

Knowledge and Attitude of Nurses Toward Glucose-6- Phosphate Dehydrogenase Deficiency in Duhok Governorate: Cross Sectional Study

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Abstract

Background: G6PD deficiency is regarded as the commonest enzyme deficiency in the world. It's an x-linked inherited genetic disease, where the absence of G6PD enzymes causes red blood cells to break down prematurely when provoked by certain triggers like fava beans, infections and certain drugs. This study is targeted to evaluate the nurses' knowledge and attitude towards the condition in the city of Duhok.

Subjects and Methods: A cross-sectional study, non-probability (convenience) sampling technique study was performed in Duhok governorate between October 2025 to May 2026. The total number of nurses working in governmental hospitals was 183 nurses, including 15 nurses who refused participation and 12 nurses that were not able to participate due to other reason like being on vacation. Data were analyzed using SPSS version 23. The chi-square test was applied to check any association between demographic data, knowledge, and attitude level.

Results: The study showed that most of the participants were 30-34 years old (53 participants) accounting for 33.8 % of the total. And most of these participants were females (103 participants) that accounts for 66.03 %, out of which 99 participants were married (63.46%). The majority of participants, numbering 93 (59.62 %) held diploma in nursing. Out of these participants, 77% had more than 10 years of experience in the clinical field, 116 nurses (74.36%) have received previous G6PD deficiency training courses. Additionally, regarding the nurses' knowledge in G6PD, more than half of the nurses, numbering 95 (60.9%) had Fair knowledge about G6PD, while 52 nurses (33.3%) had good amount of knowledge, and only 9 (5.8%) had poor knowledge. So, regarding attitude, majority of nurses totaling 105 participants (67.5%) held a positive attitude while minority measuring 4 (2.5%) held negative attitude. It was also noted that there was considerable correlation between demographic data and nurses' knowledge and attitudes.

Conclusion: The study found that nurses in Duhok had Fair degree of knowledge regarding G6PD deficiency, and had a positive attitude toward the disease. Additionally, the study showed a significant association between knowledge, attitude and some demographic variables.

Keywords: Knowledge, Attitude, Nurses, Glucose 6-phosphate dehydrogenase deficiency, Hemolytic anemia, Genetic defect.

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Introduction

Glucose -6- phosphate dehydrogenase deficiency (G6PD) is a hereditary disorder affecting red blood cells. Which carry oxygen from lungs to other body organs (Mosa, 2022). It is the commonest enzyme deficiency worldwide, causing a spectrum of disorders like neonatal jaundice, acute and chronic hemolysis (Gerber and Emadi, 2026). G6PD enzyme functions in carbohydrate metabolism, it also acts as anti-oxidant against oxygen free radicals which are potentially toxic to erythrocytes (Dahy et al.,2024). Therefore, this enzyme deficiency may lead to breakdown of red blood cells, which is triggered by external factors like infections, drugs, and some foods. Exposure to these oxidant stressors in large amounts will lead to neonatal jaundice, favism or

hemolysis (Harcke et al., 2019). Although G6PD deficiency is a very common x-linked disorder, most affected people are asymptomatic (Gerber and Emadi, 2026). However, symptoms like fatigue, shortness of breath, jaundice and dark urine may appear after exposure to specific external triggers. Possible complications are anemia and neonatal jaundice while some individuals remain asymptomatic (Abud, 2025). Healthcare providers, particularly nurses play an essential role in identifying and stopping triggers that lead to hemolytic crisis by advising patients to avoid certain medications and risk factors (Shokr and El Kotb, 2022). G6PD deficiency occurs worldwide with varying prevalence depending on geographic and ethnic factors.

