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Assessment of healthcare costs of amputation and prosthesis for upper and lower extremities in a Qatari healthcare institution: a retrospective cohort study

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ABSTRACT

Objectives To evaluate the healthcare cost of amputation and prosthesis for management of upper and lower extremities in a single institute.

Design Retrospective cohort study conducted between 2000 and 2014.

Participants All patients who underwent upper (UEA) and lower extremities amputation (LEA) were identified retrospectively from the operating theatre database. Collected data included patient demographics, comorbidities, interventions, costs of amputations including hospitalisation expenses, length of hospital stay and mortality.

Outcome measures Incidence, costs of amputation and hospitalisation according to the level of the amputation and cost per bed days, length of hospital stay and mortality.

Results A total of 871 patients underwent 1102 (major 357 and minor 745) UEA and LEA. The mean age of patients was 59.4±18.3, and 77.2% were males. Amputations were most frequent among elderly (51.1%). Two-third of patients (75.86%, 95% CI 72.91% to 78.59%) had diabetes mellitus. Females, Qatari nationals and non-diabetics were more likely to have higher mean amputation and hospital stay cost. The estimated total cost for major and minor amputations were US$3 797 930 and US$2 344 439, respectively. The cumulative direct healthcare cost comprised total cost of all amputations, bed days cost and prosthesis cost and was estimated to be US$52 126 496 and per patient cost of US$29 961. Overall per patient cost for amputation was US$59 847. The total direct related therapeutic cost was estimated to be US$26 096 046 with per patient cost of US$29 961. Per patient cost for amputation was US$989 808.

Conclusions The economic burden associated with UEA and LEA-related hospitalisations is considerable. Diabetes mellitus, advanced age and sociodemographic factors influence the incidence of amputation and its associated healthcare cost. The findings will help to showcase the economic burden of amputation for better management strategies to reduce healthcare costs. Furthermore, larger prospective studies focused on cost-effectiveness of primary prevention strategies to minimise diabetic complication are warranted.

INTRODUCTION

Limb amputation remains a major problem worldwide in spite of the advancement in the diagnostic and therapeutic measures. In the USA, 1.6 million people were estimated to be living with limb loss in 2005, of them 65% had lower extremity amputation (LEA). However, upper extremity amputation (UEA) is relatively rare (8%) and mostly related to traumatic injury (68.6%).

According to the recent WHO estimates, around 150 million individuals are affected by diabetes mellitus (DM) globally; and this figure is expected to be twofold by the year 2025. The risk of LEA is considerably higher (10-fold) in patients with DM as compared with non-diabetics. Nearly, 75% of the LEAs are performed in the patients with diabetic foot disease. Also, LEA is associated with higher risk of mortality, impaired quality of life and increased healthcare costs among diabetics. Early initiatives perused the goal to reduce the number of LEAs in patients with diabetes. However, epidemiological studies have shown marked variations in the incidence, relative risks and time trends and management of LEA in diabetic compared with non-diabetic population.
owing to differences in study design and methodological approaches. 5 9

Furthermore, the treatment strategies of LEA should carefully account for the associated complications, quality of life and healthcare cost. Lower Extremity Assessment Project study revealed similar functional outcomes in patients underwent amputation or reconstruction of the limb-threatening lower extremity injury. 10 An earlier meta-analysis, based on nine observational studies also found no significant difference in terms of functional outcome of patients with leg-threatening injuries treated either with limb salvage or primary amputation on follow-up. 11 It has been suggested that the functional outcomes are often improved after successful limb reconstruction in comparison to early amputation and appropriate prosthesis. 12 13 Also, some studies concluded that the cost of amputation is less as compared with limb salvage and early amputation is a reasonable cost-effective strategy. 11 14 Although, reconstructive limb salvage is technically challenging and time-consuming, some investigators suggested that it is associated with improved quality of life and lesser costs of treatment as compared with amputation. 15 16 Notably, in Qatar the prevalence of diabetes is rapidly increasing with an escalating problem of diabetic foot disorder that necessitates amputation. 17 Currently, there is a lack of integrated facility to treat diabetic foot ulceration which may compromise the quality of life, with lower productivity, higher medical cost and unnecessary amputations. Therefore, cost of illness (COI) analysis for diabetics and non-diabetics is imperative to provide the scientific evidence for making appropriate clinical decisions, cost-saving and resource allocation. In addition, it could be beneficial for improvement in preventative diabetic foot care, avoidance of unfavourable outcomes and will be a basis for formulation of health policies and fiscally sound decisions to improve healthcare facilities. Considering the expanding need and limitation of healthcare resource, this study presents the healthcare costs of amputation and prosthesis for management of upper and lower extremities in a tertiary healthcare institution of Qatar.

