ORIGINAL ARTICLE

Function and Preparedness of Diabetes's Surveillance System from Managers and Policymakers' Viewpoint in Iran, 2017: There Is a Long Way Ahead to Beat Diabetes

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Abstract

Background: It is estimated that in 2025, the cost of diabetes will account for 40% of total health spending. In Iran, 4.5 to 5 million people are afflicted with diabetes, and its prevalence has doubled during the past three decades. The aim of this study was to determine the function and preparedness of diabetes surveillance system in Iran.

Methods: In this cross-sectional study, all managers, health policymakers and experts of diabetes(N:125) entered the study and completed a questionnaire on the existence and implementation of the surveillance system domains (from data collection to evaluation) and the relationship between domains of this system and their function. The descriptive statistical method, path analysis, was employed using Amos.

Results: According to manager's viewpoint, the range of existence and implementation of all domains of surveillance system were 12% to 68.7% in average. They believed that 10-69% of domains of surveillance system were working properly. Most of respondents (59-87%) declared that investing in diabetes at different levels of prevention was less than expected. Satisfaction with both diabetes surveillance system function and diabetic patients was low and they don't have a good and bright future for diabetes and its various aspects. By modeling analytical structural equations, some components of surveillance system were moderately worked together.

Conclusion: we conclude that we must first formulate and prepare a standard surveillance system as well as train the relevant personnel and make clear changes in the existing care system. With the current surveillance system, we have a long way to go to prevent and control diabetes to an acceptable the average level of performance of the care system is lower than expected

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Introduction

Type 2 diabetes is one of the most common diseases of the endocrine system,[1] known as silent epidemic, that has received worldwide attention.[2] In 2012, 1.5 million deaths were directly caused by diabetes and it is estimated that overall 3.7 million people have died as the result of diabetes. Based on the reports of the World Health Organization (WHO), the number of people with diabetes has increased from 180 million in 1980 to 422 million

in 2014. About %40 of this increase has been attributed to population growth and aging. after standardizing the population of diabetic patients for age, the prevalence of the disease in people 18 years and older has doubled in 1980 compared to 2014 and has been increasing.[3] In Iran, 4.5 to 5 million people have diabetes,[4] and its prevalence has doubled over the past three decades.[5] Comparison of the burden of diabetes-related illnesses per 100,000 person in Iran in 2015 compared to 2010 showed an increase in the burden of the disease in the age group of 45 to 65 years old;[6] it is estimated that in 2025, the cost of diabetes worldwide will accounted 40% of the total health spending. It is also estimated that in 2030 the cost of the disease will reach $ 595 billion[7, 8] and in Iran by 2030, the direct cost of diabetes will be $ 4.2 billion which will reach $ 4.8 billion.[9] To control every disease or health program, a special surveillance system has been developed and announced. The surveillance system should pursue such goals as disease surveillance; strengthening and providing necessary capacities for continuous data collection; monitoring the risk factors in a precise, continuous and systematic way; analyzing the data; and disseminating them for politicians and decision-makers at the national level.[10] The surveillance system cycle is summarized in Figure 1.[11]

Precise and step-by-step implementation of each domain or stage of surveillance system can greatly enhance the effectiveness and efficiency.[12] The surveillance system domains, from data production to intervention, play an important role in disease control, but with each disease the importance of these domains can vary, so that in acute and fatal diseases the timeliness system for sending data is vital ,where as in diseases such as diabetes, identifying unknown and asymptomatic patients is very important. A surveillance system has a desirable and acceptable function if all components work together correctly and regularly in a rational and accurate relationship.[10]

Iran's Ministry of Health, after many studies, implemented the national diabetes control program into the health system in 2002, and the non-communicable disease surveillance system was established in Iran in 200413 to prevent diabetes at three levels of prevention.[10] Changing diseases transition from communicable to non-communicable in the last two decades in Iran[12] and Advances in medical techniques and economic development, as well as increasing life expectancy, reducing child mortality, and controlling infectious diseases, have led to an increase in the prevalence of non-communicable diseases.[6] The disease surveillance system is mostly prepared and provided by health policy centers. Organizational chart of the control of diabetes in Iran's health-care services is shown in Figure 2.[14]

