ORIGINAL ARTICLE

Knowledge, Attitudes and Practices of Health Care Providers in the Philippine General Hospital towards In-Patient Hypoglycemia and its Management

Sarah-Laida J. Isnani, MD, Anna Macalalad-Josue, MD and Cecilia A. Jimeno, MD

Section of Endocrinology, Diabetes and Metabolism, Department of Medicine, Philippine General Hospital, University of the Philippines Manila

ABSTRACT

Objectives. To determine the knowledge, attitudes and practices (KAP) of health care providers at the Philippine General Hospital towards hypoglycemia among non-critically ill patients using a validated, self-administered survey tool.

Methods. This study covered two phases out of a three-phased project: (1) development and validation of a 43-item KAP survey tool and (2) assessment of KAP among nurses and residents using the tool. Phases 1 and 2 are analytic cross-sectional studies. Data for the KAP survey was collected using the developed tool and focused group discussions (FGDs). Results of this study will be the framework for Phase 3, which is the development of an in-patient hypoglycemia protocol.

Results. The validated KAP survey tool yielded a low overall mean score of 12.56 ± 2.11 in the knowledge domain although high scores (4.88 ± 1) were noted for knowledge on management of hypoglycemia. In terms of attitude, majority (99.31%) of respondents believed that fewer hypoglycemia events correlates to better clinical outcomes and are willing to adopt a nurse-driven protocol. Most respondents (52.8%) employed correct practices in hypoglycemia management. The FGDs identified the perceived facilitators and barriers to hypoglycemia management.

Conclusion. There is a gap in knowledge and practices in managing hypoglycemia among health care providers which needs to be addressed further with education and training. Nevertheless, health care providers have a positive attitude towards having a standard hypoglycemia protocol that will contribute greatly to its implementation in the clinical area.

Key Words: survey, hypoglycemia, KAP, hypoglycemia protocol

INTRODUCTION

Hypoglycemia, an often underappreciated problem, is the most common and serious side effect of glucose-lowering therapies. Three large randomized controlled trials demonstrated that attempts to aggressively control glucose was associated with a three-fold increase in the risk for hypoglycemia, counterbalancing the benefits conferred by intensive glucose control.[1–3]

The key predictors of hypoglycemic events in hospitalized patients include older age, greater illness severity, diabetes,[4–6] and the use of glucose-lowering medications, particularly among patients treated with insulin.[7–9] Repeated episodes of hypoglycemia can adversely affect defense mechanisms against falling blood glucose which is associated with a six-fold increase in death.[10,11]

Paper presented at the 2019 Annual Convention of the Philippine Society of Endocrinology, Diabetes and Metabolism, March 15, 2019, Mandaluyong, Philippines.

Corresponding author: Sarah-Laida J. Isnani, MD
Section of Endocrinology
Diabetes and Metabolism
Department of Medicine
Philippine General Hospital
University of the Philippines Manila
Taft Avenue, Manila 1000, Philippines
Email: tingkahan.md16@gmail.com

Significant morbidity and mortality associated with hypoglycemia were reported in several studies.[12,13] It was noted that the length of stay in hospitals was 51% longer for those with mild-to-moderate hypoglycemia and 133% longer for those with severe hypoglycemia. In-patient mortality increased by 62% among those with mild-to-moderate hypoglycemia and 105% for those with severe hypoglycemia.

To prevent both immediate and long-term dangers of hypoglycemia, McCuen, et. al.[14] developed an evidence-based protocol in 2010 to provide safe and effective hypoglycemia management across multiple areas. The protocol significantly decreased the rates of severe hypoglycemia and empowered nurses to treat hypoglycemia events independently while providing consistent treatment regimens for optimal patient outcomes.[15]

A simple nurse-managed protocol[16] focusing on carbohydrate intake and the presence of "*hypo boxes*" which contain the necessary carbohydrate/glucose treatment for a hypoglycemic event markedly improved the rates of appropriately-managed episodes of mild to moderate hypoglycemia to 85% and of severe hypoglycemia to 94%.[17,18] Medical response to a hypoglycemic event was also quicker with a noted increase in the number of hypoglycemic events corrected within 30 minutes.[19]

Evidence-based outcomes of improved patient safety was the impetus for the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) to issue its Joint Position Statement on implementing a multidisciplinary approach to hypoglycemia management.[20–22] It empowers nursing staff under hospital policy or ward-based protocol to respond, with minimal physician oversight, with appropriate preventive actions after the occurrence of potentially triggering events for hypoglycemia.[23]

Structured hypoglycemia management protocols are available. However, it is necessary to identify gaps that affect its implementation and execution in clinical areas in order to achieve the positive outcomes intended by the protocol. In a retrospective chart audit of inpatient treatment orders, nurse compliance to the hypoglycemia protocol was suboptimal and needed strategies to increase nurses' understanding.[24] The audit determined that crucial to a successful implementation of a hypoglycemia protocol were (1) the development of a process ensuring that nursing staff had access to the necessary treatment, and (2) the education of the nursing staff in the use of the protocol.[14]

While there are approximately 20 existing hypoglycemia protocols in institutions abroad, it must be emphasized that thorough groundwork must first be done to ascertain the current knowledge of health practitioners on hypoglycemia management, existing best practices and institutional policies, if any, and the logistics of clinical areas before the protocol is applied. The use of a protocol will standardize management of hypoglycemic events and will serve as an avenue to improve patient safety, decrease hospital costs and facilitate better delivery of health services.

In this regard, this study aims to identify the gaps prior to protocol development and implementation by assessing the knowledge, attitudes and practices on hypoglycemia and its management in non-critically ill patients among medical and surgical nurses and Internal Medicine residents at the Philippine General Hospital using a validated, self-administered survey tool.

