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Development and Validation of a Carbohydrate and Insulin Dosing Knowledge Quiz in Adults with Diabetes Mellitus

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Abstract

Objectives. We aimed to develop and validate a carbohydrate and insulin dosing knowledge quiz for adult Asian patients with diabetes mellitus.

Methodology. A self-administered quiz was developed to test carbohydrate recognition; single food carbohydrate estimation; meal carbohydrate estimation and food label reading; and insulin dosing calculation for carbohydrate, blood glucose and for a meal in a multi-ethnic Asian population. The subjects' carbohydrate knowledge and insulin dosing ability were rated by the study dietitian and the subjects' primary physicians, respectively. We compared the quiz scores with the dietitians' and physician ratings and the subjects' HbA1c. Reliability of the quiz was tested by measuring internal consistency and split half reliability.

Results. Seventy-five subjects completed the study. Median (inter-quartile range) quiz score was 71.9 (60.2 to 83.6)%. The quiz score was found to be correlated with the healthcare provider assessments (r=0.652, $p<0.001$) and the subjects' HbA1c (r=-0.375, p=0.001). Cronbach alpha was 0.897 and Guttman split half coefficient was 0.930.

Conclusions. Our analysis suggested that this newly developed quiz had good reliability and validity for testing carbohydrate and insulin dosing knowledge in a group of Asian subjects with diabetes mellitus. This can be a useful screening tool in clinical practice.

Key words: diabetes mellitus, carbohydrate knowledge, insulin dosing knowledge, Asian

INTRODUCTION

An astounding 382 million people are estimated to be living with diabetes mellitus in 2013, with 72 million in Southeast Asia.[1] In addition, China and India are the two countries with the highest numbers of people with diabetes.

Medical nutrition therapy is a cornerstone of the management of diabetes mellitus (DM). Emphasis is placed on the ability to recognize and estimate the amount of carbohydrate in food, as the intake of carbohydrate has the largest impact on glycemic control.[2] Indeed, for people with type 1 DM, it is recommended that prandial insulin dose should be matched with carbohydrate intake, in addition to pre-meal glucose and anticipated activity.[2] This approach may also be extended to people with type 2 DM on a multiple daily insulin dosing schedule.

There have been numerous tools developed in the Western Hemisphere to evaluate an individual's general diabetes knowledge, diabetes numeracy skills and carbohydrate knowledge.[3-5] In contrast, standardized tools for the study of diabetes knowledge in Asian populations are not common. While quizzes targeted at evaluating general diabetes knowledge and numeracy skills can be applied universally, carbohydrate knowledge quizzes developed for Western populations may not be suitable for Asians. The typical Asian diet is considerably different, with more varied carbohydrate choices. For example, rice and rice products are the staple carbohydrate in most Asian countries including Singapore, whereas cereal, cereal products (including bread) and potatoes account for the bulk of carbohydrate intake in Western countries.[6,7] Furthermore, the conventional way of assessing each individual's

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carbohydrate knowledge by a dietitian is time-consuming and may be fraught with inconsistencies, depending on the experience and training of the dietitian. In the primary care setting, there may also be a lack of access to registered dietitians.

We thus aimed to develop and validate a carbohydrate and insulin dosing knowledge quiz for adult patients with DM who consume a predominantly Asian diet.

METHODOLOGY

Development of the Quiz

The structure of the quiz was based on the PedCarbQuiz, which consists of seven domains: 4 on carbohydrate knowledge and 3 on insulin dosing.[5] The carbohydrate knowledge domains include recognition of carbohydrates in food, estimation of carbohydrates in a single food, food label reading and estimation of carbohydrate in a meal. The insulin dosing domains include use of insulin dose correction based on blood glucose level, use of insulin to carbohydrate ratio in insulin dosing and calculation of total insulin dose for a meal.

Food items were drawn from review of existing patient food logs and from the study dietitians' experience of food that was commonly reported to be eaten during diet counselling sessions.

As a multi-racial country, the average daily diet in Singapore consists of food with Chinese, Malay, Indian, as well as regional Southeast Asian culinary influences. Representative food items commonly eaten by Chinese, Malay and Indian ethnic groups, and available at frequently patronized hawker centers, coffee shops and food courts were selected.[6] Photographs of the food items representing portion size were included for each question to avoid confusion between foods with similar sounding colloquial names.