METHODS

Study population and settings

It was a retrospective cohort study based on data obtained from the operating theatre database and medical records at Hamad General Hospital (HGH) for all patients who underwent UEA and LEA between 2000 and 2014. Median follow-up time was 19 with an IQR of 3–53 months. All patients with major and minor amputation were included in the study. Primary healthcare and tertiary referral care centres comprised the healthcare system in Qatar. HGH is the referral hospital that provides basic healthcare facilities to manage high-risk patients for amputation who require elective and emergency surgery including trauma and vascular management. During the study period, there was no provision of health insurance scheme and all emergency services were provided free of cost to patients. Both nationals and expatriates with valid resident permit used to have equal access to health facilities. All in-hospital diagnostic and therapeutic services are available free of charge at HGH for all nationals and residents in Qatar, whereas costs of prosthesis are covered by private or charity agencies for residents. HGH is the only tertiary hospital in Qatar performing amputations during the study period.

Data collection

Data were collected on patient demographic characteristics (age, gender and nationality), DM status, intervention details (indications, level of amputation, major and minor amputation) and part (limb or digit) amputated, length of hospital stay and early mortality. We obtained data for the cost of amputation and hospitalisation according to the level of the amputation (toe, finger, forefoot/hind foot, above/below knee, wrist level, above/below elbow) and cost per bed days. The procedure and material cost was included in the level of amputation cost.

The sessions were categorised as major amputations, which involved below-knee and above-knee amputation, whereas minor amputations referred to the sessions involving digit (toe or finger) and transmetatarsal amputations. Amputations were further classified based on involvement of single or multiple extremities. The major indication for amputation was diabetic foot ulcer with or without ischaemia followed by traumatic injury and tumour. The diagnosis of DM was considered based on patient’s history of diabetes and/or current antidiabetic management such as insulin therapy and oral hypoglycaemic agent.

Patient and public involvement

Patients and public were not involved in this study, because it is a retrospective cohort study and data were collected anonymously.

Cost analysis

COI studies are needed for justification of budget, establishment of preventive and interventional programmes and setting up priorities for research funding by health-care policy makers. 1 5 Depending on the objective of cost analysis, it can be either based on prevalence or incidence of the disease. Prevalence is more commonly considered for budget planning and decision making by health policy makers. 18 This includes calculation of total costs for a study population over particular period of time in a specified area. 19 19 For health economics research, medical costs and disease-associated costs are the two main criteria considered for cost evaluation. 19 20 These medical costs are further subclassified as direct (types of payments and expenses) and indirect (resource utilisation). 19 20 The direct cost involves costs incurred for in-hospital and outpatient services, medical supplies, laboratory investigations, medication, rehabilitation services at care centres, home and caregiver costs. Costs

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of resources that are lost due to morbidity and mortality referred as indirect costs. Overall cost=amputation cost+hospital stay cost+prosthesis cost+angiography-alone cost+angiography/angioplasty cost+angiography/angioplasty/stent cost+bypass for peripheral artery disease cost+diabetic foot ulceration cost+haemodialysis cost+peritoneal dialysis cost.

The institutional medical cost was obtained from the ‘Estimated Cost of Service—Summary’, cost accounting section, finance department, Hamad Medical Corporation, Doha, Qatar (table 1).

Data management and statistical analysis
Descriptive and inferential statistics were applied for data analysis. Cost estimates are presented as point estimates with 95% CIs, which were used to generalise the percentages. Linear regression analysis and scatter plot were used to find out the correlation between variables. Data were analysed using R V.3.5.1 and Statistical Package for the Social Sciences (SPSS) for Windows V.21.0 (SPSS, Chicago, Illinois, USA).