METHODS

This study comprised two out of a planned three-phase project: 1) Survey tool development; and 2) Assessment of the knowledge, attitudes and practices of healthcare providers. The third phase of this study is the development of an in-patient hypoglycemia protocol and will be discussed in a separate paper.

Phase 1. Survey Tool Development

Survey Tool

The preliminary questions in the survey tool were developed in consultation with a panel composed of two endocrinologists, two internal medicine residents and two nurses. In formulating the survey tool, the panel members followed these guidelines: (1) the tool must measure the underlying concept required for analysis, (2) the component items of the survey tool must be unbiased and (3) the language or vocabulary used for the tool must be clear and direct for respondents to be able to understand. A blueprint containing outlines and sub-contents was made to ensure that all relevant aspects were covered.

The knowledge domain was constructed with multiple-choice questions that required a single response and a checkbox with options for multiple responses. The attitudes domain items were constructed using a Likert scale, which has the advantage of supplying a more precise and definite response toward an issue .[25] The items for the practices domain consisted of categorical questions reflecting usual patient care and management in their institution.

The survey tool was arranged to have items of major relevance to the study come first. Items with similar subdomains were grouped together.

Content and Face Validity Assessment

All the items in the survey tool were reviewed by the same panel and individually assessed for content validity. Content validity index (CVI) is the most widely used index in quantitative evaluation. The item-rating continuum used was the one advocated by David [25] using a four-point ordinal scale to avoid a neutral and ambivalent midpoint. Only items with a CVI of 0.80 and above were retained in the tool. For items with CVI <0.80, the members were asked to suggest modifications to improve and make the items more relevant.

The final draft of the survey tool was completed with a consensus among the panel members.

For the face validity, ten respondents, excluding those in the survey proper, reviewed the survey tool for clarity, comprehensibility and importance.

Pre-testing of the Survey Tool

The draft of the survey tool was administered to ten eligible respondents to test its comprehensibility. The tool was self-administered and respondents were made to answer it without any verbal instructions. The average time to complete the survey tool was noted. After answering the survey tool, the respondents were asked for feedback on the clarity, comprehensibility and the importance of the items included in the tool. The survey tool draft was revised accordingly.

Item Analysis and Internal Consistency Reliability

The final survey tool had 43 items with 4 sections that required information on (1) demographic background of the respondent, (2) knowledge items (5 subscales; total 20 items), (3) attitudes (4 subscales; 12 items), and (4) practices (3 subscales; 11 items) (Table 1).

The results of the respondents' performance in the knowledge section of the survey tool were used to determine the difficulty and discrimination index of each item. The difficulty index (p) is the proportion of examinees who answered the item correctly. The higher the difficulty index value, the easier the item, whereas, the greater the difficulty of an item, the lower its index. Ideally, items should have indices ranging from 0.3 – 0.7. The discriminative index (D) measures how well the item is in distinguishing those who are knowledgeable and those who are not. The higher the discrimination index, the better the item can determine the difference between respondents with high and low scores. The items with D>0.20 were retained and those with low or negative discriminative indices were reviewed.

The reliability of the survey tool was also assessed by test-retest using the Kappa coefficient, which is the most commonly used statistic to test interrater reliability. The same survey tool was administered twice over a period of one week to the same group of ten respondents. A kappa coefficient score of 0.41–1.00, which was interpreted as fair-to-perfect, are acceptable results for reliability.[26] A reliability rating of poor or none, however, does not render the tool unreliable. Several factors can be considered in why respondents answered differently in the retest. For example, respondents may already know the correct answers. There is no kappa for items where there is no variation in the answers.

Table 1. Knowledge, attitudes and practices domains and their subscales

Domains	Subscales	Items
Knowledge	1. Definition of hypoglycemia	4
	2. Causes of hypoglycemia	4
	3. Detection	2
	4. Management	7
	5. Prevention and outcomes	3
Attitudes	1. Clinical outcomes	3
	2. Health care delivery and cost	3
	3. Management of hypoglycemia across all levels of severity	4
	4. Following a standardized protocol	2
Practices	1. Management of hypoglycemia across all severity levels	6
	2. Prevention of hypoglycemia	3
	3. Preference of nurse-driven protocol	2

Phase 2. Assessment of the Knowledge, Attitudes and Practices of the Healthcare Providers

Survey Tool

A respondent is a passer if he/she met the criteria of Minimum Passing Level (MPL) equal to 70%. This means that among the 20 knowledge questions, the respondent has answered at least 14 correct answers. A positive attitude is a respondent having an attitudinal score mean score of > 4.1 ± 0.5. Whereas, a good practice is regarded as a respondent having a score above the mean score > 5.8 ± 0.4.

Survey Proper

We recruited nurses from the medical and surgical wards and medical residents of the Department of Internal Medicine of the Philippine General Hospital to participate in the study. The minimum computed sample size was 317 respondents, based on prevalence of knowledge and practices of nurses on hypoglycemia which was 29%.[27] Prior to the survey, informed consent was obtained from each participant. Participants were also given printed explanation of the purpose of the study and assured of the confidentiality of the responses. The survey tools were handed out to the medical residents during their available time, whereas the nurses were given the tools during ward meetings and change of shifts. More than one meeting was conducted to allow recruitment of as many respondents as possible. An average of 20 minutes was allotted to complete the survey. Participants were not allowed to share information or use reference materials while answering.

Focused Group Discussion

Two separate focus group discussions were conducted for medical residents and nurses who were selected by convenience sampling. The 60-minute activity was conducted in a quiet room where the participants and the facilitator were seated face-to-face in circular formation. The facilitator explained the purpose and the flow of the FGD. Information on participants' demographics, years of training, and experience in managing in-patient hypoglycemia was collected through a brief survey.

