibly due to an error in the records. The number used in this study was imputed by obtaining the average for 2003 and 2005 of the ratio of amputation procedures to total diabetic foot hospitalisations. The 2004 ratio used is less than one standard deviation from the mean of the values observed in 2001-2003 and 2005-2011

Table III
FINANCIAL ACSH COST (2011 MILLION MXN*)

Complication	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Scenario 1: Full IMSS DRG Cost											
Kidney failure	243.01	266.97	285.79	285.92	323.40	339.36	385.10	462.39	461.12	438.21	433.13
Retinopathy	2.76	2.97	2.71	2.03	3.71	4.68	3.69	3.71	3.35	2.92	6.19
Neuropathy	9.54	11.07	9.72	12.61	14.17	14.35	12.29	14.94	16.23	14.69	15.04
Diabetic foot	193.34	219.85	244.54	259.04	291.50	319.42	352.57	404.67	433.66	485.53	508.25
Amputation	121.02	130.36	158.29	168.92	191.50	211.05	224.55	263.95	269.95	317.20	322.07
Total	569.66	631.22	701.04	728.52	824.28	888.86	978.20	1 149.66	1 184.30	1 258.56	1 284.68
Scenario 2: 56% of IMSS DRG Cost‡											
Kidney failure	136.09	149.50	160.04	160.11	181.10	190.04	215.65	258.94	258.23	245.40	242.56
Retinopathy	1.54	1.66	1.52	1.14	2.08	2.62	2.07	2.08	1.88	1.64	3.47
Neuropathy	5.34	6.20	5.44	7.06	7.94	8.03	6.88	8.37	9.09	8.23	8.42
Diabetic foot	108.27	123.12	136.94	145.06	163.24	178.87	197.44	226.62	242.85	271.90	284.62
Amputation	67.77	73.00	88.64	94.60	107.24	118.19	125.75	147.81	151.17	177.63	180.36
Total	319.01	353.49	392.58	407.97	461.59	497.76	547.79	643.81	663.21	704.80	719.42

Notes:
* 2013 IMSS DRG costs were transformed to 2011 MXN using annual inflation rates published by the National Institute of Geography and Statistics - INEGI (available in: http://www.inegi.org.mx/sistemas/indiceprecios/CalculadoraInflacion.aspx). The only change assumed in the costs during this period was inflation
‡ 56% of the cost of each of the IMSS DRGs selected was used to obtain Scenario 2 results, adjusting by the cost-differential suggested by Arredondo and De Icaza[9]

Table IV
DISABILITY ADJUSTED LIFE YEARS (DALYS) ASSOCIATED WITH DIABETIC COMPLICATIONS ACSH. MEXICO 2001-2011.*

Complications	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Kidney failure	21 517	24 450	24 790	25 199	29 734	30 258	35 295	45 165	43 421	42 623	44 356
Retinopathy	2 526	2 954	2 417	1 877	3 384	3 954	3 285	3 366	3 026	2 528	5 457
Neuropathy	1 236	1 217	1 145	1 420	1 534	1 728	1 612	1 875	2 208	2 135	1 941
Diabetic foot	3 415	5 194	4 505	4 646	3 692	5 330	5 900	6 107	7 120	7 431	7 410
Amputation	5 372	5 683	7 289	7 902‡	8 303	9 310	9 192	11 684	11 227	13 295	12 976
Total	34 067	39 498	40 145	41 044	46 647	50 580	55 284	68 197	67 002	68 013	72 140

Notes:
* Disaggregation of DALYs in years of life lost (YLL) and years lived with disability (YLD) is available upon request
‡ In 2004 only 129 amputations were reported. However, this number is not consistent with the observed trend possibly due to an error in the records. The number used in this study was imputed by obtaining the average for 2003 and 2005 of the ratio of amputation procedures to total diabetic foot hospitalisations. For computing the years of life lost, the average for 2003 and 2005 of the ratio yll amputation to yll diabetic foot was used in 2004. For computing YLD (both for amputation and diabetic foot), the average of observed values in 2003 and 2005 was used because net diabetic foot is affected by amputations and if the latter is underestimated the former will be over recorded

YLD, amputation, grew 15% during 2001-2011, but in the last four years this difference narrowed as the trend in kidney failure YLD remained relatively stable while the amputation YLD experienced a 26% increase.