Most domains contained 8 questions, with the exception of 24 items for recognition of carbohydrate in a single food item and 2 questions for calculation of total insulin dose for a meal. This yielded a maximum total score of 64 for the quiz. The quiz was designed such that the odd-numbered questions mirrored the even-numbered ones. The quiz was then pre-tested in a group of 5 DM patients and non-study dietitians to assess ease of administration and clarity. The final quiz was designed to be self-administered and completed in 15 to 20 minutes. The quiz is appended in the online supplement.

Study Subjects

The study was approved by the National Healthcare Group Domain Specific Review Boards (Singapore). Subjects were sequentially recruited from patients attending a diabetes centre in a single institution. We included English-literate participants who were at least 21 years of age, diagnosed with diabetes mellitus and treated with prandial insulin (short- or rapid-acting, including pre-mixed), regardless of type of diabetes. Informed consent was obtained for all subjects. Subjects who were unable to give or declined consent were excluded.

Study Procedures

The recruited subjects were given the self-administered quiz after informed consent was obtained. Each correct answer was equivalent to 1 mark; for carbohydrate counting domains (single food and in a meal), ½ mark credit was given for answers close to the correct one.

Expert assessment for the carbohydrate domains was performed by the study dietitians (M.Y. and P.K.) who were blinded to the results of the quiz through a semi-structured subject interview. The study dietitians were asked to rate the knowledge of the subject in each of the carbohydrate domains using a 7-point scale, ranging from "not at all" to "very well." For the insulin dosing domains, the usual diabetes physician of the subject, who was also blinded to the quiz results, was asked to rate insulin dosing knowledge for each domain on a 7-point scale.

The expert assessments were correlated with the quiz results by the combined carbohydrate domains, the combined insulin dosing domains and overall total.

Chart review was performed to obtain demographic information (including age, gender and ethnic group), diabetes duration, insulin regimen and HbA1c within 3 months of the quiz administration.

Statistical Analysis

Results are expressed as median (interquartile range) for non-categorical variables and number of patients (percentage) for categorical variables. Respondents were categorized based on the median knowledge quiz score. Comparison of the characteristics of subjects with scores equal to, below and above the median score was done using the Mann Whitney U test for non-categorical variables and chi-square test for categorical variables.

Two methods were used to assess reliability of the quiz by measuring internal consistency: calculation of Cronbach α and determination of split half reliability by Guttman split half coefficient between the two equivalent halves (odd-numbered vs. even numbered halves).

Criterion related validity was assessed by calculating Spearman correlation between the quiz scores and HbA1c, and quiz scores and expert (healthcare provider) assessments (for combined carbohydrate and insulin dosing domains and in total).

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Wilcoxon signed rank test was used to compare scores between the different carbohydrate domains. The level of significance was set at 5%. Analyses were performed using IBM® SPSS® for Windows (version 21).

RESULTS

Study Subjects

All 75 recruited subjects were able to complete the study. Subject characteristics are shown in Table 1. The study subjects represented all 3 major ethnic groups in Singapore, and included both type 1 and type 2 DM. Majority of the subjects were on multiple daily insulin dosing regimens.

Quiz and Healthcare Provider Scores

The median quiz score was 71.9% (range 60.2 to 83.6), while the median total healthcare provider score was 26 out of a maximum total of 49 (range 21 to 33). The quiz and healthcare provider scores for each domain are shown in Table 2.

The subjects performed better in the simpler carbohydrate compared to the more complex carbohydrate domains. Scores for recognizing carbohydrate in food was significantly higher than estimating carbohydrate in a single food ($p<0.001$) and estimating carbohydrate in a meal ($p<0.001$). Food label reading scores were also higher than estimating carbohydrate in a single food ($p<0.001$) and estimating carbohydrate in a meal ($p<0.001$). The subjects also scored better in the recognition of carbohydrate in a single food compared to a meal ($p<0.001$). There was no difference in scores between recognizing carbohydrate in food and food label reading ($p=0.386$).

Quiz Validity

There was a significant, albeit weak to moderate negative correlation of the total quiz, carbohydrate domain and insulin dosing domain scores with the subjects' HbA1c. Similarly, the total quiz and carbohydrate domain scores had strong and significant positive correlation with the healthcare provider assessments, which was not observed in the insulin dosing domain (Table 3).

Quiz Reliability

Cronbach α was 0.897 for the whole quiz, with a range of 0.641 to 0.866 for individual domains. Guttman split half coefficient was 0.930 for the whole quiz, with a range of 0.700 to 0.866 for individual domains (Table 4). These results indicate good internal consistency and split half reliability respectively.