In reviewing studies on determining the function and preparedness of the surveillance system, some studies in this area have shown that the implementation of the surveillance system is effective in prevention and control.[8, 15, 16]

Since the surveillance system is considered as a framework for disease control, prioritizing, monitoring and evaluating the programs, identifying problems and facilitating research to be done, WHO has chosen "2016 the year of overcoming diabetes" as its motto16 and, according to the first document compiled by the Iranian Ministry of Health, the prevalence of diabetes should remain constant until 2025;[17] therefore, a complete and effective surveillance system is one of the most important tools that should be thoroughly updated and utilized by involved authorities in diabetes surveillance. What needs to be examined is whether the surveillance system has ever had an optimal function and preparedness for controlling diabetes? Is the diabetes surveillance system currently capable of achieving the mentioned national document goal? And with the current surveillance system, can we hope to keep the prevalence of diabetes constant in the future? This study was conducted to determine the function, preparedness, and completeness of diabetes surveillance system in our country and the relationship between domains of a surveillance system based on path analysis, as shown in Figure 1.

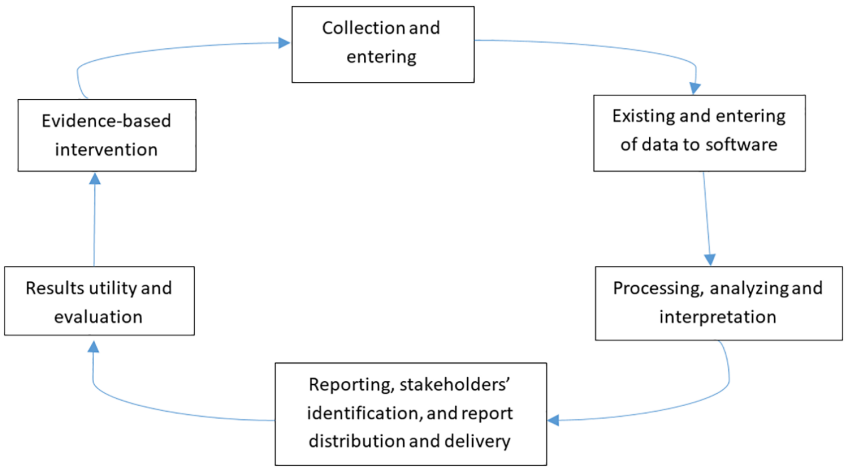

Figure 1: Surveillance system cycle and its components or steps[12]

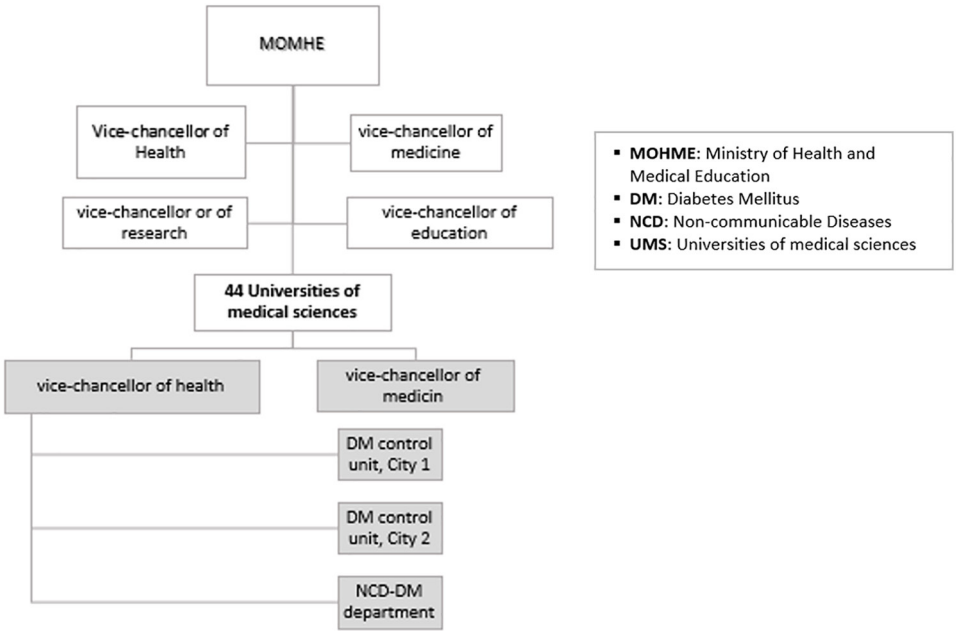

Figure 2: The organizational chart of the health system in Iran and diabetes prevention and control units (Gray boxes)[14]

