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The Role of Diabetes Educators in Promoting Diabetes-based Knowledge on Insulin Pump Therapy to School Nurses and Physicians

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ABSTRACT

A total of 137 school healthcare professionals, 3 diabetes educators provided basic pump education and training on diabetes complications management specifically hyperglycemia, hypoglycemia and ketosis. The program was followed by hands-on workshop training on insulin pumps. Pre- and post-knowledge -assessment about insulin pump therapy basic management was performed using a 10-item knowledge questionnaire. Additionally, pre- and post-confidence level were assessed with a 9-item questionnaire using Likert's scale.

Results: 62 school nurses mean age 41.5 ± 11.7 , with school experience 8.8 ± 9.1 y and 75 school physicians, mean age 36.25 ± 6.2 , with school experience 3.4 ± 1.5 y; attended the program. Pre- and post-knowledge assessment and confidence level scores were compared using Pearson's correlations. Significant improvement was found for both knowledge (school physicians, $r=0.007$ and nurses $r=0.01$) and confidence (school physicians, $p\text{-value}=0.047$ and school nurses, $p\text{-value}=0.018$).

Discussion: Pre-assessment showed the lack of knowledge and confidence of school healthcare professionals about insulin pump therapy. Significant improvement in knowledge and confidence in caring for T1D students on insulin pump therapy resulted from the delivery of this workshop, which confirmed the effective role of diabetes educators.

Conclusion: This is the first nationwide educational program conducted at Kuwait in private schools in 2018, the positive impact of the program will be followed up for implementation at governmental schools as well.

KEYWORDS

Diabetes Management, Diabetes Educators, Insulin Pump, Type 1 Diabetes

INTRODUCTION

Childhood type 1 Diabetes (T1D) is an autoimmune disease characterized by destruction of pancreatic β -cells resulting in insulin-deficiency [1]. According to the World Health Organization (WHO) and the National Institute of Health (NIH); T1D incidence is rapidly increasing with 22.9 new cases per year per 100,000 persons up to age 15 worldwide being the most prevalent disease in school-age children [2]. Previous report from Kuwait has demonstrated a statistically significant trend increase in the prevalence of childhood T1D exceeded those reported in neighboring countries and North America [3]. With the introduction of Continuous Subcutaneous Insulin Infusion (CSII) therapy via insulin pumps; many children with T1D are receiving CSII therapy while attending school [4]. Accordingly, school-age children with diabetes must adhere to schedules that require access to blood glucose equipment, insulin delivery systems, oral, fast-acting carbohydrate and glucagons, and adequate nutrition [5]. Parents expect their children to receive quality diabetic care during school hours and after-school activities [6], they also anticipate that school's preparedness toward diabetes emergencies are well established [7]. The National Association of School Nurses (NASN) recognized school nurses as the appropriate coordinator of diabetes management at schools [8], where their ability is governed by their

knowledge basis and competency on CSII [9]. However, recent reports showed that children with T1D are facing inadequate diabetic care by school nurses' and/or physicians due to their lack of knowledge and training related to CSII [10]. Our aim in this is to conduct an educational program to examine diabetic care management from the perspective of the school nurses and/or physicians who provide care to students with T1D.

Objectives:

- (i) to evaluate their knowledge and perceptions on how to provide diabetic care during emergencies for students with T1D on CSII;
- (ii) to explore their ability in providing technical support to school children with insulin pumps during emergencies.

MATERIALS & METHODS

Study Participants:

The School Health Department (SHD) at Ministry of Health (MOH) received families concerns about the safety measures taken for their children with T1D on insulin pump in school setting. The SHD evaluated the school nurses and physician's knowledge and skills on handling students with T1D on CSII therapy during school day, after-school activities and during emergencies. The initial evaluation showed a critical need to train school nurses and physicians on the foresaid topic. An attempt to recruit all school nurses and physician was taken. There were 551 private schools and 820 public schools listed in the 2017–2018 academic year for Kuwait [11] where this study was conducted. As primary stage, all private schools were contacted to nominate group of school nurses and physicians to attend the training which later will be conducted for all public schools as well. Education & Training Unit at DDI organized and conducted a joined training program between MOH and DDI for the school nurses and physicians. Diabetes educators, who are healthcare professionals provide individualized education and promoting behavior change to patients, families and other healthcare personnel's, who are also certified pump trainers, were informed about the requested MOH needs to foster the school nurses and physicians' knowledge and skills on T1D, in general and CSII (insulin pump) therapy, in particular. The task force team consisted of pediatric physician (primary contact with MOH and seconded at DDI), diabetes educators and a scientist (Research Department, DDI) was involved in planning, organizing and conducting the training program. The DDI diabetes educators' team and physician planned, organized and conducted the theoretical and practical training. While, the scientist and a senior specialist diabetes educator developed the program design in recruiting participants, analyzing the questionnaires data on exploring the participants perceptions and evaluate their learning needs. The program design had two complementary phases, participants were segregated based on level of education and expertise. Phase I started from 15 January 2018 till 18 January 2018 included training of private school nurses (group I); phase II started from 25 March 2018 till 28 March 2018 included training of private school physicians (group II).

Workshop Training Program:

The workshop learning objectives were as follow;

- (i) recognize & manage related acute diabetes complications for students with diabetes,
- (ii) familiarize with basic types and features of insulin pumps,
- (iii) acquire essential information and skills to assist in entering data or delivering insulin with a pump.

Diabetes emergencies were defined as (a) Hypoglycemia, (b) Severe hypoglycemia, (c) Hyperglycemia and (d) Diabetic Ketoacidosis DKA. The workshop program was conducted over 5 days of theoretical and practical training. The training agenda consisted of 2 sessions, session one for theoretical training and session two for practical training. Before starting theoretical training, participants underwent a pre-educational assessment, to evaluate their baseline knowledge and confidence on diabetes management. During theoretical training, participants attended number of lectures on

diabetes, T1D, T2D, diabetes management presented by the pediatric physician. Followed by, lectures by diabetes educators on the basic types and features of insulin pump, how to recognize and manage related acute diabetes complications for students with diabetes? and how to acquire essential information and skills to assist in entering data or delivering insulin with a pump? For effective communication, all school health caregivers involved in the diabetic care management program must learn to talk the unique terminology associated with CSII therapy. During verbal discussion, several participants referred to theme of "learning the language" of CSII. The terms basal rate, counting grams of carbohydrates, and calculating insulin boluses, which are dependent upon the amount of carbohydrates consumed, were not familiar to most of the school nurses in this study. The diabetes educators' team prepared a leaflet which contain major important terminologies used and must know along with general and ketones guidelines to assist and guide during their day-to-day activities specially during their daily routine supervision on students with T1D on CSII (figure 1). Later, participants started two-hours practical hands-on training on using and monitoring the insulin pump. The training was focused on how insulin pump operates? How to deliver routine boluses for carbs and high blood glucose? How to disconnect or "suspend" the pump? The workshop training program was concluded by post-educational assessment questionnaire to evaluate the school nurses and/or physicians' knowledge and confidence "after training" on handling insulin pump during emergencies; and their ability to properly care for a child with insulin pump at schools' hours.

Study Questionnaires:

Demographic data were collected for both groups, pre-educational and post-educational questionnaires used in this study were previously validated [13], confidence (pre-, post-) and knowledge (pre-, post-) questionnaires had 9 and 10 questions, respectively. Confidence questionnaires were formulated to measure confidence of participant in understanding insulin pump, their ability to properly care for student with T1D on insulin pump, how to utilize insulin pump readings? How to manage food bolus and correction bolus to students on insulin pump? their ability to treat and manage students with insulin pump during emergencies such as ketones, low or high blood sugar, how to manage insulin pump malfunction? On the other hand, knowledge questionnaires were formulated to evaluate the participant background about insulin pump, the dose of insulin required to treat high blood glucose, the black circle indication if shown on insulin pump screen, the type of insulin used for pump therapy, how to deal with student on insulin pump in case of high blood sugar? what is the rule of 15? what is the first action if student is using insulin pump and had high or low blood sugar? How to monitor insulin pump device? What is the time-line in re-checking student using insulin pump blood sugar in case of high blood sugar?

Data analysis:

Data organization and analysis were performed by using the SPSS. Descriptive statistics were calculated for all response variables. Analysis of variance was used to compare continuous data, and the X²-test was used to compare categorical data. 95% confidence intervals (CIs) were calculated by standard methods. Significance was indicated by a P- value of 0.05.