Each FGD session had two parts and was aided by guidelines. For the first part, participants were asked about

the items in the KAP survey, specifically items which they found difficult to answer or those that they think should be modified or excluded. The second part focused on discussions about: 1) current practices in the management of in-patient hypoglycemia; 2) factors that aid and challenge in-patient hypoglycemia management and 3) attitudes toward having a standard hypoglycemia protocol. For the duration of the activity, both verbal responses and non-verbal cues such as gestures and body language were noted by the facilitator. The FGD concluded with the facilitator summarizing the discussion. The FGDs were conducted until no new themes emerged, the discussions reaching the point of saturation.

Statistical Analysis

Descriptive statistics was used to summarize the demographic characteristics of the participants. Frequency and proportion was used for nominal variables, median and range for ordinal variables, and mean and standard deviation for interval/ratio variables. Test-retest reliability was tested using Kappa statistic coefficient.

The difficulty index was calculated as the number of respondents who answered correctly for a particular item. The discrimination index was calculated using the extreme group method – the top 1/3 minus the bottom 1/3 of respondents who answered incorrectly.[28]

Wilcoxon rank-sum test was used to determine if there was a mean rank difference on the age and number of service years between passers and non-passers. Fisher's exact test was used to determine if there was an association between the respondent's profession and the frequency of positive attitude towards following a standard protocol on hypoglycemia, its clinical impact, its health care delivery and cost, and management. One-way analysis of variance, independent sample T-test and Chi-squared/Fisher's exact test were used to determine differences in the selected knowledge, attitude, and practices responses.

We included all valid data in the analysis. Missing variables were neither replaced nor estimated. Null hypothesis was rejected at 0.05 α-level of significance. We used STATA 15.0 for data analysis.

RESULTS

Phase 1. Survey Tool Development

Content and Face Validation

A 43-item survey tool was developed and subjected to validation. For the content validation, the panel members commented on items that required revisions in initial versions of the survey tool. Suggestions and options were provided for terminologies used in the tool and for items requiring revisions. Suggestions were also provided for the formatting of the tool questions. The final version of the survey tool was deemed clear, simple, and adequately relevant by the panel. The CVI (0.95) for the final survey tool was acceptable. For the face validation, the 10 respondents acknowledged most of the items in the tool as important, clear and easy to understand. Based on the suggestions and feedback provided, the survey tool was revised accordingly for better comprehensibility and readability. At the end of the iterative process, the survey tool was deemed valid.

Item Analysis

The difficulty index scores of the knowledge domain items ranged from 0.33–1.00. The higher the score, the easier the question. The discriminative index scores meanwhile ranged from and 0– 0.59, with 11 items having indices >0.20. nine items having indices <0.20. The items in the knowledge domain had an acceptable level of difficulty, and overall, was able to discriminate between the respondents (Table 2).

Reliability

The Kappa coefficients range for each domain are as follows: knowledge (0.001 – 1), attitude (0.001 – 0.755) and practice (0.001 – 0.255). , with items mostly having fair to perfect test-retest reliability.

Phase 2. Assessment of Knowledge, Attitudes and Practices of Healthcare Providers

Demographic Characteristics

A total of 340 nurses and residents participated in the survey proper but only 326 had valid data and were included in final analysis. Fourteen respondents had more than 3 missing answers in the KAP and were therefore excluded. The average time it took for the respondents to complete the survey was 20 minutes.

Most of the respondents were female (76.69%). Fourteen percent of the participants were doctors. The majority of the respondents' highest educational attainment was a bachelor's degree (80.67%). Nearly all have come across a diabetic patient in the ward (99.08%), however only 74 (22.7%) have had training on hypoglycemia management (Table 3).

Knowledge on Hypoglycemia

The overall mean percentage of the score for the knowledge domain on hypoglycemia was 62.8% (range, 35–95). The histogram of the knowledge score (Figure 1) has a symmetrical and unimodal distribution with an approximate score range of 12. The data is centered around the scores 12–14 with no outliers. Around 62.8% of respondents passed using the computed minimum pass level (MPL) of 70%.

The questions with the highest frequency of correct answers were: (1) omitting of insulin in a hypoglycemic patient who is unconscious (99%), (2) hold feeding of patients who are unconscious with long acting carbohydrates (98%), and (3) Rosuvastatin as a medication not causing hypoglycemia (98%). The items with the lowest number of correct answers were for: (1) IV insulin infusion with glucose infusion is a medical issue that is a risk factor for

Table 2. Difficulty and discrimination indices of the knowledge domain (n=10)

	p	D
K1. Cut-off CBG level (mg/dL) for hypoglycemia	0.36	0.55
K2. Severe classification of hypoglycemia	0.46	0.40
K3. Event during which symptoms typical of hypoglycemia are not accompanied by a plasma glucose <70mg/dL	0.51	0.59
K4. Event during which the person with diabetes reports any of the typical symptoms of hypoglycemia with a plasma glucose >70mg/dL	0.38	0.42
K5. Medical issues that are risk factors for hypoglycemia	0.96	0.08
K6. Lifestyle/dietary issues that are risk factors for hypoglycemia	0.99	0.03
K7. Risk factors for in-patient hypoglycemia	1.00	0.01
K8. Medications that commonly cause hypoglycemia	1.00	0.01
K9. Hunger as adrenergic symptom of hypoglycemia	0.44	0.13
K10. Speech difficulty as a neuroglycopenic sign of hypoglycemia	0.53	0.22
K11. Fifteen grams of fast acting carbohydrate is equivalent to three hard candies	0.18	0.11
K12. Meaning of 15/15 hypoglycemia rule	0.66	0.23
K13. Intervention to be done in a hypoglycemic patient who is awake and oriented	1.00	0
K14. Intervention in a hypoglycemic patient who is unconscious or having seizures	1.00	0
K15. Options for treating a patient with hypoglycemia who is on NPO	0.93	0.12
K16. A 15g glucose will produce an estimated increase in the blood glucose by 65mg/dL	0.35	0.21
K17. Rechecking of CBG should be done 15 minutes after the initial intervention in a hypoglycemia event	0.76	0.29
K18. Modifications in the insulin regimen to help reduce the risk for hypoglycemic event is recommended when blood glucose are below 100mg/dL	0.33	0.30
K19. Seizure is a short term outcome of hypoglycemia	0.37	0.35
K20. Retinal cell death is a long term outcome of hypoglycemia	0.35	0.28

p = Difficulty index; D = Discriminative index

Table 3. Demographic profile of healthcare providers (n=326)