Methods

In this national cross-sectional study, all managers, health policymakers, head of non-communicable disease officers, and diabetes experts from two cities from 44 universities were selected, as illustrated in Figure 2 with gray boxes from each university.

there are 44 universities in the country, of which 2 cities were selected from the cities under their coverage, and their diabetes experts were included in the study.

Inclusion criteria: People in the universities of medical sciences who have the position of vice-chancellors of Health, experts in charge of diabetes, and the experts of diabetes in all 44 universities of medical sciences of the country, and people who did not complete the questionnaire and did not consent to participate in the study were excluded from the study.

Considering that from each university, based on the position, 5 people have to complete the questionnaire and there are 44 universities in the country, 220 people have to complete the questionnaire. And considering that people who did not complete the questionnaire were excluded from the study and a number of universities have only one city, 36 universities and 125 questionnaires were finally evaluated.

The tool used in this study was a researcher-made questionnaire. The questionnaire was prepared using the opinion of 3 diabetes control experts, 2 epidemiologists who worked in diabetes surveillance system directly. Content and face validity were evaluated by two separate active epidemiologists in diabetes surveillance and two physician epidemiologists. The internal consistency of the two-choice questionnaire was assessed, using *the Kuder-Richardson* coefficient.[18] This index is, in fact, equivalent to Cronbach's alpha, which is used to evaluate the reliability of two-choice questions.[19] The questionnaire had 98 questions in 17 sections, section 8-13 indicating 6 domains of surveillance system (Table 1).

Initially, questions were asked about a set of prerequisites and general information about education and prevention, and then the existence and implementation of each domain of the surveillance system, from data collection to evaluation and intervention, were assessed. Also, we collected data on the manager's viewpoints of the success of diabetes surveillance system in each prevention level, effectiveness, cost-effectiveness, investment and cost allocation by public section, people and insurance companies. Finally, we assessed service satisfaction at each prevention levels, current status of the disease control, and the future perspective of diabetes in Iran.

Path analysis was used to evaluate the relationship between each component of the diabetes surveillance system with each other. To this end, at first a factor analysis model was used to identify related questions to each component of the surveillance system. After that, a principal component consists of the related questions was formed as an identifier of each component. Then, path analysis was used to identify the strengths and weaknesses of associations between components of surveillance system (Figure 1), whether directly or indirectly. It should be added that, as the path analysis can model complex structures beyond regression, this model was applied to simultaneously evaluate both the affected and affecting roles of each component. Further, model parameters were estimated by maximum likelihood method.

Table 1: Sections of questionnaire including some diabetes related issues and domains of diabetes surveillance system

Questionnaire section	No. items	Kuder-Richardson coefficient (%)
1. Personal and professional information	4Qs (1-4)	-
2. General questions assessing respondents' knowledge of the surveillance system	17Qs (5-21)	73
3. Existence of primordial and primary prevention program of diabetes	4Qs (22-25)	70
4. Implementation of primordial and primary prevention program of diabetes	4Qs (26-29)	79
5. Existence of counseling and special education for high-risk groups	3Qs (30-32)	74
6. Implementation of counseling and special education for high-risk groups	3Qs (33-35)	70
7. Prerequisite issues and logistics for running diabetes surveillance system	14Qs (36-49)	85
8. Existence and Implementation of the protocol of generation and collection of data	6Qs (50-55(	84
9. Existence and entering of data into the software	3Q (56-58)	70
10. Processing, analyzing, and interpreting data	7Qs (59-65)	78
11. Reportion, stakeholders' identification, and report distribution and delivery	10Qs (66-75)	89
12. Results utility and evaluation of diabetes surveillance system	5Qs (76-80)	84
13. Evidence-based intervention	5Qs (81-89)	75
14. Managers' viewpoints on success, investment, cost allocation and future of diabetes	4Qs (90-93)	76
15. Matching between Government, insurance and persons investment and prevention levels	3Qs (93-95)	71
16. Satisfaction	2Qs (96-97)	72
17. Future	1Qs (98)	86

The model goodness of fit was also assessed by absolute, comparative and parsimonious indices. Finally, the preliminary model was developed according to both of mentioned indices and theoretical justification.