Comparison of subjects with higher versus lower quiz scores

We used the median of 71.9% as a cut-off to divide the group into higher and lower quiz scores. Subjects who were younger, with type 1 DM, on more complex insulin regimens and with lower HbA1c scored better on the quiz. No significant difference was found between the two groups in terms of gender, duration of diabetes or duration of insulin use (Table 1).

DISCUSSION

Most subjects with type 1 DM are on multiple daily insulin injection regimens for diabetes management. The majority of patients with type 2 DM start with lifestyle measures and oral hypoglycemic agents for glycemic management. Subsequently, many require insulin to maintain good control, frequently starting with basal insulin and then progressing to basal-bolus type regimens similar to that used in type 1 diabetes.[8,9] However, many patients do not practice flexible insulin dosing. This may be due to the lack of carbohydrate knowledge, numeracy skills, education and confidence in self-adjustment of insulin dose, among other reasons.

Table 1. Baseline patient characteristics

Characteristic	All (n=75)	Quiz Score ≤71.9 (n=38)	Quiz Score >71.9 (n=37)	p-value[a]
Age, year	40 (31- 53)	50 (37-58)	36 (28-35)	<0.001
Male (%)	35 (46.7)	20 (52.6)	15 (40.5)	0.294
Ethnic group				
Chinese (%)	46 (61)	16 (42)	30 (81)	0.005
Malay (%)	12 (16)	10 (26)	2 (5)	
Indian (%)	15 (20)	11 (29)	4 (11)	
Others (%)	2 (3)	1 (3)	1 (3)	
Diabetes type				
Type 1 (%)	45 (60)	14 (37)	31 (84)	<0.001
Type 2 (%)	30 (40)	24 (63)	6 (16)	
Diabetes duration, year	12 (5-21)	12 (7-22)	11 (2-19)	0.112
Insulin regimen				
BD[b] (%)	23 (30.7)	20 (52.6)	3 (8.1)	<0.001
MDI[c] (%)	50 (66.7)	18 (47.4)	32 (86.5)	
CSII[d] (%)	2 (2.7)	0 (0)	2 (5.4)	
Insulin use duration, year	6 (1-13)	6 (2-10)	6 (1-19)	0.641
HbA1c, %	8.7 (7.5-9.6)	9.1 (8.0-11.2)	8.1 (6.9-9.3)	0.012

[a]p-value for comparison between subjects with quiz score ≤71.9 and >71.9. Results expressed as median (interquartile range).
[b]BD, twice daily
[c]MDI, multiple daily injection
[d]CSII, continuous subcutaneous insulin injection

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Table 2. Quiz and healthcare provider scores

Domain	Score
Total quiz score, %	71.9 (60.2-83.6)
Carbohydrate domains, %	70.7 (56.5-79.3)
Recognize carbohydrate in food, %	75.0 (66.7-91.7)
Estimate carbohydrate in single food, %	68.8 (56.3-81.3)
Food label reading, %	83.3 (66.7-83.3)
Estimate carbohydrate in a meal, %	43.8 (37.5-68.8)
Insulin dosing domains, %	86.1 (65.3-94.4)
Calculate correction dose insulin, %	81.3 (62.5-100.0)
Calculate insulin for carbohydrate, %	87.5 (75.0-100.0)
Calculation of total insulin, %	100 (0-100)
Total healthcare provider score[a]	26 (21-33)
Carbohydrate domains	12 (9-17)
Recognize carbohydrate in food	5 (4-6)
Estimate carbohydrate in single food	2 (1-3)
Food label reading	4 (2-6)
Estimate carbohydrate in a meal	1 (1-3)
Insulin dosing domains	14 (10-18)
Calculate correction dose insulin	5 (4-6)
Calculate insulin for carbohydrate	4 (3-6)
Calculation of total insulin	4 (3-6)

Results expressed as median (interquartile range).
[a] Maximum score for each domain is 7, and maximum total score is 49

Table 3. Correlation of quiz scores with healthcare provider scores and HbA1c

	Correlation coefficient	p
Correlation with healthcare provider scores		
Total quiz score	0.652	<0.001
Carbohydrate domains	0.663	<0.001
Insulin dosing domains	0.180	0.135
Correlation with subjects' HbA1c		
Total quiz score	-0.375	0.001
Carbohydrate domains	-0.380	0.001
Insulin dosing domains	-0.277	0.020