	Mean ± SD	Frequency, n (%)
Age	29 (range, 22–58)	
Sex		
Male		76 (23.3%)
Female		250 (76.7%)
Number of years in service/ training	5 (range, 1–37)	
Highest educational attainment		263 (80.7)
Bachelor's degree		16 (4.9)
Masters		47 (14.4)
Doctorate		
Attended to diabetic patients in the ward		323 (99.1)
With training in hypoglycemia management		74 (22.7)

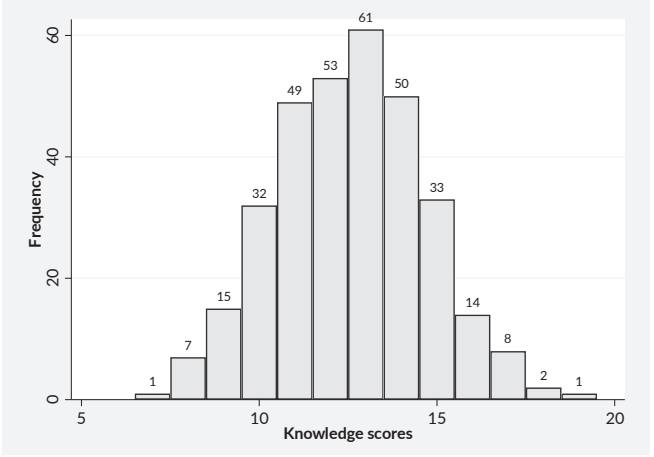

Figure 1. Frequency distribution of the knowledge score.

hypoglycemia (30.7%); (2) to give Glucagon SC and D10 IV bolus to a hypoglycemic patient who is on NPO (19.63% and 25.15%, respectively); and (3) that 15 grams of fast acting carbohydrate is equivalent to three hard candies (17.85%). The rest of the knowledge profile are tabulated in Table 4

For the medical residents, there was a significant difference noted between passers (23.53%) and non-passers (69.23%) in terms of those who had training on hypoglycemia (17 ± 0.8; p = 0.006). Age, gender and residency year level did not differ between the two groups. For the nurse respondents group, on the other hand, the only factor that significantly differed was gender, where most of the males (87.75%) and females (70.43%) were not able to reach the MPL (12.24 ± 1.96; p = 0.013). Both respondent groups had a mean age of 30, and no significant difference was noted between the two in terms of number of years in service, educational attainment, whether they attended to diabetic patients, or had training in hypoglycemia management.

The mean overall knowledge scores of respondents differed significantly across age groups (12.56 ± 2.11; p <0.001), professions (13.2 ± 1.96; p <0.001), number of years in service/training (_12.28 ± 1.7; p = 0.028), and highest educational attainment (13.15 ± 1.93; p <0.001). Younger health providers were generally more knowledgeable about

Table 4. Knowledge profile of healthcare providers on hypoglycemia among Filipino diabetic patients (n=326)

	Frequency of respondents with correct answer (%)
Definition	
1. Cut-off capillary blood glucose level (mg/dL) for hypoglycemia	118 (36.2)
2. Severe classification of hypoglycemia	151 (46.5)
3. Event during which symptoms typical of hypoglycemia are not accompanied by a documented plasma glucose	167 (51.2)
4. Event during which the person with diabetes reports any of the typical symptoms of hypoglycemia	125 (38.5)
Causes	
5. Risk factors for hypoglycemia	
a. Recovery from acute illness/stress	173 (53.1)
b. Inappropriately timed insulin or oral hypoglycemic therapy in relation to meal or enteral feed	287 (88.0)
c. IV insulin infusion with glucose infusion	100 (30.7)
d. NOT gradual discontinuation of long term steroid therapy	248 (76.1)
6. Lifestyle/dietary issues that are risk factors for hypoglycemia	
a. Change of the timing of the biggest meal of the day	153 (46.9)
b. Prolonged starvation time	301 (92.3)
c. No access to usual between meal or before bed snacks	253 (77.6)
d. Less carbohydrate than normal	155 (47.6)
7. A 25-year old male, diabetic, was admitted for acute pancreatitis and was placed on NPO. His blood sugars were monitored and was noted to be persistently elevated and was then started on insulin therapy. Risk factors for in-patient hypoglycemia are:	
a. Nutritional intake	227 (69.6)
b. Type of insulin used	235 (72.1)
c. NOT young patients	306 (93.9)
d. Co-morbidities	226 (69.3)
8. Medications that commonly cause hypoglycemia	
a. NOT Rosuvastatin	320 (98.2)
b. Glitazone	115 (35.3)
c. Glimepiride	266 (81.6)
d. Insulin	283 (86.8)
Signs and symptoms	
9. Hunger as sign/symptom of hypoglycemia	144 (44.4)
10. Speech difficulty as a neuroglycopenic sign/symptom of hypoglycemia	174 (53.4)
Management	
11. 15 grams of fast acting carbohydrate is equivalent to three hard candies	58 (17.9)
12. Meaning of 15/15 hypoglycemia rule	215 (66.2)
13. Intervention to be done in a hypoglycemic patient who is awake and oriented	
a. Allow patient to take 200mL of any fruit juice	304 (93.3)
b. To NOT omit due to basal insulin	199 (61.0)
c. To NOT give 1 vial of D50 if with IV access	213 (65.3)
d. To NOT give a concurrent 10% dextrose containing IV fluid to run at 100mL/hr	315 (96.6)
14. The following may be done in a hypoglycemic patient who is unconscious or having seizures	
a. Check for airway, breathing, and circulation	273 (83.7)
b. To NOT feed patient with long-acting carbohydrates	321 (98.5)
c. Give a concurrent 10% dextrose containing IV fluid to run at 100mL/hr	246 (75.5)
d. Omit due insulin	322 (98.8)
15. Options for treating a patient with hypoglycemia who is on NPO	
a. D10 IV bolus	82 (25.2)
b. Glucagon SC	64 (19.6)
c. NOT D5W IV bolus	271 (83.1)
d. D50W IV bolus	269 (82.5)
16. A 15g glucose will produce an estimated increase in the blood glucose by 65mg/dL	115 (35.5)
17. Rechecking of CBG should be done 15 minutes after the initial intervention in a hypoglycemia event	247 (75.8)
Prevention	
18. Modifications in the insulin regimen to help reduce the risk for hypoglycemic event is recommended when blood glucose are below 100mg/dL	108 (33.1)
Outcomes	
19. Seizure is a short term outcome of hypoglycemia	119 (36.6)
20. Retinal cell death is a long term outcome of hypoglycemia	114 (35.3)