It should be noted that since there was no any report at the academic level to the stakeholders in all collected questionnaires, this component was excluded from the analysis. The analysis was performed using AMOS version 20 software based on the remaining five dimensions. This study was confirmed by the Ethics Committee of Shiraz University of Medical Sciences (Ethics code: IR.SUMS.REC.1397.859). The complete questionnaire along with the important analysis of all the questions (98 questions) is included in the supplementary file (*supp.DM*).

Results

Of the 125 questionnaires received from universities, 27, 25, and 48% were from Type 1 (developed) universities, Type 2 (developing) universities, and Type 3 (underdeveloped) universities, respectively. A total of 16, 14.6, 33.3, and 36.1% of the questionnaires were completed by the Vice-chancellor for Health, Vice-chancellor for medicine, experts in charge of diabetes and diabetes experts who were working as the county supervisors, respectively. The mean work experience in these positions was 5.6±4.6 years.

The level of existence and implementation of programs and domains of diabetes surveillance system in Iran from the health managers' viewpoint is shown in Table 2.

Table 2: Existence and implementation of diabetes surveillance programs and its domains from the diabetes managers' perspectives in Iran

Domains	Respondents said Yes in each domain's question (%)			If yes, how much works correctly (real percent)			Ensure their answer (%)
	Average	Min	Max	Average	Min	Max	
1. General questions assessing respondents' knowledge of the surveillance system (%)	46.19	15.2	86.4	30.01	3.39	78	83.18
2. Existence of primordial and primary prevention program of diabetes	59.25	46	88	42.8	32.3	66.2	81.36
3. Implementation of primordial and primary prevention program of diabetes	68.7	54	88.8	39.57	27.16	61.97	81.14
4. Existence of counseling and special education for high-risk groups	64	62	65	60	59.31	62.84	83.65
5. Implementation of counseling and special education for high-risk groups	62	51	70	52.27	50.22	53.63	84.97
6. Prerequisite issues and logistics for running diabetes surveillance system	44.11	24	79	57.83	30.63	79.18	85.61
7. Existence and implementation of the protocol of generation and collection of data	36.5	16.5	66	23.5	7.72	46.13	75.74
8. Existing and entering of data into software	48.33	35	57	31.53	20.5	39.78	84.35
9. Processing, analyzing, and interpreting data	12.25	9.5	22	7.21	3.2	12.89	81.88
10. Reporting, stakeholders' identification, and report distribution and delivery	12	7	17	10.1	5.15	14.87	92.95
11. Use of results and evaluation of Diabetes surveillance system	17.6	13.6	20	12.09	10.15	14.27	85.68
12. Evidence-based intervention	60	32.8	82.4	68.77	49.35	81.99	90.52

The lowest score in the surveillance system belonged to the domains of reporting, stakeholders' identification, and report distribution and delivery (12%), and existence and implementation of the protocol of generation and collection of data (12.25%). The highest value belongs to intervention (60%). Prerequisite issues and logistics for running diabetes surveillance system has the weakest score (44.11%) in non-surveillance system domains. To better understand which questions have the highest or lowest effect in each domain, you can see the file in the supplementary material section.

According to Table 3, secondary prevention has the highest role in diabetes control (44.46%) and has accounted for the most costs (37.99%) from the managers' viewpoint, but they believed that primary prevention had the highest cost-effectiveness. Most of the managers believed that there was disproportionateness between cost investment and prevention level effectiveness, especially primary prevention (86.6%), so it was lower than the expected range. Diabetes expenditure allocated by the government was 20, 41 and 39% and that allocated by people was 16, 36 and 48% according to primary, secondary and tertiary prevention levels, respectively. Most of the managers were dissatisfied with the current diabetes control program (59%). Most of the health managers (39-84%) believed that the status of risk factors, incidence of new cases, prevalence, incidence of side effects, and disease burden would increase.