Table 4. Reliability of quiz

	Cronbach's alpha	Guttman split half coefficient
Total quiz	0.897	0.930
Carbohydrate domains	0.832	0.861
Carbohydrate domain 1 (Recognize carbohydrate in food)	0.796	0.760
Carbohydrate domain 2 (Estimate carbohydrate in single food)	0.710	0.770
Carbohydrate domain 3 (Food label reading)	0.700	0.700
Carbohydrate domain 4 (Estimate carbohydrate in a meal)	0.641	0.792
Insulin dosing domains	0.867	0.911
Insulin dosing domain 1 (Calculate correction dose insulin)	0.745	0.855
Insulin dosing domain 2 (Calculate insulin for carbohydrate)	0.713	0.833
Insulin dosing domain 3 (Calculation of total insulin)	0.866	0.866

Central to flexible insulin dosing would be the ability to estimate the amount of carbohydrates in commonly eaten food, and the numeracy skills to estimate the insulin dose appropriate for the food to be eaten and for the correction dose based on pre-meal glucose. Even with fixed dose insulin regimens, the ability to recognize carbohydrates and estimate carbohydrate amounts in food is important to allow regular distribution of carbohydrates throughout the day. Thus, an objective tool to assess these key knowledge elements is crucial.

To the best of our knowledge, this is the first tool developed and validated for patients consuming a Southeast Asian diet. Some advantages of this tool are that it is brief, allows self-administration and includes visuals by way of food photographs. We also tested the calculation of insulin correction dose based on pre-meal glucose by two different methods: one following a correction scale and another by using an insulin sensitivity factor and a target glucose level. This allowed us to assess subjects with different practices. The PedCarbQuiz only utilized a correction scale.[5]

While attempts were made to include food commonly consumed by the different ethnic groups, it is possible that some items were not commonly eaten by others. However, in the melting pot food culture of Singapore, since we included commonly available foods, most people would be at least be familiar with the different food items. Furthermore, with increasing globalization, international travel and the availability and popularity of many of these food items worldwide, this quiz may also be applied to people with diabetes who enjoy ethnic variety in their food choices.

Overall, the quiz had good reliability (good internal consistency and split-half reliability) and validity (correlation with HbA1c and healthcare provider assessments). However, insulin dosing domains were not significantly correlated with healthcare provider assessment. A possible reason is that many of the study subjects do not routinely adjust insulin on their own, and may not be familiar with how it is done. Accurate assessment of these subjects' numeracy skills may be challenging since they did not self-adjust insulin regularly. Since healthcare provider assessment for the insulin domains were performed by the subjects' usual physicians, wider inter-physician assessment variability may be observed. In contrast, less variability may be seen between the 2 study dietitians for the carbohydrate domains. We attempted to minimize variability in ratings by having detailed descriptions for each point on the rating scale.

We found that subjects with higher quiz scores had lower HbA1c results. This may indicate that better knowledge had translated to better glycemic control. While knowledge alone is insufficient for good glycemic control, it is also clear that the lack of it would preclude the ability to follow a flexible insulin dosing regimen recommended in many guidelines.[10,11] This quiz may then be used as a screening tool to identify subjects who are deficient in the necessary health literacy and numeracy skills for targeted education, with greater attention paid to domains with lower scores. As an example, subjects who do well at identifying carbohydrates in food but fare poorly at carbohydrate counting may attend advanced carbohydrate counting classes, while those who are not able to identify carbohydrates in food or read food labels may be more suited for basic carbohydrate counting classes.

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CONCLUSION

Our study demonstrated the development and validation of a new carbohydrate and insulin dosing knowledge quiz in a multi-ethnic population of diabetic adults with on prandial insulin. It addresses an important gap in the current management of this population of patients. It may be applied within the Southeast Asian region, in migrant Asian populations, as well as to individuals who consume a more cosmopolitan diet. There are numerous potential uses of the quiz, including as a screening tool for knowledge gaps before intensifying insulin therapy and as an objective assessment tool following educational interventions.

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Supplement 1. Carbohydrate and insulin dosing knowledge quiz with answers and scoring notes

Question 1.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[x]   Banana

[ ]   Chicken

[x]   Wholemeal bread

[x]   2-in-1 Instant Coffee mix

Question 2.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[ ]   Bittergourd

[x]   White rice

[ ]   Egg

[x]   Low fat milk

Question 3.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[x]

Potato

[ ]

Olive Oil

[x]

Bee Hoon (Rice vermicelli noodles)

[x]

Peanut Butter

Question 4.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[x]

Pumpkin

[ ]

Margarine

[x]

Soya Bean Milk (regular)

[x]

Chee Cheong Fun

Question 5.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[x]

Corn

[ ]

Fish

[ ]

Clear Chicken Soup

[x]

Chappati

Question 6.
Which of the following food(s) contain(s) carbohydrates?
Please choose all the answers that apply.