RESULTS
Sociodemographic characteristics
A total of 871 patients underwent 1102 (major 357 and minor 745) upper and lower extremities amputation over the 14-year study duration. The mean age of patients was 59.4±18.3, 77.2% (95% CI 74.25 to 79.82) were males and 37.4% were citizens (table 2). Amputations were most frequent in the age group >60 years (51.1%) followed by 41–60 years (33.2%) and ≤40 years (15.7%). The majority of patients (75.9%, 95% CI 72.91% to 78.59%) were angiography/angioplasty/stent, bypass for peripheral artery disease, management cost of diabetic foot ulceration, haemodialysis and peritoneal dialysis. All costs are represented in US dollars.

Evaluation of amputation costs
The total medical cost of upper and lower limb amputation was calculated by multiplying the number of amputations, hospital stays, prosthesis and therapeutic interventions with the respective unit costs. Figure 1 shows the overview of total medical cost analysis. The direct medical costs were also computed for amputations, hospital stays and prosthesis. The direct related (therapeutic) medical cost evaluation in this study mainly comprised procedural cost involving angiography, angiography/angioplasty,
The most common indication for amputation was diabetic foot complications (74.8%), followed by trauma (18.9%) and ischaemia (5.6%).

Cost analysis
Analysis of the cost of amputation and hospital stay stratified by sociodemographic factors, aetiology and early mortality are shown in table 2. The total and mean amputation and hospital stay cost were highest for elderly patients (>60 years) as compared with other age groups. However, females, Qatari nationals and patients with no diabetes were more likely to have higher mean amputation and hospital stay cost even though the total cost was more in their counterparts. Also, early mortality accounted for higher mean cost of amputation and hospital stay but the total cost for both was relatively lower as compared with those who survived.

Table 3 shows analysis of the cost of amputation according to level of amputation. A total of 357 patients underwent major amputations in the index admission and on follow-up with an estimated total cost of US$3 797 931 and 745 patients required minor amputations which were estimated to cost US$2 344 439. As per the level of amputation, below-knee (n=172) and above-knee (n=164) amputations involved in maximum cost with a total estimate of US$1 829 815 and US$1 744 708, respectively.

Table 4 represents the estimated cost of hospital stay according to the level of amputation. For major and minor amputations, the hospital cost was estimated to be US$21 351 511 and US$24 103 434, respectively. Toe amputations incurred maximum total cost (US$21 454 121) followed by above-knee (US$13 778 159) and below-knee (US$6 815 522) amputations.

The cumulative direct healthcare cost comprised the total cost of all amputations US$6 142 370 (mean: 7052; 95% CI 6642 to 7462), total bed days cost US$45 434 945 (mean: 52 187; 95% CI 42 618 to 61 756) and total prosthesis cost (n=74) US$529 181. Therefore, the total direct healthcare cost was estimated to be US$52 126 496, and per patient direct healthcare cost was found to be US$59 846.

Table 5 represents the estimated total cost (amputation cost+hospital stay cost) according to the level of amputation. For major and minor amputations, the hospital cost was estimated to be US$25 149 442 and US$26 447 873, respectively.
### Table 3: Analysis of cost of amputation according to level of amputation in the index admission and on follow-up in US$