Table 5. Demographic profile and knowledge scores of respondents by subscales

	Overall (20)	Definition (4)	Causes (4)	Signs and symptoms (2)	Management (7)	Prevention (1)	Outcomes (2)
	Mean ± SD						
Overall	12.56 ± 2.11	1.72 ± 1.25	3.94 ± 0.23	0.98 ± 0.68	4.88 ± 1	0.33 ± 0.47	0.71 ± 0.68
Age							
≤30	12.97 ± 2.11	1.85 ± 1.25	3.97 ± 0.18	1.02 ± 0.67	4.98 ± 1.01	0.37 ± 0.48	0.79 ± 0.7
31 – 40	11.91 ± 2.02	1.49 ± 1.28	3.89 ± 0.32	0.94 ± 0.72	4.74 ± 0.99	0.27 ± 0.44	0.58 ± 0.67
≥41	12.19 ± 1.93	1.66 ± 1.13	3.96 ± 0.2	0.87 ± 0.65	4.7 ± 0.91	0.32 ± 0.47	0.68 ± 0.63
p-value	***<0.001****	*0.077**	***0.023****	*0.385**	*0.073**	*0.261**	*0.052**
Sex							
Male	12.83 ± 2.4	1.84 ± 1.32	3.93 ± 0.25	0.96 ± 0.68	4.97 ± 0.94	0.39 ± 0.49	0.72 ± 0.76
Female	12.48 ± 2.01	1.68 ± 1.23	3.95 ± 0.22	0.98 ± 0.69	4.85 ± 1.01	0.31 ± 0.46	0.71 ± 0.66
p-value	*0.213†*	*0.335†*	*0.646†*	*0.828†*	*0.337†*	*0.181†*	*0.897†*
Profession							
Medical residents	14.49 ± 1.98	2.98 ± 0.99	3.98 ± 0.15	0.7 ± 0.55	5.32 ± 0.86	0.51 ± 0.51	1 ± 0.81
Nurses	12.24 ± 1.96	1.51 ± 1.16	3.94 ± 0.24	1.02 ± 0.69	4.8 ± 1	0.3 ± 0.46	0.67 ± 0.65
p-value	***<0.001†***	***<0.001†***	*0.272†*	***0.003†***	***<0.001†***	***<0.001†***	***0.002†***
Number of years in service/training							
≤10	12.71 ± 2.12	1.77 ± 1.25	3.95 ± 0.22	0.99 ± 0.7	4.95 ± 1.01	0.34 ± 0.47	0.72 ± 0.69
11-20	11.76 ± 1.9	1.41 ± 1.24	3.92 ± 0.27	0.94 ± 0.65	4.53 ± 0.86	0.31 ± 0.47	0.65 ± 0.66
21-30	12.86 ± 2.25	2.07 ± 1.33	4 ± 0	0.79 ± 0.58	4.93 ± 1	0.36 ± 0.5	0.71 ± 0.73
≥31	12.2 ± 1.79	1.6 ± 0.89	3.8 ± 0.45	1 ± 0.71	4.6 ± 0.89	0.2 ± 0.45	1 ± 0.71
p-value	***0.028****	*0.204**	*0.330**	*0.715**	***0.046****	*0.914**	*0.708**
Highest educational attainment							
Bachelor's degree	12.23 ± 1.93	1.52 ± 1.16	3.94 ± 0.25	1.02 ± 0.7	4.77 ± 0.99	0.3 ± 0.46	0.67 ± 0.65
Masters	12.44 ± 2.48	1.25 ± 1.24	4 ± 0	1 ± 0.52	5.38 ± 1.02	0.25 ± 0.45	0.56 ± 0.73
Doctorate	14.49 ± 1.98	2.98 ± 0.99	3.98 ± 0.15	0.7 ± 0.55	5.32 ± 0.86	0.51 ± 0.51	1 ± 0.81
p-value	***<0.001****	***<0.001****	*0.300**	***0.012****	***<0.001****	***0.017****	***0.007****
Come across diabetic patients in the ward							
No	12.67 ± 0.58	1.33 ± 0.58	3.67 ± 0.58	0.67 ± 0.58	6.33 ± 0.58	0	0.67 ± 0.58
Yes	12.56 ± 2.12	1.72 ± 1.25	3.95 ± 0.22	0.98 ± 0.68	4.86 ± 0.99	0.33 ± 0.47	0.72 ± 0.69
p-value	*0.933†*	*0.59†*	***0.034†***	*0.433†*	***0.011†***	*0.222†*	*0.903†*
Had training on hypoglycaemia management							
No	12.6 ± 2.09	1.66 ± 1.26	3.94 ± 0.24	1.03 ± 0.68	4.88 ± 0.99	0.35 ± 0.48	0.74 ± 0.71
Yes	12.46 ± 2.18	1.92 ± 1.21	3.96 ± 0.2	0.8 ± 0.66	4.88 ± 1.02	0.27 ± 0.45	0.64 ± 0.59
p-value	*0.627†*	*0.121†*	*0.531†*	***0.011†***	*0.992†*	*0.201†*	*0.256*