The finalized path model is shown in Figure 3. This Figure reveals the resulted relationships between the components of surveillance system. It should be reminded that each component was derived from a principal component analysis on significantly related questions in the questionnaire. All the plotted arrows, in Figure 3, represent significant relationships except the dashed one. The thickness of arrows identify the effect size and the strange of associations. The most prominent cause effect was the effect of data collection on analysis. As expected, the quality of analysis directly affected the use of results but it had no effect on the distribution of reports. In other words, although the quality of analysis had no effect on the distribution of reports but the quality of reporting affected the use of results as the second most effect size. Furthermore, the analysis was also influenced by quality of data entry into appropriate software. Finally it revealed that evidence-based intervention depended on both of implementation of protocols and evaluation of surveillance system.

The acceptable amount of expression of model fitting[20, 21]

RMSEA<0.0[8], CFI>0.9, CMIN/DF<3

PRATIO>0.5, GFI>0.9

According to Table 4, in the proposed model, the Glycemia Fluctuation Index (GFI) was 0.99 which was in the desired range. The Root Mean Square Error of Approximation (RMSEA) was also 0.01,

Table 3: Managers' viewpoints on success, investment, cost allocation, satisfaction and future of diabetes in Iran

Managers' viewpoints n=125	**Average weighted-Priority (%)**		
	Primary prevention	**Secondary prevention**	**Tertiary prevention**
Contribution of each prevention level in diabetes control	31.38	44.46	24.16
Cost allocation in diabetes control by the level of prevention	24.95	37.99	37.06
Cost-effectiveness of diabetes control by prevention level	46.2	34.95	18.85
Proportion among the government, insurance and personal investments, and prevention levels effectiveness (%)	Primary prevention	Secondary prevention	Tertiary prevention
Appropriate and the expected range	12.4	23.2	12.2
Inappropriate and over the expected range	0.8	17.8	15
Inappropriate and under the expected range	86.8	59	72.8
% of total diabetes expenditure allocated by the government, according to the level of prevention	20	41	39
% of total diabetes expenditure allocated by people, according to the level of prevention	16	36	48

Satisfaction (%)	**Very satisfied**	**Moderately satisfied**	**Neutral**	**Moderately dissatisfied**	**Very dissatisfied**
Satisfaction with all current diabetes control programs	0.8	33.4	8	40.8	17
Patients' satisfaction with all diabetes surveillance measures	0	46	16	30	7

Fate and future of diabetes, its risk factors and burden of disease in the country (%)	**Will be decreased**	**Will not be changed**	**Will be increased**	**I do not know or cannot to answer**
Risk factors of diabetes	16	11	66	7
Incidence of new diabetes cases	8	4	84	4
Prevalence of diabetes	8	4	84	4
Incidence of diabetes complications	16	8	67	9
Success in diabetes control and treatment	12	32	39	17
Success in treatment and control of diabetes complications	13	22	46	19
Burden of diabetes	12	12	60	16

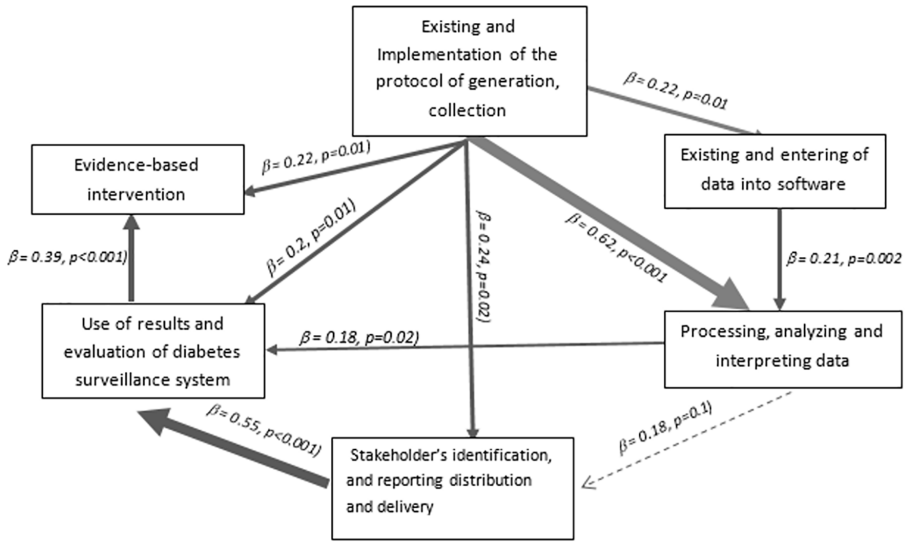

Figure 3: The final model of relations among the diabetes surveillance system domains in Iran