| Level of amputation | Total (n=1102) | Follow-up | First admission | Second admission | Third admission | Fourth admission | Fifth admission | Sixth admission | Seventh admission |
|---------------------|----------------|-----------|----------------|------------------|----------------|------------------|----------------|----------------|-------------------|
|                     | n | Total | Mean | n | Total | Mean | n | Total | Mean | n | Total | Mean | n | Total | Mean | n | Total | Mean | n | Total | Mean |
| Toe (n=671)         | 573 | 1330060 | 2322 | 71 | 169609 | 2389 | 19 | 57915 | 3048 | 6 | 12410 | 2068 | – | – | – | – | – | – | – | – | – | – | 1574132 |
| Forefoot (n=68)     | 39 | 414900 | 10639 | 15 | 159577 | 10639 | 10 | 106385 | 10639 | 3 | 319159 | 10639 | – | – | – | – | – | – | 1 | 10639 | 10639 | – | – | 723415 |
| Hind foot (n=4)     | 4 | 42554 | 10639 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 42554 |
| Below knee (n=172)  | 118 | 1255339 | 10639 | 37 | 393623 | 10639 | 7 | 74469 | 10639 | 6 | 63831 | 10639 | 3 | 319157 | 10639 | – | – | – | 1 | 10639 | 10639 | 1829815 |
| Above knee (n=164)  | 114 | 1212785 | 10639 | 40 | 425539 | 10639 | 4 | 42554 | 10639 | 2 | 21277 | 10639 | – | – | – | – | – | – | 1744708 |
| Finger (n=2)        | 2 | 4339 | 2170 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 4339 |
| Wrist level (n=6)   | 6 | 63831 | 10639 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 63831 |
| Below elbow (n=5)   | 5 | 53192 | 10639 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 53192 |
| Above elbow (n=10)  | 10 | 106385 | 10639 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 106385 |
| Type of amputation  |               |           |           |               |           |           |               |           |           |               |           |           |               |           |           |           |               |           |           |           |           |               |           |           |
| Major amputation (n=357) | 253 | 2691531 | 10639 | 77 | 819162 | 10639 | 11 | 1170239 | 10639 | 10 | 106385 | 10639 | 5 | 531927 | 10639 | – | – | – | 1 | 10639 | 10639 | 3797931 |
| Minor amputation (n=745) | 618 | 1791852 | 2900 | 86 | 329186 | 3828 | 29 | 164300 | 5666 | 9 | 44326 | 4925 | 2 | 4137 | 2069 | 1 | 10639 | 10639 | – | – | – | 2344439 |
| Total (n=1102)      | 871 | 4483383 | 163 | 1148348 | 40 | 2813239 | 19 | 150710 | 7 | 57329 | 1 | 10639 | 1 | 10639 | 6142370 |
| Follow-up | First admission | Second admission | Third admission | Fourth admission | Fifth admission | Sixth admission | Seventh admission | Total | Total |
|-----------|----------------|-----------------|----------------|-----------------|----------------|----------------|------------------|-------|-------|
| Toe (n=671) | 573 | 19191758 | 33493 | 71 | 1509478 | 21260 | 19 | 561264 | 29540 | 6 | 164423 | 27404 | 2 | 27198 | 13599 | 21454121 |
| Forefoot (n=68) | 39 | 1485989 | 38102 | 15 | 615659 | 41044 | 10 | 182967 | 18297 | 3 | 140934 | 46978 | 1 | 6181 | 6181 | 2431731 |
| Hind foot (n=4) | 4 | 186676 | 46669 | 1 | 186676 | 186676 | 1 | 186676 | 186676 | 1 | 186676 | 186676 | 1 | 186676 | 186676 | 186676 |
| Below knee (n=172) | 118 | 5671978 | 48068 | 37 | 823352 | 22253 | 7 | 76648 | 10950 | 6 | 179258 | 29876 | 3 | 54396 | 18132 | 1 | 9890 | 9890 | 6815522 |
| Above knee (n=164) | 114 | 12507280 | 109713 | 40 | 1084203 | 27105 | 4 | 87775 | 21944 | 4 | 39560 | 9890 | 2 | 59341 | 29670 | 13778159 |
| Finger (n=2) | 2 | 30907 | 15453 | 2 | 30907 | 30907 | 2 | 30907 | 30907 | 2 | 30907 | 30907 | 2 | 30907 | 30907 | 2 | 30907 |
| Wrist level (n=6) | 6 | 233654 | 38942 | 6 | 233654 | 233654 | 6 | 233654 | 233654 | 6 | 233654 | 233654 | 6 | 233654 | 233654 | 6 | 233654 |
| Below elbow (n=5) | 5 | 217582 | 43517 | 5 | 217582 | 217582 | 5 | 217582 | 217582 | 5 | 217582 | 217582 | 5 | 217582 | 217582 | 5 | 217582 |
| Above elbow (n=10) | 10 | 306593 | 30659 | 10 | 306593 | 30659 | 10 | 306593 | 30659 | 10 | 306593 | 30659 | 10 | 306593 | 30659 | 10 | 306593 |
| Total (n=1102) | 871 | 39832418 | 45732 | 163 | 4032692 | 24740 | 40 | 908654 | 22717 | 19 | 524176 | 27588 | 7 | 140934 | 20134 | 1 | 6181 | 6181 | 1 | 9890 | 9890 | 45454945 |
| Type of amputation | | | | | | | | | | | | | | | | | | | |
| Major amputation (n=357) | 253 | 19837088 | 74850 | 77 | 1907555 | 24773 | 11 | 164423 | 14948 | 10 | 218819 | 21882 | 5 | 113736 | 22747 | 0 | 1 | 9890 | 9890 | 21351511 |
| Minor amputation (n=745) | 618 | 20895330 | 33811 | 86 | 2125137 | 24711 | 29 | 744231 | 25663 | 9 | 305357 | 33929 | 2 | 27198 | 13599 | 1 | 6181 | 6181 | 0 | 24103434 |
| Level of amputation | Follow-up | First admission | Second admission | Third admission | Fourth admission | Fifth admission | Sixth admission | Seventh admission | Total |
|---------------------|-----------|-----------------|------------------|-----------------|------------------|----------------|----------------|------------------|-------|
| Toe (n=671)         | Total     | 20521.181       | 35815            | 71              | 1679087.19      | 23649.1         | 6               | 619179.32588     | 29472.16820 | 31334.15667     | 23028253 |
| Forefoot (n=68)     | Total     | 1900889.48741   | 51683            | 10              | 289352.28936    | 3               | 460993.57617    | 16820.16820   | 364919      | 3155146  |
| Hind foot (n=4)     | Total     | 229230.57308    |                  |                 |                  |                 |                 |                  | 229230      |                  |         |
| Below knee (n=172)  | Total     | 6927317.58707   | 32892            | 7               | 21589.243089    | 3               | 373553.28771    | 120529.20529  | 8645337     |                  |         |
| Above knee (n=164)  | Total     | 13720065.120352 | 37744            | 4               | 130329.82114    | 2               | 80618.40309     | 15522867      |                  |         |
| Finger (n=2)        | Total     | 35246.17623     |                  |                 |                  |                 |                 |                  | 35246        |                  |         |
| Wrist level (n=6)   | Total     | 297485.49581    |                  |                 |                  |                 |                 |                  | 297485       |                  |         |
| Below elbow (n=5)   | Total     | 270774.54156    |                  |                 |                  |                 |                 |                  | 270774       |                  |         |
| Above elbow (n=10)  | Total     | 412978.41298    |                  |                 |                  |                 |                 |                  | 412978       |                  |         |
| **Total (n=1102)**  | Total     | 44315801.45732 | 24740            | 40              | 3721893.22717   | 19              | 674886.27588    | 198263.20134  | 16820       | 51597315 |                  |