*Statistical tests used: * – One-way ANOVA; † – Independent sample T-test*

hypoglycemia than the providers in the older age group across all subscales. Likewise, those with less than 10 years of service/training were more knowledgeable on hypoglycemia management than those with longer training years (4.95 ± 1.01, p = 0.046). However, further stratification and analysis must be done for sufficient evidence of correlation. Details are in Table 5.

Medical residents were more knowledgeable than nurses in the definition (t = 2.98 ± 0.99, p <0.001), management (t = 5.32 ± 0.86; p <0.001), prevention (t = 0.51 ± 0.51; p <0.001), and outcomes (t =1 ± 0.81; p = 0.002) of hypoglycemia while nurses were more knowledgeable in its signs and symptoms (t = 1.02 ± 0.69; p = 0.003) (Table 5).

Overall, the number of years of practice is negatively and weakly correlated with the knowledge scores. That is, the longer a professional has been practicing, the lower the knowledge (12.2 ± 1.79; p < 0.001). When stratified according to profession, there was no correlation between years of practice and knowledge scores.

Attitudes towards hypoglycemia

Majority of respondents either agreed or strongly agreed (4/6), and were somewhat comfortable or very comfortable (6/6) in 10/12 items for the attitudes domain (Table 6). Most respondents strongly agreed that hypoglycemia is one of the important complications to avoid during tight glycemic control (68.4%), and that a hypoglycemia management protocol must be initiated by the institution to provide prompt and proper management of any hypoglycemic event (63.8%). Most of the respondents are comfortable in their

Table 6. Attitudes of health care providers in handling hypoglycemic in-patients

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
	Frequency (%)				
A1. Hypoglycemia is one of the important complications to avoid during tight glycemic control	1 (0.31)	0	3 (0.92)	99 (30.37)	**223 (68.4)**
A2. Hypoglycemia is associated with increased risk of mortality and a marker of severity of illness in various hospitalized patients	2 (0.61)	10 (3.07)	32 (9.82)	132 (40.49)	**150 (46.01)**
A3. Prevention and appropriate management of hypoglycemia does not significantly decrease hospital costs	84 (25.77)	**108 (33.13)**	43 (13.19)	55 (16.87)	36 (11.04)
A4. Tight glycemic control without any hypoglycemic event is associated with good clinical outcome	2 (0.62)	15 (4.62)	33 (10.15)	**155 (47.69)**	120 (36.92)
A5. Standardized management of hypoglycemia is additional work for health care providers	45 (13.8)	**90 (27.61)**	62 (19.02)	67 (20.55)	62 (19.02)
A6. A hypoglycemia management protocol must be initiated in our institution to provide prompt and proper management of any hypoglycemic event	3 (0.92)	0	9 (2.76)	106 (32.52)	**208 (63.8)**

	Very uncomfortable (1)	Somewhat uncomfortable (2)	Somewhat comfortable (3)	Very comfortable (4)
	Frequency (%)			
A7. Managing hypoglycemia among patients who are awake and alert	0	0	93 (28.53)	**233 (71.47)**
A8. Managing severe hypoglycemia when patients are either unconscious or unable to help themselves	7 (2.15)	76 (23.31)	**178 (54.6)**	65 (19.94)
A9. Nurses autonomously managing hypoglycemia when patients are awake and alert	6 (1.85)	14 (4.31)	**170 (52.31)**	135 (41.54)
A10. Nurses independently managing any type of hypoglycemia	17 (5.21)	67 (20.55)	**188 (57.67)**	54 (16.56)
A11. Doing prompt rechecking of blood glucose 15 minutes after initial hypoglycemia intervention	3 (0.92)	21 (6.44)	92 (28.22)	**210 (64.42)**
A12. Following standardized protocol in managing any hypoglycemic event	2 (0.62)	6 (1.85)	106 (32.62)	**211 (64.92)**

capability to manage hypoglycemia among patients who are awake (71.5%), to do prompt rechecking of CBG 15 minutes after initial hypoglycemia intervention (64.4%), and to follow standardized protocol in managing any hypoglycemic event (64.9%). In the remaining 2 items, the highest percentage of responses corresponded to the 'disagree' option (prevention and appropriate management of hypoglycemia do not significantly decrease hospital costs [33.1%] and that standardized management of hypoglycemia is additional work for healthcare professionals [27.6%]).

Overall attitudes of respondents are positive in terms of clinical impact, healthcare delivery and cost, managing hypoglycemia, and following a standard protocol.

Practices in managing hypoglycemia

Majority of respondents had correct practices in 5/9 practice points. The highest percentage of correct practices were to give 50mL D50 IV bolus to a patient with hypoglycemia who is on insulin and is awake but unable to swallow (81.3%), to repeat the CBG in 15 minutes after initial intervention (78.8%), to give 50 ml D50 IV bolus in a patient with hypoglycemia who is difficult to rouse (74.9%), to call attending physician when the CBG is still low after intervention (73.01%), and to feed hypoglycemic patients who are awake and able to swallow (70.3%). Details are in Table 7.