It is estimated that about 8% of the population in malaria endemic regions carry a G6PD deficient allele, affecting approximately 220 million males and 133 million females (Monteiro et al., 2014). Diagnosis can be made by quantitative spectrophotometric analysis or more commonly a rapid fluorescent spot test which reveals the synthesis of NADPH from NADP (Luzzatto et al., 2016; Frank, 2005). However, the gold standard laboratory test remains spectrophotometric analysis assay that gives total activity of the enzyme in a blood sample. White blood cells can be removed from the sample for more accurate results (Bancone et al., 2017). Best treatment for G6PD deficiency is to avoid oxidative stress that causes hemolysis. Screening tests are done in each community according to how common the disorder is there (Gerber & Emadi, 2026; Cappellini & Fiorelli, 2008). Improving knowledge and attitude is the best way to improve the quality of healthcare. Therefore, healthcare institutions should emphasize on arranging training programs for nurses to provide better clinical skills, knowledge and attitude on using evidence-based practice for higher quality of care (Ghuloom et al., 2022). In conclusion, the goal of this study is assessing the knowledge and attitude of Duhok nurses toward G6PD deficiency in Duhok governorate. It also to evaluate patient safety, educational interventions and practice (Lee et al., 2022).

Aim of Study

This study aims to assess nurses' knowledge and attitude towards Glucose-6-phosphate dehydrogenase deficiency in Duhok governorate.

Subjects And Methods

Descriptive, cross-sectional design was used for this study to assess and describe the knowledge and attitude of Duhok nurses regarding Glucose -6-phosphate dehydrogenase (G6PD) deficiency. It is a cross-sectional study, as data was collected at one point in time. This study was done in the governmental hospitals in Duhok city, located in Kurdistan region of Iraq. The hospitals involved were Hevi pediatric teaching hospital and the department of neonatal intensive care unit (NICU) at Duhok maternity hospital. Regarding sampling method, a convenience sampling technique was used, which is a non-probability sampling method, where sampling is taken from the whole population of this study. The total number of nurses overall governmental hospitals were (183) nurses. But nurses who refused to participate in this study were (15) nurses and the number of the participant did not attend to participate because of vacation or any other reasons were (12) nurses. This study includes nurses who were available at the time of data collection in both major hospitals, who accepted to participate at the time of data collection. This study excluded those nurses who refused to participate and those who were not available at the time of data collection. Data collection was done within a period of 4 months from beginning of

December 2025 to end of March 2026 by the researcher himself (9 hours per day, 3 hours in morning, 3 hours in the afternoon and 3 hours at night) in order to collect a large number of participants. The total period of this study was from (October of 2025 to May 2026). Consent was attained from the ethical committee at directorate of health of Duhok. Then a drafted inquiry of the agreement was sent to hospitals to facilitate the researcher's work, then the aim of the study was clarified for nurses in Hevi pediatric teaching hospital and Duhok maternity hospital's NICU department, verbal consent was obtained from the participating nurses, keeping the right of withdrawing from the interview, they were assured that data would remain confidential, it was also clearly stated on cover page that participation is voluntary and participants can stop at any time. After obtaining an authorization from general directorate of health and the hospital's administrations in Duhok, the researcher distributed a self-construction questionnaire. Available participants during data collection filled the questionnaire, spending 35 to 50 minutes; the researcher made sure that data will keep confidentiality and anonymity since there was no questionnaire regarding glucose-6-phosphate dehydrogenase (G6PD) deficiency available previously, the researcher coordinated a questionnaire that showed the study's variables, examining the knowledge and attitude of nurse working in hospitals. The questionnaire was prepared into three parts, first part is for assessing the socio-demographical characteristics, second one for evaluating the nurse's knowledge in G6PD deficiency and the third one for identifying the attitude of nurses toward G6PD deficiency. The questionnaire was afforded by the researcher to (6) experts specialized in pediatrics and nursing, their responses were considered by the researcher and organized the questionnaire accordingly, using Cronbach's alpha coefficient, the reliability was tested to guarantee the dependability and consistency of the survey. Cronbach's alpha value for the survey was 0.712, meaning an agreeable level of reliability and consistency. In addition to, pilot study was done ensure the feasibility of the research instrument. sample constituted 10 Nurses who contributed in the completion of the questionnaire, which was organized in the English language, and it took about 30 minutes to manage. After finishing the pilot study, some modifications were done according to the feedback to enhance the accuracy of the research tool. Analysis of data was done with statistical package for social science (SPSS) software version 23, the aim was to answer the research questions. Descriptive statistics have been organized to question responses, repetitiveness and percentages of good/Fair/poor were measured. Inferential data, specifically Chi-square (fisher exact test) was used to check the association between knowledge and attitude scores about G6PD deficiency and selected demographic characteristics in Duhok.