*Table 5: Analysis of total cost (amputation+hospital stay) according to level of amputation in the index admission and on follow-up in US$*
Table 6 demonstrated the estimation of direct related therapeutic interventions cost of amputation. The total direct related therapeutic interventions cost was estimated to be US$26,096,046. Haemodialysis (US$515,495), management of diabetic foot ulceration (US$24,590,940) and peritoneal dialysis (US$677,120) accounted for the major direct therapeutic cost.

Regression analysis
Overall cost = 36,458.27 + 1.02 hospital stay cost
There was a positive strong correlation between overall cost and hospital stay cost ($r^2=0.96$, $p=0.00001$). Other variables showed a weak correlation ($r^2<0.30$). Hospital stay cost was an independent predictor of overall cost. Figure 2 depicts the correlation between overall cost and the regression adjusted predicted value.

DISCUSSION
To the best of our knowledge, this is the first study on healthcare cost associated with amputation and prosthesis in the Arab Middle East region. We estimated the association between patient demographics, characteristics, DM, mortality and direct medical costs of upper and lower extremities amputation managed at a tertiary care institution over 14 years. Despite some limitations, the present study attempts to estimate the economic burden of extremity amputation on the healthcare system. The study revealed that the total direct healthcare cost of amputation per patient in Qatar was US$89,808. The expected management cost is considerable and varies according to patients characteristics.