Table 4: Findings of data fitness in the analytic structural equation model

	RMSEA[a]	PRATIO[b]	CFI[c]	GFI[d]	CMIN/DF[f]
Model fit	0.06	0.4	0.98	0.99	1.66

[a]Root Mean Square Error of Approximation; [b]Parsimony ratio; [c]Comparative Fit Index; [d]Goodness of fit index; [f]Normed chi-square

which indicates that the model fits the data and can be directly and indirectly calculated and evaluated. And about PRATIO, 0.4 indicates that the model contains a large number of parameters.

Discussion

This study was conducted to determine the function and preparedness of diabetes surveillance system in controlling diabetes, status of the factors affecting the surveillance system, future of diabetes, and relationships and connections between domains of the diabetes surveillance system from the health managers' perspective who were affiliated to medical universities in Iran.

So far, most of the studies have focused on the evaluation of the surveillance system and its sensitivity, and less attention has been paid to the function and preparedness of the surveillance system and whether the domains of the surveillance system work right. A study published by Rift Aton et al. evaluated the surveillance system in low-and middle-income countries by linking non-communicable disease surveillance system such as diabetes with communicable disease surveillance system such as tuberculosis and AIDS. They showed success in controlling non-communicable diseases.[15] In a study by Caroline Emery et al. in 2011, on the assessment of risk factors for football injuries in adolescents by establishing a surveillance system, they could identify the type and location of the injury, indicating that function and preparedness of the surveillance system can negatively affect prevention in the future.[22] In a study carried out in order to evaluate dengue disease surveillance system in 1990, Dletz VJ GD et al. stated that the efficiency and preparedness of the surveillance system depended on equipment and facilities and could help us identify timeliness and accuracy, and reduce false-positive cases and caring for patients,[8] which have been confirmed by other studies.[23, 24] The reason that can be stated is the difference in the definitions and inference of the disease surveillance system in different countries. In the present study, we achieved our goal by identifying the strengths and weaknesses of the diabetes surveillance system.

In the present study, the presence of equipment, human and support facilities, such as the existence of electrical records, was favorable (79.18%). Also, 3.39% of the managers knew the percentage of diabetic patients, who used insulin because it reduced not only the risk of diabetes complications, but also that of cancer.[25, 26]

According to the findings, there were more than 88% of the guidelines, surveillance instructions and training packages merely in public health centers, indicating that the authorities do not pay attention to private sectors and non-government organizations. Studies have emphasized that key messages and awareness of people with diabetes, their families and high-risk individuals should be delivered by both health care providers and volunteers,[27] which is also confirmed by other studies.[28, 29]

Participation in workshops increases awareness and knowledge, and improves the practice of health care providers, which can be effective in the management

of diseases.[30, 31] Holding periodic retraining courses for diabetes managers was 81.99%, which could be a strong point in improving the surveillance system and better management in diabetes control.[32] The findings obtained from the present study confirmed that 84% of the participants believed primary prevention had cost-effectiveness; a systematic review of 56 studies in 20 countries showed that lifestyle changes to prevent diabetes and risk factors control such as controlling blood pressure, smoking cessation, screening for diabetic retinopathy, and caring the foot regularly were highly cost-effective, indicating that all prevention levels were important and they could be cost-effective.[33] In our study, funding and spending for diabetes were 41% for the second and 39% for the third levels of prevention, which were consistent with the study conducted in the United States, by Joao Da Rocha Fernandes et al. which showed that the expenditure of the health system in the second and third levels of prevention was high.[34] Most policy-makers (69%) believed that the second level had the highest success in the function in the health system; given the expenditure of 41%, the conclusion is not odd. It should be noted that the function will be successful in all three levels of prevention.[33, 35-37]The expenditure for self-care by the government and people were below the second and third levels of prevention. Although the expenditure in all three levels of prevention should be reasonable according to cost-effectiveness, the priority of the primary prevention has been neglected, due to allocating funds and spending by the government and people. Investment by the public, insurance and government for diabetes care at prevention levels was inappropriate and lower than the expected range, indicating that we are only willing to pay after we get sick. In addition, the quality of life and financial burden on the public and government also increase. A study in the United States in 2012 showed that direct and indirect costs of diabetes was 245$ billion, of which 176$ billion belonged to the direct medical costs and $69 billion was related to decline in productivity. The largest medical costs included hospital care costs (43% of total medical costs), prescription drugs for diabetes complications (18%), anti-diabetic drugs (12%), doctor visits (9%), and nursing in-house fees (8%). People diagnosed with diabetes have an average medical cost of about 13,700$ a year. On average, people with diabetes pay 3.2 times higher medical costs; the aforementioned findings are consistent with those of the present study.[38]