Cut of point of knowledge (Scoring)

Item	Poor Knowledge	Fair knowledge	Good knowledge
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Knowledge	0-5	6-10	11-15
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Cut of point of attitude (Scoring)

Item	Negative	Neutral	Positive
Attitude	10-25	26-37	38-50

Results

Table (1): Distribution of socio-demographic data of Participants

Demographic data	Class	No. N=156	Percent (%)
Age	Less than 25	20	12.82
	25-29	35	22.44
	30-34	53	33.8
	35-39	26	16.67
	40 and above	22	14.10
Gender	Male	53	33.97
	Female	103	66.03
Marital status	Single	51	32.96
	Married	99	63.46
	Divorced	5	3.21
	Widowed	1	0.64
Educational level	Nursing diploma	93	59.62
	Bachelor's degree	60	38.46
	Master degree	3	1.92
Department/unit	Pediatric wards	44	28.21
	Emergency wards	54	34.62
	Medical wards	44	28.21
	ICU	14	8.97
Years of clinical experience	<1 year	5	3.21
	1-3 ears	20	12.82
	4-6 years	39	25.0
	7-10 years	44	28.21
	>10 years	48	30.77
Training courses	Yes	116	74.36%
	No	40	25.64%

Table (2): Knowledge of Nurses about G6pd deficiency

Items	Knowledge responses	
	Correct	In correct
	No. (%)	No. (%)
Definition of G6PD deficiency	96 (61.54)	60 (38.46)
Causes of G6PD deficiency	106 (67.95)	50 (32.05)

Functions of G6PD enzyme	116 (74.36)	40 (25.64)
Pattern of G6PD deficiency	51 (32.69)	105 (67.31)
Most affected group (G6pd) deficiency	61 (39.1)	95 (60.9)
Triggers of hemolysis	100 (64.1)	56 (35.9)
Signs and symptoms of G6pd deficiency	134 (85.9)	22 (14.1)
Diagnosis of (G6pd) deficiency	99 (63.46)	57 (36.54)
Dangerous complication of (G6pd) deficiency	96 (61.45)	60 (38.46)
Drugs to avoid in (G6pd) deficiency	118 (75.64)	38 (26.92)
Nurses should suspect G6PD deficiency in infants presenting with	114 (73.08)	42 (26.92)
In management of g6pd crisis, nurses should	68 (43.59)	88 (56.41)
Prevention method of g6pd deficiency	97 (62.18)	59 (37.82)
Screening recommendation in g6pd deficiency	83 (53.21)	73 (46.79)
Role of nurses in G6PD deficiency care	136 (87.18)	20 (12.82)

Table (3): overall Knowledge of Nurses about G6pd deficiency

Poor (0-5)	9	5.8
Fair (6-10)	95	60.9
Good (11-15)	52	33.3

Table (4): Awareness level regarding Triggers of hemolytic crisis in G6pd deficiency patients.

Low awareness (0)	18	11.5
Fair awareness (1)	56	37.2
High awareness (2)	80	51.3
Total	156	100%

Table (5): Attitude of nurses toward G6pd deficiency

Statements	Nurse's Attitude				
	No. N=156 Percent (%)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Caring for G6PD patients requires special nursing attention	6 (3.8)	17 (10.9)	14 (9.0)	88 (56.4)	31 (19.9)
I feel confident in identifying signs of hemolysis in G6PD patients.	10 (6.4)	9 (5.8)	27 (17.3)	71 (45.5)	39 (25.0)
Education of parents about avoiding triggers is an important nursing responsibility.	8 (5.1)	10 (6.4)	13 (8.3)	69 (44.2)	56 (35.9)
Nurses should play an active role in early detection of G6PD deficiency	9 (5.8)	8 (5.1)	20 (12.8)	79 (50.6)	40 (25.6)