Doctors preferred to give standing orders for hypoglycemic events (68.09%). Nurses preferred to carry these orders out (94. 07%) rather than call the doctor first.

Medical residents and nurses did not differ significantly on two practice points: 1) practice point 3 where most of them would give 50 mL D50 IV bolus on a patient who is awake with a CBG <50 but is unable to swallow (nurses 79.9% vs residents 89.4%; p = 0.125), and 2) practice point 7, where only a few of them (nurses 22.66% vs residents 19.15%, p = 0.051) will give a 15gm fast acting carbohydrate plus a protein source to hypoglycemic patients if the next meal is still an hour away.

More residents than nurses were correct in managing hypoglycemic patients with due insulin (45.2% vs 53.2%; p = 0.007), patients on insulin who are due for surgery to prevent hypoglycemia (39.2% versus 12.8% , p = <0.001), and patients who still have depressed sensorium even after initial intervention (87.2% vs 14.3%, p = <0.001) and deferral of Regular Insulin administration (74.5% vs 49.8%, p = 0.002).

Table 7. Proportion of respondents who have correct practices

	Correct Practices n=326 (%)	Correct Practices (Nurses) n=279 (%)	Correct Practices (Residents) n=47 (%)	p value
P1. Managing hypoglycemia in an awake patient who is able to swallow	229 (70.3)	187 (67.0)	42 (89.4)	0.002§
P2. Insulin administration due before breakfast during a hypoglycemic event	151 (46.3)	126 (45.2)	25 (53.2)	0.007‡
P3. Managing hypoglycemia in an awake patient but is unable to swallow	265 (81.3)	223 (79.9)	42 (89.4)	**0.125§**
P4. Managing hypoglycemia in a patient who is difficult to rouse	246 (75.5)	200 (71.7)	46 (97.9)	<0.001‡
P5. When to repeat CBG after initial intervention	257 (78.8)	214 (76.7)	43 (91.5)	0.001‡
P6. Managing hypoglycemia in a patient who still has depressed sensorium after initial intervention	81 (24 .9)	40 (14.3)	41 (87.2)	<0.001‡
P7. Intervention given to a patient with resolved hypoglycemia with the next meal just an hour away	185 (56.9)	63 (22.7)	9 (19.2)	**0.051‡**
P8. Insulin administration on a patient due for surgery the next morning to prevent hypoglycemia	115 (35.4)	6 (12.8)	109 (39.2)	<0.001‡
P9. CBG level to defer giving regular insulin to prevent further hypoglycemia	174 (53.4)	139 (49.8)	35 (74.5)	0.002§

Statistical tests used: ‡ – Fisher's exact test; § – Chi squared test; In bold font, not signficant

Focused Group Discussion

Six volunteers from both the medical residents and nurses groups participated to discuss the items they deemed easy or difficult, and the possible reasons for having low or high scores on select items in the survey tool.

Generally, most found the classification of hypoglycemia and its specific complications difficult because these subtopics were not included in their training curriculum but agreed that these subtopics are essential and must be retained in the assessment tool. Risk factors, signs and symptoms, and hypoglycemia management are relatively easier for them to answer because they encounter these in their daily practice. There are some variations in the knowledge aspect of hypoglycemia management as respondents attributed their knowledge to what they learned from orders of physicians. Nevertheless, respondents deemed items on these subscales easy.

No recommendations on inclusions or exclusions of subtopics were given. Respondents collectively agreed that although some items in the tool were challenging and required good theoretical background, they were all important and must be included in the survey tool.

The respondents described their existing practices, in brief, as follows:

1. *Independent nursing practice.* Nurses do initial assessment; however, administration of therapeutics may only be done with physician's orders.
2. *Standing orders.* For high-risk patients, physicians usually write their orders for intervention in case a hypoglycemic event occurs.
3. *Re-checking of blood sugar levels*. Re-checking is usually done 30 minutes after initial intervention. If the patient is already asymptomatic, no re-checking of the blood glucose is done.
4. *Referral to physicians.* Nurses always notify the physician of a hypoglycemia event and the results of the repeat blood glucose after intervention.

For the perceived facilitators of and barriers to the management of hypoglycemia, the emerging points were the following:

1. *Prompt physician response time to referrals.* Residents ensure that they would personally assess the patient before and after the intervention.
2. *Available standing orders to be carried out by the nurses.* With the availability of standing orders, nurses are able to carry out interventions promptly.
3. *Availability of therapeutics.* D50W vials are available at all times and are included in the ward emergency carts.
4. *Delayed detection and initial response to hypoglycemia*. Most hypoglycemia episodes are detected through routine blood glucose monitoring. Frequently, patient sensorial changes prompts assessment, whereas other mild to moderate symptoms are often under-recognized.
5. *Delayed referral time from nurse to physician***.** The nurses would refer hypoglycemic events to physician depending on the severity of symptoms. For mild symptoms, nurses usually intervene without referral to physician. In the peripheral wards, response often takes time because the referral would be coursed through the primary physician then to the medical residents.
6. *Materials for detection and re-checking of blood glucose may not be readily available*. There are some problems in the availability of glucose meter and strips because the pharmacy issues limited strips on a daily basis. Non-compatibility and non-functional meters are also issues of concern.
7. *Lack of training on hypoglycemia.* Most of the nurses lack hypoglycemia management training. Special core group composed of diabetes educators per ward has been dissolved.

Physicians generally have confidence in a nurse-driven hypoglycemia protocol while nurses are willing to adopt and autonomously run a standard hypoglycemia protocol.

DISCUSSION

A team approach involving physicians and nurses is needed in the recognition and treatment of hypoglycemia. Consequently, it is vital to evaluate the knowledge of health care providers in its management in order to identify the gaps.