RESULTS

Group I consisted of 62 school nurses (7 males, 55 females, and mean age 41.1±11.4) divided over 4 semi-groups each of 15-16 participants. Similarly, group II consisted of 75 school physicians (13 males, 62 females, and mean age 37±6.5) divided over 4 semi-groups each of 18-19 participants. All responders were working as school nurse and/or physician at the time of program. Majority of responders had Baccalaureate (BSc) degree (45 physicians vs. 15 nurses). The average subject had over 9.3 years of experience working as a school nurse and 3.4 years of experience working as school physician. The general experience of doctors and nurses participated in our Program correlated positively with their general experience and age (R= 0.73,

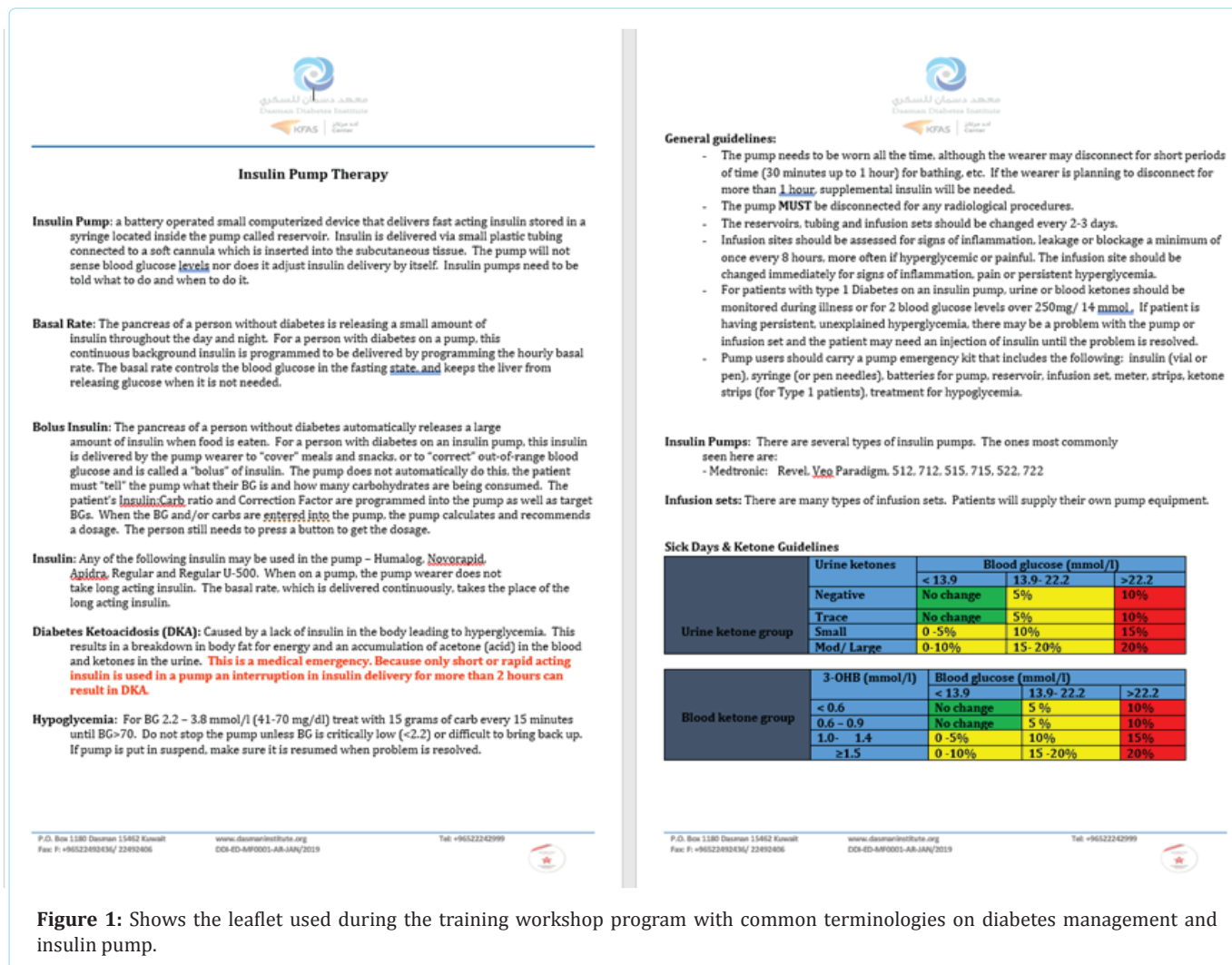


Figure 1: Shows the leaflet used during the training workshop program with common terminologies on diabetes management and insulin pump.