Managing G6PD patients is difficult due to lack of knowledge.	7 (4.5)	12 (7.7)	23 (14.7)	69 (44.2)	45 (28.8)
G6PD deficiency is a serious health problem in our community	10 (6.4)	9 (5.8)	25 (16.0)	68 (43.6)	44 (28.2)
Continuous education and training about G6PD deficiency are necessary for nurses	7 (4.5)	5 (3.2)	24 (15.4)	75 (48.1)	45 (28.8)
I feel anxious when assigned to care for a G6PD patient	4 (2.6)	29 (18.6)	14 (9.0)	70 (44.9)	39 (25.0)
I believe nurses can prevent hemolytic crises through proper education	4 (2.6)	6 (3.8)	24 (15.4)	73 (46.8)	49 (31.4)
Hospital policies should include clear guidelines for G6PD patient care	7 (4.5)	5 (3.2)	18 (11.5)	69 (44.2)	57 (36.5)

Table (6): Overall Attitude of nurses toward G6pd deficiency

Negative (10-25)	4	2.5
Neutral (26-37)	47	30,0
Positive (38-50)	105	67.5
Total	156	100%

Table (7): Association between knowledge and socio-demographic data of nurses

Demographic data	Class	Knowledge level No. (%) N=156			*P value
		Poor	Fair	Good	
Age	Less than 25	0 (0.0)	14 (8.97)	6 (3.85)	0.125**
	25-29	3 (1.92)	20 (12.82)	13 (8.33)	
	30-34	2 (1.28)	31 (19.87)	19 (12.18)	
	35-39	4 (2.56)	16 (10.26)	6 (3.85)	
	40 and above	0 (0.0)	14 (8.97)	8 (5.13)	
Gender	Male	5 (3.21)	33 (21.15)	14 (8.97)	0.664**
	Female	4 (2.56)	62 (39.74)	38 (24.36)	
Marital status	Single	3 (1.92)	30 (19.23)	18 (11.54)	<0.001
	Married	4 (2.56)	72 (46.15)	33 (21.15)	
	Divorced	1 (0.64)	3 (1.92)	1 (0.64)	
	Widowed	1 (0.64)	0 (0.0)	0 (0.0)	
Educational level	Nursing diploma	5 (3/21)	58 (37.18)	30 (19.23)	0.811**
	Bachelor's degree	4 (2.56)	35 (22.44)	21 (13.46)	
	Master degree	0 (0.0)	2 (1.28)	1 (0.64)	
Department/unit	Pediatric ward	2 (1.28)	27 (17.31)	14 (8.97)	0.905
	Emergency ward	5 (3.21)	35 (22.44)	15 (9.6)	
	Medical ward	2 (1.28)	25 (16.03)	17 (10.90)	

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	ICU	0 (0.0)	8 (5.13)	6 (3.85)	
Years of clinical experience	<1 year	0 (0.0)	3 (1.92)	2 (1.28)	0.287
	1-3 ears	0 (0.0)	11 (7.05)	9 (5.77)	
	4-6 years	3 (1.92)	25 (16.03)	11 (7.05)	
	7-10 years	4 (2.56)	23 (14.74)	17 (10.9)	
	>10 years	2 (1.29)	33 (21.15)	13 (8.33)	
Have you ever received training course about G6PD deficiency	Yes	7(4.22)	72(49.4)	37(12.29)	
	No	2(1.2)	23(13.86)	15(9.04)	0.436**

* The p value determined using chi-square test

** fisher exact test

Table (8): Association between Attitude and socio-demographic data of nurses

Demographic data	Class	Attitude Level No. (%) n=156			*P value
		Negative	Neutral	Positive	
Age	less than 25	0 (0.0)	13 (8.33)	7 (4.49)	0.134**
	25-29	2 (1.28)	9 (5.77)	25 (16.03)	
	30-34	2 (1.28)	14 (8.97)	36 (23.08)	
	35-39	0 (0.0)	4 (2.56)	22 (14.10)	
	40 and above	0 (0.0)	7 (4.49)	15 (9.62)	
Gender	Male	4 (2.56)	18 (11.54)	30 (19.23)	0.181**
	Female	0 ()	29 (18.59)	75 (48.08)	
Marital status	Single	2 (1.28)	20 (12.82)	29 (18.59)	0.920**
	Married	2 (1.28)	26 (16.67)	71 (45.51)	
	Divorced	0 (0.0)	1 (0.64)	4 (2.56)	
	Widowed	0 (0.0)	0 (0.0)	1 (0.64)	
Educational level	nursing diploma	3 (1.92)	29 (18.59)	61 (39.1)	0.891**
	bachelor's degree	1 (0.64)	18 (11.54)	41 (26.28)	
	Master degree	0 (0.0)	0 (0.0)	3 (1.92)	
Department/unit	Pediatric ward	1 (0.64)	14 (8.97)	28 (17.95)	0.384
	Emergency ward	1 (0.64)	12 (7.69)	42 (26.92)	
	medical ward	2 (2.28)	18 (11.54)	24 (15.38)	
	ICU	0 (0.0)	3 (1.92)	11 (7.05)	
Years of clinical experience	<1 year	0 (0.0)	4 (2.54)	1 (0.64)	0.005**
	1-3 ears	1 (0.64)	9 (5.77)	10 (6.41)	
	4-6 years	2 (1.28)	8 (5.13)	29 (18.95)	