[x]

Oats

[x]

Peas

[ ]

Silken Tofu

[ ]

Diet Soda

Question 7.
How many grams of carbohydrates
are in this portion of food?

1 cup (250 mL) of low fat milk

(1)	15
(1/2)	30
( )	45
( )	60
( )	75

Question 8.
How many grams of carbohydrates
are in this portion of food?

1 bowl of **cooked** white rice

( )	15
( )	30
(1/2)	45
(1)	60
(1/2)	75

Question 9.
How many grams of carbohydrates
are in this portion of food?

3 tablespoons of **uncooked** oats

(1)	15
(1/2)	30
( )	45
( )	60
( )	75

Question 10.
How many grams of carbohydrates
are in this portion of food?

1 medium banana (8 inches long)

(1/2)	15
(1)	30
(1/2)	45
( )	60
( )	75

Question 11.
How many grams of carbohydrates
are in this portion of food?

1 rice bowl of yellow noodles (mee)

( )	15
(1/2)	30
(1)	45
(1/2)	60
( )	75

Question 12.
How many grams of carbohydrates
are in this portion of food?

1 slice of wholemeal bread

(1)	15
(1/2)	30
( )	45
( )	60
( )	75

Question 13.
How many grams of carbohydrates
are in this portion of food?

1 whole corn on the cob
(medium, 7 inches long)

(1/2)	15
(1)	30
(1/2)	45
( )	60
( )	75

Question 14.
How many grams of carbohydrates
are in this portion of food?

1/4 cup barley (uncooked)

(1/2)	15
(1)	30
(1/2)	45
( )	60
( )	75

Question 15.
Look at this food label and answer
the following questions.

NUTRITION INFORMATION		
Servings per package: 10		
Serving size: 3 pieces (25g)		
	Per Serving	Per 100g
Energy	142 kcal	567 kcal
Protein	2.2 g	8.7 g
Total Fat	8.0 g	33.5 g
Carbohydrate	14.0 g	55.8 g
Dietary fibre	1.0 g	4.0 g
Sodium	150 mg	600 mg

What is the serving size? 3 pieces (5 pieces/10 pieces)
How many grams of carbohydrates are there in one serving?
14g (28g/55.8g)
How many grams of carbohydrates are there in the whole
packet? (14g/42g/55.8g) 140g

Question 16.
Look at this food label and answer
the following questions.

NUTRITION INFORMATION		
Servings per package: 1		
Serving size: 1 cup (150g)		
	Per Serving	Per 100g
Energy	153 kcal	102 kcal
Protein	3.8 g	2.5 g
Total Fat	2.4 g	1.6 g
Carbohydrate	30 g	20 g
Dietary fibre	6.0 g	4.0 g
Sodium	74 mg	49 mg

What is the serving size? 1 cup (2 cup/3 cups)
How many grams of carbohydrates are there in one serving?
(20g) /30g / (45g)
For one serving, how many grams of carbohydrates should you
use to calculate the insulin dose? (24g)/ 27g /(30g/36g)

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Question 17.
How many grams of carbohydrates are there in the following breakfast?

1 plate of mee siam with
1 glass of kopi-C (coffee with evaporated milk and sugar)

( )   30g
( )   45g
( )   60g
(1/2)   75g
(1)   90g

Question 18.
How many grams of carbohydrates are there in the following lunch?

1 bowl of ban-mien soup + 1 medium green apple + 1 can of isotonic sports drink (e.g. 100 Plus, Pocari)

( )   60g
(1/2)   75g
(1)   90g
(1/2)   105g
( )   120g

Question 19.
How many grams of carbohydrates are there in the following snack?

1 piece kuih lapis + 1 cup of kopi-O (coffee with sugar)

( )   15g
(1)   30g
(1)   45g
(1/2)   60g
( )   75g

Question 20.
How many grams of carbohydrates are there in the following dinner?