$P < 0.001$ with 95% confidence interval). Most of responders (98.5%, 62 nurses vs. 73 physicians) had experience on T1D and insulin pump. While, majority of nurses (82.2%) showed more experience in handling meter testing versus 38.6% of physician, as shown in Table 1. Majority of responders (78%) reported the attendance of students with diabetes on insulin pump in physical education class reflecting on the school nurses and physicians understanding on the students' health and academic performance. Total number of students with T1D was 9 times higher of that with T2D (1654 vs. 177), Table 2. Thus, minor number of students reported with T1D were on insulin pump therapy (302 out of 1654). Taking into consideration the number of students with diabetes reported in private schools versus the number of health caregivers (school nurses and/or physicians), shows that the nurse-to-student ratio is 1:2.87 ~ one nurse to 3 students. Such ratio is important in determining the limitations or effectiveness in delivering a safe diabetic care to students with diabetes specially those on insulin pump therapy.

To address the program's aim, we first examined the distribution and mean scores of the baseline assessment and final assessments. For the first aim, school nurses and physician's knowledge and perceptions on how to provide diabetic care during emergencies for students with T1D on CSII before and after the training was examined. The baseline assessment on diabetes care showed that majority (88%) of school physicians had better based-knowledge on diabetes than school nurses (3%) due to attending educational courses on routine basis, (Table 1). This observation was further confirmed from the pre-knowledge scores of physicians versus those of nurses (Figure 2). Physicians' pre-knowledge scores showed higher scores (51%) reflecting on their understanding to the educational material before starting the training, unlike nurse's pre-knowledge scores

(26.8%), which showed their knowledge deficiency and perception relevant to diabetes emergencies and insulin pump therapy. Similarly, the post-knowledge scores after completing the training program of physicians was higher than that of nurses (93.8% vs.87.4%). The difference between physicians' to nurses pre- and post-knowledge was found to be significant ($P < 0.001$).

For the second aim, school nurses and physician's ability in providing technical support to school children with insulin pumps during emergencies was examined. The average baseline scores of both groups perceptions was similar (32 for physicians vs. 33.6 for nurses), Figure 3. The average scores at the end of training increased and were also similar between physicians (93.8%) and nurses (87.16%). The relative increase in the post-confidence score of physician was relative to the higher number of participants in that group. The increase between the pre- and post-assessments for both groups was found significant ($P < 0.001$).