This survey tool evaluated the knowledge, attitudes and practices of nurses and physicians towards in-patient hypoglycemia in a tertiary institution as they are the front liners responders to hypoglycemic event. Respondents had normally distributed results which makes the standardized test useful in predicting the scores towards the central tendency. This study showed low overall knowledge on hypoglycemia among health care providers and identified gaps. While the medical residents and nurses are proficient in the knowledge area of risks factors and management of hypoglycemia, they needed more reinforcement as to the theoretical aspects of hypoglycemia such as overall cut-off value and classifications. A plausible explanation to this outcome is explained by Balijepalli et. al[29] which stated that substantial heterogeneity exists in the definition of overall hypoglycemia, severe/major hypoglycemia, and nocturnal hypoglycemia across randomized controlled trials investigating Type 2 Diabetes Mellitus interventions. This should be addressed by coming up with one standard definition.

Unfamiliar treatment options such as glucagon, which is not locally available, made hypoglycemia management more challenging for respondents. Moreover, the protocol of giving a 15-gram carbohydrate and its dietary equivalent to patients experiencing hypoglycemic event needs to be reviewed. Similar findings by Coats and Marshall,[24] showed that only 40.4% of patients were given appropriate initial oral carbohydrate in response to a hypoglycemia event despite an established hypoglycemia protocol in their institution. Relative to this, dieticians may be tapped for assistance to supplement modules on practical carbohydrate exchanges.

The duration of professional practice was expected to contribute to the knowledge in managing hypoglycemia. However, results of the study showed insufficient evidence for correlation of years of practice to knowledge. Medical residents having higher knowledge scores on hypoglycemia definition, management, prevention and outcomes is an expected outcome given the training and lectures on hypoglycemia incorporated in their practice. Nurses, on the other hand, were able to recognize signs and symptoms better since they frequently respond first to hypoglycemia events. Chinnasammy[27] showed similar findings where most of the nurses had knowledge in the recognition of symptoms of hypoglycemia.

Overall, there was a positive attitude among the respondents in acknowledging that hypoglycemia can significantly impact the clinical outcomes of patients and that a standard protocol must be initiated for effective response. Majority of the respondents are comfortable in managing hypoglycemia across all severity levels. Close follow-up and prompt re-checking of blood glucose is essential in subsequent steps for managing any hypoglycemia event. It is important to note that the respondents are somewhat comfortable in having nurses autonomously run a protocol on hypoglycemia management. Their hesitation stemmed from their perception of their competence to run the protocol. This may be addressed by modules and training.

The receptivity from the end-users may make it easier for a standard protocol to be implemented. Some studies[16] showed that although a hypoglycemia protocol added to the work of the nursing staff, it was nevertheless met with favorable acceptance due to its capacity to prevent and address mild and severe hypoglycemic episodes. Moreover, nurses particularly appreciated the autonomy and involvement provided by the protocol in the management of patients with diabetes.

Majority of the nurses and residents have correct practices in the initial response to hypoglycemia. Therapeutic intervention is readily available at the wards and close monitoring is being observed. However, in cases where hypoglycemia persists, nurses would put on hold further interventions and call the attention of the physician. This is in contrast to treatment guidelines for hypoglycemia, which states that the response to a hypoglycemic event should be nurse-driven for efficiency and that a physician should be contacted if a proper response is not obtained after three doses.[19,21] The practice points included in the survey tool are essential and designed in such a way that appropriate steps in responding to a hypoglycemic event are covered. The incorrect practices identified by the tool must be noted and addressed in the education and training of nurses and medical residents.

Among the perceived barriers to hypoglycemia management is that the subtle signs and symptoms of hypoglycemia are often under-recognized. Hypoglycemia events are only often identified in patients experiencing severe hypoglycemia and sensorial changes. The lack of manpower and time contributes to the incomplete assessment and evaluation of the symptoms of hypoglycemia. Despite this deficiency, it is vital for healthcare professionals to ask patients about their hypoglycemic experiences, its frequency and severity, as these reduces recurrences.[30] On the other hand, the availability of standing orders for a hypoglycemic event is deemed one of the facilitators to effective management of hypoglycemia because it allows nurses to rapidly carry out interventions.

The results of this study provides an insight to the feasibility of establishing a nurse-driven hypoglycemia protocol and its acceptance in the institution.

CONCLUSION

We developed and validated a survey tool covering the knowledge, attitudes and practices among nurses and

medical residents towards hypoglycemia management. The low scores for the overall knowledge domain indicate that further training and educational interventions of medical residents and nurses are necessary. Positive attitudes and correct self-described practices among the health care providers towards the clinical impact, health care delivery, and cost of managing hypoglycemia, as well as the autonomous execution of an institutionalized protocol by nurses are essential in the subsequent development of an in-patient hypoglycemia protocol.

Recommendations of this study include revising items included in the knowledge domain to improve its difficulty and discriminative indices and to re-administer the survey tool for test and retest reliability to more respondents to increase the power and interclass correlation coefficient.

The present study serves as Phase 1 and 2 of a three-phased project that will lead to the development of a more relevant and specific in-patient hypoglycemia protocol catering to the needs and resources of the institution.

Acknowledgments

The authors would like to thank the consultants from the Section of Endocrinology, Diabetes, and Metabolism of UP-PGH for their valuable contributions to this study. We also express our gratitude to all residents of the Department of Medicine and nursing staff who took part in this study.

Statement of Authorship

All authors participated in data collection and analysis, and approved the final version submitted.

Author Disclosure

All authors declared no conflicts of interest.

Funding Source

This research was supported by the Philippine General Hospital Research Grant 2017 and the Philippine Society of Endocrinology, Diabetes, and Metabolism (PSEDM) Grant for Diabetes 2018.

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