In the present study, the mean age of patients was 59 years and amputations were performed mostly among the elderly group. Prior population-based studies reported a mean age of 65 years in patients with LEA. Moreover, females, Qatari nationals and patients with no diabetes were more likely to have higher mean amputation and hospital stay cost in our study cohort; however, the total cost of amputation and hospital stay remains higher among males, non-Qataris and diabetics. Lefebvre and Chevan suggested that females were more likely to undergo major amputation than males which could be attributed to delayed presentation of women with vascular disease. Furthermore, female usually have a longer time for the diagnosis of DM, and its associated complications which might result in higher costs.

The current analysis extends the previous results to demonstrate that the total costs are higher in patients with DM than patients with no diabetes.
The global incidence of LEA has dispersion because of population heterogeneity. Even though there is a declining trend over time but the incidence rate of LEA remains high. In our study, 67% of amputations were minor in nature. Globally, there exists a higher incidence of LEA among diabetics which ranges from 46.1 to 9600 per 100 000 population than those without DM (5.8–31 per 100 000 population). Similarly, our study showed that the majority of amputations were done in patients with diabetes (75.86%, 95% CI 72.91% to 78.59%). An earlier study reported a high prevalence of DM (16.7%) in adult Qatari population. In our study, the mean amputation cost was US$6985 and mean hospital stay cost was US$52 000 among diabetics. Brandle et al found the median cost of an amputation as US$37 600 (US$23 300–US$62 200) in 2003. The present study reported a higher overall total direct healthcare cost of amputation per patient which was found to be US$59 846. Similar to our estimates, Margolis et al reported that the mean total annual Medicare payments for any beneficiary with diabetes-related LEA were roughly US$52 000 in 2008. Rinkel et al study on patients with diabetic foot disease, revealed an average in-hospital costs to be US$10 827 (range: 702–82 880) per episode. The average cost of single minor amputation, multiple minor amputations and major amputations were US$13 580, US$31 835 and US$73 813 per episode, respectively. Mundell et al identified the mean medical costs for transfemoral amputations of hospitalised patients as US$25 652 (95% CI US$10 468 to US$38 872) and emergency department as US$18 091 (95% CI US$7820 to US$57 368). Franklin et al reported that the annual mean treatment cost to be US$56 453, which is comparatively higher than the estimated cost per patient per year US$3990 in the present study.

According to the WHO Qatar report 2016, around 38 000 individuals are diagnosed with DM, which is predicted to increase to 88 000 by 2030. Appropriate and efficient treatment of DM could significantly prevent or reduce vascular complications. Therefore, prevention of complication related to DFU is considered as the most effective means of healthcare cost reduction.

Another alternative to minimise the cost is delaying the complication as long as possible. For prevention of DFU, it is useful to train the high-risk patients and to spread awareness among patients with diabetes which have implications for cost savings. The present study revealed a high cost of amputation and prosthesis. Findings of our analysis have implications to inform healthcare policy makers about the financial burden of amputations and urge the need for effective planning to improve outcomes of DM in Qatar.

A major limiting factor of the present study is the retrospective nature; therefore, the collected data might have missing information about the exact duration of diabetes. We might have underestimated the total costs as we mainly focused on the direct medical costs and cost of therapeutic interventions but did not include, payments incurred by patient, out-of-pocket costs, direct non-medical costs or other indirect costs.

We could not account pharmacy-related costs separately. The laboratory and radiological investigations, medical supplies and medications that were directly used during the course of treatment, and non-medical direct expenses were not considered in cost evaluation due to lack of sufficient data. In addition, it is imperative to know the indirect costs associated with work loss hours and residual disability. This study did not account for the indefinite costs involving pain, distress, depression, suffering and stress caused by amputation. Also the indirect costs of amputation from the societal perspective resulted in disabilities, lost productivity on the part of the patient, or premature mortality were not taken into consideration. This cost analysis study has other limitations such as lack of information about the cost of outpatient care and use of resource for chronic diseases, like hospital or home-based rehabilitation after amputation or other diabetic complications. We attempted to remove
uncertainty as much as possible by getting good quality data, to obtain a more accurate and standardised cost estimates from the hospital finance accounting. This study has a good external validly of results because all the amputation cases were managed in our national centre.