With the exception of neuropathy, the health burden of all complications increased by more than 100%; the most dramatic increment was amputation DALYs which increased by 142% from more than 5 000 DALYs in 2001 to almost 13 000 in 2011.

Figure 1 presents, graphically, the behaviour of the financial and health burden for each of the complications analysed. It shows that both financial and health bur-

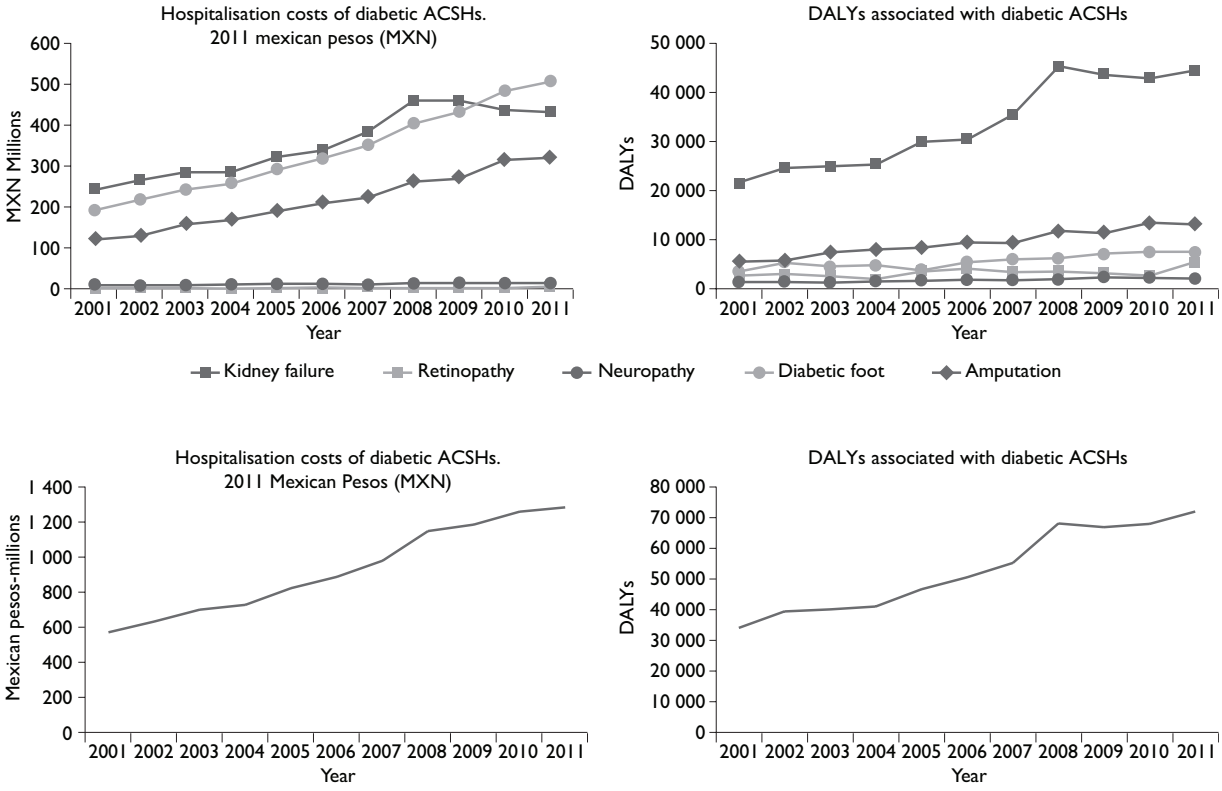

Figure 1. Financial cost and health burden of diabetic ACSH. Mexico 2001-2011

den for kidney failure and amputation seemed to have reached a plateau in the last four years. Diabetic foot and retinopathy show no major changes in the health burden in the last years of the period although their financial cost rose, especially in the case of diabetic foot.