1 plate of fried bee hoon +
1 piece fish otah

( )   15g
( )   30g
(1/2)   45g
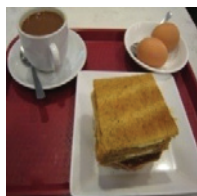(1)   60g
(1)   75g

Question 21.
How many grams of carbohydrates are there in the following breakfast?

2 pieces wholemeal bread + 2 tablespoons butter + 2 tablespoons kaya + 2 soft boiled eggs + 1 cup kopi-C (Coffee with evaporated milk and sugar)

( )   15g
( )   30g
(1/2)   45g
(1)   60g
(1/2)   75g

Question 22.
How many grams of carbohydrates are there in the following snack?

3 pieces of high fiber crackers +
1 cup of plain malted drink (e.g. Milo, Horlicks) (without milk or sugar)

(1/2)   15g
(1)   30g
(1/2)   45g
( )   60g
( )   75g

Question 23.
Look at the insulin scale to determine how much insulin to give for the blood glucose reading.

Blood glucose is 8.6 mmol/L. You should give _3_ (2/4/5/6) units of insulin.
Blood glucose is 21.2 mmol/L. You should give _6_ (2/3/4/5) units of insulin.
Blood glucose is 12.0 mmol/L. You should give _3_ (2/4/5/6) units of insulin.

Question 24.
Look at the insulin scale to determine how much insulin to give for the blood glucose reading.

Blood glucose is 10.8 mmol/L. You should give _2_ (0̶/4/6̶/8̶) units of insulin.
Blood glucose is 5.5 mmol/L. You should give _0_ (2̶/4̶/6̶/8̶) units of insulin.
Blood glucose is 15.4 mmol/L. You should give _6_ (0̶/2̶/4̶/8̶) units of insulin.

Question 25.
1 unit of insulin covers 10g of carbohydrate.
Please answer the following questions.

For 30 g of carbohydrate, you should give _3_ (1/2/4/5) units of insulin.
For 15 g of carbohydrate, you should give _1.5_ (1/2/2.5/3) units of insulin.
For 50 g of carbohydrate, you should give _5_ (1/2/3/4) units of insulin.

Question 26.
1 unit of insulin covers 15g of carbohydrate.
Please answer the following questions.

For 30 g of carbohydrate, you should give _2_ (3/4/5/6) units of insulin.
For 45 g of carbohydrate, you should give _3_ (2/4/5/6) units of insulin.
For 60 g of carbohydrate, you should give _4_ (2/3/5/6) units of insulin.

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Question 27.
1 unit of insulin covers 5g carbohydrate.
1 unit of insulin lowers blood glucose by 1.5 mmol/L. Your **target blood glucose** is **6 mmol/L**.
Your blood glucose before dinner is **11.9 mmol/L.**

Your dinner is:
1 plate of chicken rice with cucumbers + 1 bowl of cheng tng
Fill in the blanks.

The total amount of carbohydrates in this dinner is 105 g.
(1/2 mark for 90g or 120g)
To cover carbohydrates, you should give 21 units of insulin.
To lower your blood glucose to your target, you should give 4 units of insulin.
The total amount of insulin you should give is 25 units.

Question 28.
1 unit of insulin covers 15g carbohydrate.
1 unit of insulin lowers blood glucose by 3 mmol/L. Your **target blood glucose** is **5 mmol/L**.
Your blood glucose before lunch is **8.1 mmol/L.**

Your lunch is:
1 plate of biryani rice + 1 piece curry chicken + stir fried cabbage +
1 small papaya +1 bottle of water
Fill in the blanks.

The total amount of carbohydrates in this dinner is 120 (105)g.
(1/2 mark for 90g or 135g)
To cover carbohydrates, you should give 8 (7) units of insulin.
To lower your blood glucose to your target, you should give 1 unit of insulin.
The total amount of insulin you should give is 9 (8) units.

Quiz Scoring Notes
1. For questions 1 to 6, [x] denotes the food item contains carbohydrates. One (1) mark is given for every correct answer, including correctly identifying that the food does not contain carbohydrates.
2. For questions 7 to 14 and questions 17 to 22 , 1 mark is given for the correct answer (shown as [1]) and ½ mark credit is given for answers close to the correct answer.
3. For questions 15, 16, 23 to 26, the correct answer is underlined. One (1) mark is given for each correct answer.
4. For questions 27 and 28, full credit (1 mark) was given for calculation of insulin for carbohydrates based on the total amount of carbohydrate estimated in the answer and for calculation of total amount of insulin given based on answers for insulin to be given for carbohydrates and correction dose insulin.