From the managers' viewpoint, the current state of diabetes surveillance was not satisfactory (57.8%) and that of service satisfaction was low; more efforts are needed to improve the patients' satisfaction. Another study conducted in Pakistan on the dimensions of diabetic patients' satisfaction revealed that with regard to patient education and occupation, physician interactions lead to increased satisfaction, but issues such as inaccessibility of physicians, misdiagnosis, lack of criticism, high dependence on medical tests, and lack of physical examination have been reported as the most important causes of patient dissatisfaction.[39] This study did not elaborate on the details of satisfaction and expressed satisfaction in general, which can be considered as a weakness of the study.

According to the authorities' predictions, risk factors, new cases, prevalence, complication and burden of diabetes will increase by 66, 84, 84, 67, and 60% in future, respectively. In addition, success in the treatment and control of the disease, and the treatment of complications will increase 39 and 46%, which is in line with the World Diabetes Report.[3] There is a need to reconsider the functioning of the surveillance system by policymakers.

We also used path analysis in this study to investigate the study hypotheses and assess the direct and indirect effects of the dimensions of the surveillance system. Based on the path analysis model, five hypotheses are proposed: 1) Data collection has an effect on data entry, analysis, and interpretation of data, reporting of results, use of results and evaluation; 2) Data entry has an effect on the analysis and interpretation of data, reporting of results, use of results and evaluation; 3) Analysis and interpretation of data has an effect on reporting of results, use of results and evaluation; 4) Reporting of results has an effect on the use of results and evaluation; and 5) Use of results has an effect on evaluation. In the present study, the effect of data collection on all parts of the surveillance system is directly and indirectly significant, especially in the part of the analysis, because in the case of inaccurate or incomplete data collection, the surveillance system will face major challenges and it will not only help us care for the disease, but also impose a high cost on the health system. Therefore, in designing the surveillance system, it is first necessary to identify the sources of data collection through careful studies. In a study conducted by Rahim Tahmasebi et al. about the determinants of self-care among people with diabetes using path analysis, they have been able to investigate the direct and indirect effects of individual and environmental factors affecting self-care against diabetes.[21] Regarding the importance of data collection, it can be said that the quality of data collection can be effective in our informed decision-making and evaluation.[40] The surveillance system needs robust software with trained experts to collect data more appropriately. What is important is the failure to report the results to stakeholders, indicating the separation of the health surveillance system and health policymakers, which can be one of the challenges in achieving the goal of keeping the prevalence of diabetes stable.[41] Evaluation by

performing an activity and correction of the weak points of this system is not very favorable, so it is necessary to send feedback to the departments and then receive a report of the actions taken by specifying evaluation periods to improve the process.

Constraints

Geographical distribution of universities has reduced access to participants in this study, thus reducing the participation of authorities in the study. In this study, only people who were executive officer were enrolled. The academic people and those who taught the scientific foundations of the surveillance system in universities and were in charge of training future executives were not included in the study. Another limitation of this study was the lack of a definite, accurate, complete and comprehensive guideline to evaluate the function and preparedness of the diabetes surveillance system.

Conclusion

We conclude that we must first formulate and prepare a standard surveillance system as well as train the relevant personnel and make clear changes in the existing care system. With the current surveillance system, we have a long way to go to prevent and control diabetes to an acceptable the average level of performance of the care system is lower than expected.

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Conflicts of Interest: None declared.

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