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	7-10 years	0 (0.0)	15 (9.62)	29 (18.59)	
	>10 years	1 (0.64)	11 (7.05)	36 (23.08)	
Have you ever received training or education about G6PD deficiency	Yes	3 (1.92)	28 (17.95)	85 (54.49)	0.073
	No	1 (1.64)	19 (12.18)	20 (12.82)	

* The p value determined using chi-square test

** fisher exact test

Discussion

The results of this study show that the majority of participants were between 30-34 years old (33.8%). Which is shadowed by those aged 25-29 years old (22.44%). These results indicate that most nurses were young and middle of age. This age group is considered a stage of highest activity, in which nurses can provide most during their professional careers. Nurses who are younger have a better chance to have up to date programs related to education and their clinical guidelines. These results are in the same line Al-Hamdan et al. (2024), who say that most of the participants are within the young age group. But this results opposite of Hamad et al. (2023), who found that the majority of participants were in the older age category. Concerning the gender, the majority of the participants were female (66.03%), and whereas male (33.97), this represents that in many countries, females are the dominant of professional nursing. The results are supported by Al Hamdan et al. (2024), who found that the largest number of nurses were females. However, Kahsay and Pitkääjärvi (2019) reported that male nurses constituted the largest number of nurses who were working in a department of emergency. Regarding marital status, more than half of the sample were married (63.46%), and only (32.96%) were single. This indicates that most of nurses are within marriage age range. This result supported by Hamad et al. (2023), who found that majority of their sample were married. Educational levels also show that the majority of nurses had diploma in nursing (59.62%), whereas (38.46) had Bachelors in nursing and only a few samples held master degree in nursing (1.92%). This result reveals that diploma in nursing is the primary requirement among nurses in numerous healthcare institutions. This result disagrees with Al-Hamdan et al. (2024), who found that the majority of nurses held bachelors in nursing. But in the same line with Hamad et al. (2023). who reported that diploma degree in nursing is the primary qualification is required. Moreover, about the distribution of departments, nurses who worked in pediatric wards were reported as the largest proportion of sample (34.62%), and the Neonatal intensive care unit is considered the smallest proportion of sample (8.97%). This result also reflects the fact that emergency department requires more nursing staff because of high number of patients and workload. Comparable findings were stated by Kahsay and Pitkääjärvi (2019), who noted that huge number of staff nurses in emergency care department. With respect to years of clinical experience, the majority of nurses had more than 10 years of clinical practice (30.77%), and (28.21%) those had with 7-10 years. This result show

that most of nurses had professional experience in clinical practice, which heavily impacts the knowledge of nurses. Similar finding reported by Hamad et al. (2023), who noted that high number of participants had longer experience in clinical practice. In contrast, Al-Hamdan et al. (2024) reported that the majority of participants had fewer years in clinical practice. Finally, more than half of the nurses (74.36%) had previous training courses on G6PD deficiency, and only (25.64%) had not attended any. This result positively influences the nursing career. This result also agrees with Mosa (2022) who found that training and educational program significantly progresses the knowledge of nurses and clinical practice.