Discussion

Despite promotion and prevention efforts to improve the control of diabetes across the Mexican health system, the financial and the health burden of ACSH associated with diabetic complications increased dramatically in 2001-2011. Some factors, not necessarily related to the effectiveness of primary care, can explain this rise. First, the prevalence of the disease grew importantly from 5.8% in 2000 to 9.17% in 2012, thus, increasing the demand for diabetes care.[20] Second, the gradual health insurance expansion fostered by the 2003 Health Reform improved access for people with poorly controlled chronic conditions for whom preventable hospitalisations could not be avoided by the time they sought health care.[2] However, whether or not the ACSH rate is a valid indicator of the performance of an expanding primary care system, the financial and health burden of ACSHs requires attention since this double burden highlights an inefficient use of health resources and should be seen as a future reallocation target to improve the value for the money invested in health care in Mexico.

This paper found that financial costs of ACSH associated with diabetic complications have continuously increased but that the trend differs by complication. It is worth highlighting that the most worrying case is the one of diabetic foot, a complication that can easily be avoided through basic primary care but that it is still the leading cause of hospitalisation among the complications analysed; moreover, in 2010 and 2011 this complication became the most costly of the ACSHs due to diabetic complications.

It is important to emphasise the relevance of the magnitude of the financial costs of diabetic ACSH within the Mexican context. The estimated costs under Scenario 1 reached in 2011 almost MXN 1 300 million (approximately 105 million USD) equivalent to the *Seguro Popular* federal transfers to the state of Tabasco in that year (that had at that time more than 1.5 million *Seguro Popular* beneficiaries) and to 0.83% of the total direct costs of

treating the main complications of diabetes in 2013 in Mexico estimated by Barraza-Lloréns and colleagues.[10,21]

As a novel approach to ACSH, this paper also estimated the health burden of diabetic complications ACSH. In 2010, this health burden was estimated to be more than 68 000 DALYs accounting for 4.2% of total DALYs associated with diabetes in Mexico.[13]

Given the WHO cost-effectiveness criterion (an intervention is highly cost-effective if the cost of averting one DALY is less than or equal to GDP per capita), in 2011 it would have been cost-effective to spend up to $(Int) 1 146.1 million on primary care interventions that could avert the DALYs associated with diabetic complications; if DALYs are discounted at the annual rate of 3%, then the threshold is $(Int) 718.4 million ($Int stands for 2011 international dollars).[22] This approach clearly highlights the importance of the health burden of diabetic ACSHs.

The present paper is subject to the following limitations. First, due to the lack of cost data from local health ministries, IMSS-DRG costs were used as proxy which could represent an overestimate of the real hospitalisation costs observed in local health ministries. With the intention of alleviating the potential bias, this paper followed Arredondo and De Icaza and assumed that costs at local health ministries are 56% of IMSS costs. Second, this study assumes a homogenous system in the provision of care when in practice there are 32 subsystems (one per state) that can face different costs and different diabetes prevalence rates.[20] Consequently this analysis may over-estimate the hospitalisation costs in some areas and under-estimate them in others. For this reason, figures are reported at the national level such that, on average, these over-and underestimations are balanced. Third, this analysis does not estimate the indirect costs of diabetic ACSH that would include the productivity implications of premature mortality, permanent and temporary disability. Fourth, given that the hospital discharge database does not record the severity of the condition for which patients were hospitalised, and also owing to the lack of disability weights for different severity levels of certain conditions, such as kidney failure and retinopathy, all kidney failure and retinopathy admissions were assumed to have the same severity level: stage IV and blindness, respectively. This assumption clearly overestimates the associated DALYs and, therefore, should be taken as an upper bound of the health burden associated with ACSH due to diabetic complications, a sensitivity analysis of this assumption is available upon request. Fifth, since it is not possible to identify when a patient was discharged more than once in the same year or during the study period, DALYs will be double-counted when patients are admitted more than once for the same cause. Finally, DALYs may also be overestimated due to the assumption that a complication avoided in one period is avoided for the rest of the patient's life.

Avoiding preventable hospitalisations potentially releases resources within the health system making them available for other health purposes, but providing the services that could prevent these hospitalisations implies investment in primary care not taken into account in this study. This paper showed that the health burden associated with diabetic ACSHs is important and should be consider, in addition to financial costs, in primary care decision making. Sound evidence of what works to prevent ACSHs is crucial to ensure the efficient allocation of resources in primary care. Therefore, further research on the evaluation of national campaigns aiming to improve both the delivery of primary care and patients' adherence to treatments that consider both the financial and the health burden of ACSH is needed to better understand the extent to which Mexicans are getting value for their money invested in health.

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