**CONCLUSIONS**

The economic burden associated with upper and lower extremity amputation-related hospitalisations is considerable. DM, advanced age and sociodemographic factors influence the incidence of amputation and its associated healthcare cost in Qatar.

The findings of this study will help to showcase the economic burden of amputation, which will be the basis for better management to reduce healthcare costs. There is an urgent need for effective standardised institutional screening protocol for minor and major extremity amputations among high-risk populations. Particularly, the effective approach to manage high-risk patients with diabetes includes an extensive patient education, early assessment and aggressive treatment by a multidisciplinary team. Furthermore, effective interventions may curb the otherwise impending clinical and economic burden of amputation in population with high prevalence of risk factors.

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**Competing interests** None declared.

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**Table 7** Prevalence of diabetes and diabetic foot complications in the Arab population

| Country          | WHO estimates on prevalence of diabetes | Prevalence of diabetes mellitus | Prevalence of diabetic foot complications |
|------------------|----------------------------------------|---------------------------------|------------------------------------------|
|                  | 2000 | 2030 | 9.9% (9.5% in men vs 10.1% in female) it doubled in 15-year period | Data not available |
| Tunisia          | 166 000 | 388 000 | 6.6% | Data not available |
| Morocco          | 427 000 | 1 138 000 | 10.6% (10.8% male vs 10.5% female) | Diabetic foot ulcer 11.9%, Neuropathy 84.85% & Peripheral arteriopathy 78.78% |
| Algeria          | Data not available | Data not available | 1.88% (1.3% males vs 2.29% female) | Data not available |
| Mauritania       | Data not available | Data not available | Data not available | Data not available |
| Libya            | 88 000 | 245 000 | Data not available | Peripheral arteriopathy 60% & Neuropathy 40% |
| Sudan            | 4 470 000 | 1 277 000 | 8.3% (9.9% male vs 7.5% female) | Neuropathy 37% & PVD10% |
| Egypt            | 2 623 000 | 6 726 000 | 2.4% rural area & 8.4% in low socioeconomic class & 10% in high socioeconomic class | Foot ulcer 1% & Diabetic neuropathy 22% |
| Somalia          | 97 000 | 331 000 | 2.3% | Data not available |
| Djibouti         | 7000 | 9000 | 4.1% | Data not available |
| Yemen            | 327 000 | 1 286 000 | 4.6% (7.4% male vs 2% female) | Data not available |
| Oman             | 1 130 000 | 343 000 | 16.1% | Data not available |
| United Arab Emirates | 350 000 | 684 000 | DM 29.2%, prediabetes 24.2% | Neuropathy 34.7% & PVD 11.1% |
| Qatar            | 38 000 | 88 000 | DM 16.7%, prediabetes 13.8% | Data not available |
| Bahrain          | 37 000 | 99 000 | DM 25.5%, prediabetes 14.7% | Neuropathy 36.6% PVD 11.8% Foot ulcer 5.9% |
| Kuwait           | 104 000 | 319 000 | 12.8% | Data not available |
| Iraq             | 668 000 | 2 009 000 | 21.4% | Diabetic foot 2.3%, Neuropathy 13%, Amputation 0.7% & PVD 0.2% |
| Syria            | 627 000 | 2 313 000 | 15.6% | Data not available |
| Lebanon          | 1 460 000 | 378 000 | 11.3% | PVD 18.3% |
| Jordan           | 1 950 000 | 680 000 | 17.1% | Diabetic foot ulcer 5%, Neuropathy 19% & Amputation 5% |
| Saudi Arabia     | 8 900 000 | 2 523 000 | 23.7% | Peripheral neuropathy 13.7%–35.9%, Diabetic foot 4.3% & Amputation 1.9% |
| Palestine        | Data not available | Data not available | 9.6% | Data not available |

PVD, peripheral vascular disease.
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