DISCUSSION

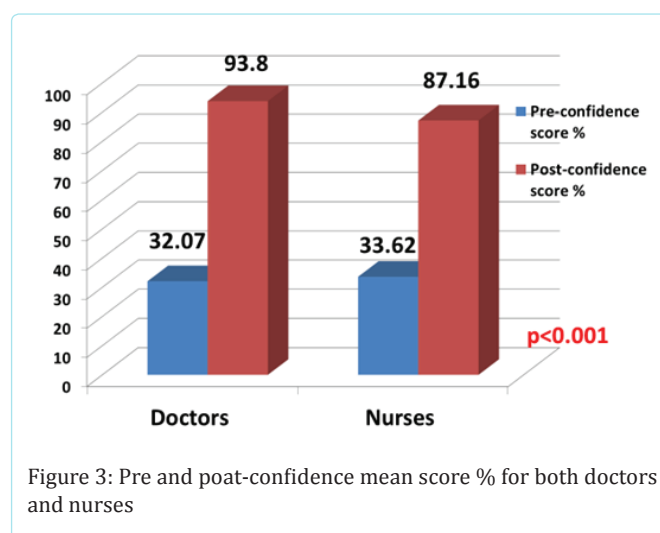
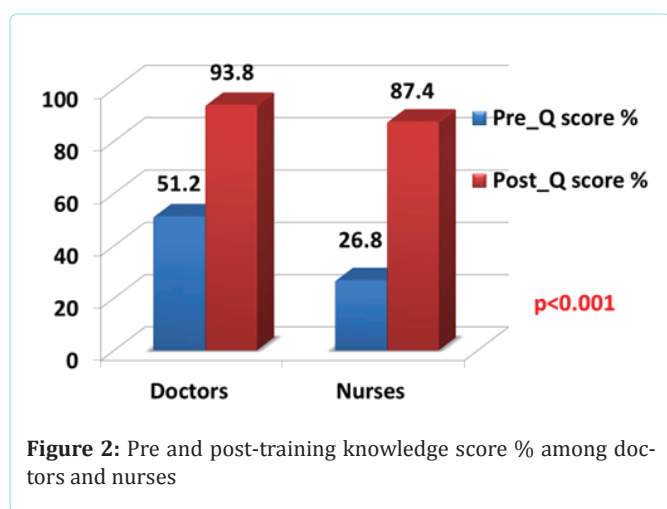
International recommendations by NASN and IDF emphasized on the importance to provide appropriate training in diabetes care and emergency management to school personnel supervising and caring of students with diabetes at school setting [12]. One of the critical paradigms of The American Diabetes Association (ADA) is to ensure a physically and psychologically safe environment to students with T1D on CSII in the school and day care setting [13]. CSII is currently considered as an optimal treatment option for patients with T1D as it can achieve near normal glucose control for such patients [14]. Optimal medical management of children with T1D and CSII therapy consists of a multidisciplinary team approach which incorporates the family, the child, health care professionals, and the school personnel.

Table 1: Demographic Data of Participants (School nurses and Physicians)

Variables	All responders N = 137	Nurses N= 62	Physicians N = 75	P-value
Gender				
Male	20	7	13	
Female	117	55	62	0.01
Mean age (yrs) ± SD	38.8 ± 9.3	41.1 ± 11.4	37 ± 6.5	0.01
Level of education				
• Diploma	47	44	3	< 0.001
• Bacalaureate	60	15	45	
• Post graduate	30	3	27	
Experience (Avg)				
• General medical experience	137	62 (16.0 ± 10.8)	75 (11.6 ± 5.3)	0.002
• School experience	127	54 (9.36 ± 9.1)	69 (3.49 ± 1.5)	<0.001
Supervision of meter testing for students with diabetes				
• Yes (%)	58.3% (N = 80)	82.2% (N = 51)	38.6% (N = 29)	
• No (%)	41.6% (N = 57)	17.7% (N= 11)	61.3% (N= 46)	
Attendance of previous diabetes courses				
• Yes (%)	49.6% (N = 80)	3.2% (N = 2)	88% (N = 66)	
• No (%)	50.3% (N= 69)	96.7% (N = 60)	12% (N = 9)	
Reported types of insulin pump in schools				
• Accu-ckek Combo	11	5	6	0.03
• Veo-Medtron	8	7	1	
• 640-Medronic	2	0	2	
• Unknown	106	41	65	

Table 2: Number of students with Diabetes Reported from School Nurses or Physicians

Number of students reported (M ± SD)	All responders N= 2133	Reported by Nurses N= 296	Reported by Physicians N = 1837	P- Value
• Student with T1D	1654	178	1476	
• Students on insulin pump	302	58	244	
Students with T2D	177	60	117	
Attending physical education (%)	108 (78.8%)	61(98.4%)	47 (62.7%)	<0.001



A child with CSII therapy must be willing to wear the pump and able to tolerate the needle insertion process. The parent or caregiver and the school nurse must demonstrate an understanding of basal and bolus insulin dosages and calculations, as well as trouble shooting and programming the insulin pump. In addition, the caregivers must know how to count carbohydrates for every meal and snack, as well as know how to correct for high or low blood sugar levels. The insulin dosage may have to be changed during periods of stress, exercise, illness, travel, or other special situations. Measuring ketones and determining what measures to take when ketones are present is another element of diabetes management that must be mastered [15].