The Results of this study found that the majority of participants 95 (60.9%) had a Fair level of knowledge about G6PD deficiency, whereas 52(33.3%) had good level of knowledge and only 9 (5.8%) had poor knowledge. This showed that nurses have an adequate knowledge toward G6PD deficiency. But it doesn't mean that nurses do not require training and continuous education programs about the disease. The same conclusions were noted by Shokr and El Kotb (2022) who reported that Most of participants had Fair level of knowledge regarding G6PD deficiency and it focused on the significance of continuous education for enhancing nurses' awareness, furthermore, the study had been conducted in Mina university Hospital which support the current results. In contrast, Abass et al. (2015) study disagree with the findings which has been conducted at Assiut University children hospital, which showed that the participants had not enough knowledge toward G6PD deficiency.

The results revealed that the huge number of nurses 105 (67.5%) had positive attitude toward G6PD deficiency, while 47 (30.0%) had a neutral attitude and only small numbers of participants had negative attitude. This finding show that the nurses had satisfactory perception about management and care of G6PD deficiency patients. Positive attitude of nurses associated to the educational background and clinical experience in Neonatal intensive care unit and pediatric wards, where G6PD deficiency is frequently encountered. The findings are supported by Abass et al. (2015). who reported that nurses held a positive attitude toward caring for children with genetic disorders, early screening and diagnosis and management of neonatal G6PD deficiency. Moreover, the results of study Montgomery et al. (2016), also noted that nurses who working in pediatric wards mostly held positive attitude because of direct contact with G6PD deficiency patients and their education. But Essa et al. (2026), disagree with the findings of the current study he

reported that the majority of nurses held negative attitude toward disorders of blood, which may be related to training programs, population of study or any other reasons. Concerning the occurrence of neutral and negative attitude among some of the nurses, highlights the need for training and educational programs, seminars, workshops to enhance perception of nurses and quality of care.

The study revealed that there was no statistically significant link between knowledge level and age, gender, educational level, years of clinical experience, training course, department or unit ($P>0.05$). Nevertheless, Marital status showed that a significant association with level of knowledge ($P<0.001$). similar finding reported by Mosa (2022) and Shash et al., (2023), which noted that there was no significant association between age, gender, marital status, education level and knowledge level among nurses. In contrast, the current results disagree with the study of Abass et al., (2015) which found that a statistically significant among nurses' knowledge and their demographic variables like years of experience and educational level. Furthermore, study of Shokr and Elkotb (2022) revealed that level of education had highly significant association with knowledge of nurses about safe and unsafe medications for treatment of G6PD deficiency. The presence of significant association between knowledge and marital status of current study may be related to exposure of family health experiences and social responsibility among nurses who are married. This indicate that awareness may be enhanced concerning genetic disorders such as G6PD deficiency. The findings of current study showed that demographic characteristics like age, gender, level of education, marital status, department of hospital and training course had no statistically significant association with attitude of participants. But it only revealed that years of clinical practice had a significant association with attitude of nurses. This result agrees with Abass et al., (2015) which reported that majority of nurses had positive attitude and there was no significant association with demographic variables. In contrast, the current study disagrees with the result of Shokr and Elkotb, (2022) who mentioned that training course and level of education statistically significant with attitude of nurses toward G6PD deficiency. In the same line Rekiesso et al (2022). noted that nurses who had advanced qualification and longer years of experience had a statistically significant correlation with attitude towards the disease.

Conclusions

This study concluded that the majority of participants overall had Fair level of knowledge on D6PD deficiency. So, regarding attitude of nurses toward the disease, the study revealed that Most of nurses held a positive attitude toward G6PD deficiency. Moreover, some of demographic variable for example (marital status, years of experience,) had a significant association with knowledge and attitude of participants.

Recommendations

Based on the results of this study the researcher recommends the following points:

1. provide a regular training and educational program for nurses regarding G6PD deficiency to improve knowledge of nurses and prevention of the disease.
2. Ministry of health should give special consideration to offer educational material like posters, brochures to raise awareness about safe medications and food for G6PD deficiency patients.
3. Standardized protocols should be created by healthcare institutions for the care of G6PD deficiency patients and management to improve the best quality of care.
4. Curriculum of nursing should be updated and should include theoretical and practical information about the nature of G6PD deficiency and how to manage cases.
5. Further studies with larger samples are recommended regarding G6PD deficiency to improve generalizability of findings related to knowledge and attitude of nurses.
6. Continuous educational program regarding G6PD deficiency should be supported by healthcare and hospitals.

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