Colberg and Walsh (2002), reported that approximately 10% of individuals with T1D have insulin pumps, among those, 6% are reported to be school-age children [16]. Though, various guidelines regarding optimal diabetes management at schools were published; however, school communities still deficient on how to manage emergencies of school-age children with T1D which may occur during the school day or during after-hours/off-campus activities [17]. Unfortunately, several studies showed that many schools had deficiency in providing adequate care for students with diabetes. These deficiencies were defined based on number of factors, lack of diabetes-related knowledge, inadequate training on insulin pump, inappropriate food availability for students with diabetes, insufficient perception on the importance of physical activity to students with diabetes, and lack of school preparedness toward managing diabetes emergencies [12]. The dilemma and concern of parents having children with T1D confined in how to assist their children with insulin pumps specially during school hours. Whereby, during the growth and development age periods, insulin requirements are fluctuated accordingly. Such fluctuations are relatively associated with low and high blood sugar episodes, eating habits, physical activity, frequent infections, and difficulties in measuring and administering small doses of insulin. Therefore, a continuous supervision from parents at home and school nurses and/or physician during school days is a must to monitor especially with insulin infusions regimens [8].

To build an initial understanding of the essential structure of school nurses' and/or physicians experience of caring for students with T1D is a fundamental approach to ensure that schools have well-trained and confident staff members who can facilitate an acute care facility to children with T1D on insulin pumps. In this study, our purpose was to report the school nurses and physician perceived self-efficacy in providing diabetes care to students with T1D at school hours during emergencies. Pre- and Post-educational and confidence assessments questionnaires were used to resolve their knowledge-based and confidence-based with diabetes care. Confidence scores were categorized as high, moderate, low, and no confidence. Pre-assessment questionnaires revealed that school nurses and physicians in this program were poorly confident in providing diabetes care and education as was shown in the result section, Figure 3. A significant relationship between poor confidence of school nurses and/or physicians caring for students with T1D on insulin pump, and their lack of knowledge-based on diabetes was found (Figure 2). Confidence-to-Knowledge relationship in our study was found in agreement with reports from other studies. Whereby in 2006, Darby et al. reported that school nurses expressed their lack of confidence when caring for children with insulin pumps and how they overcome their fear by gaining knowledge on insulin pumps as well as hands-on training experience with pumps [5]. Fisher et al., on the other hand, also reported that some school nurses had only moderate confidence in their ability to provide diabetes care for the students and that these concerns were found due to lack of educational information and insufficient resources on diabetes care [18]. Furthermore, scientists found that school nurses positively affected the academic success and well-being of students with diabetes [19]. This was evident by number of studies where significant better glycemic control was achieved with students who received regular supervision on glucose monitoring and insulin-dose adjustment by school nurses than students who independently managed their own care at school [20].

CONCLUSIONS

Providing a safe school environment to student with diabetes by training workshops provided by diabetes educators at DDI to help and support school nurses and physicians in their role as primary health care providers during school hours. Maintaining continuous education and training programs on diabetes care management for school nurses and/or physicians increase their opportunities to learn new information, interact with peers, and share ideas and experiences.

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DISCLAIMER

No potential conflicts of interest relevant to this article were reported.

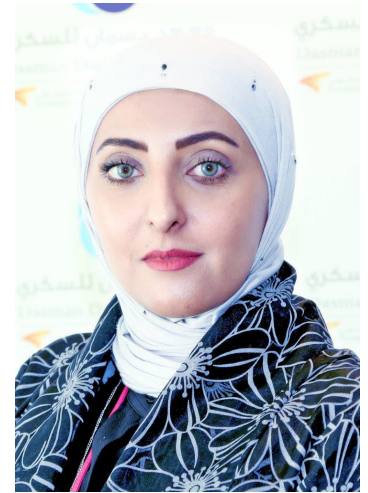
AUTHORS' CONTRIBUTION

Zahra Rahme formulated the task force team and conducted the theoretical and practical training. Nehad Taha and Naglaa Mesbah conducted the theoretical and practical training. Zahra Rahme, Nehad Taha and Naglaa Mesbah surveyed the literature and reviewed the manuscript. Fahad Aljaser formulated the collaboration between MOH and DDI, conducted the theoretical training program and reviewed the manuscript. NS performed statistical data analysis, prepared charts and tables. Maisa Kamkar planned the program design, analyzed the results and drafted the manuscript. Zahra Rahme and Nashwa Osman edited and provided feedback on the content of the manuscript.

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