

Evaluating Malaysian Government Primary Healthcare Workers Knowledge, Attitude and Practice in Managing Iron Deficiency Anaemia During Pregnancy

ABSTRACT

Introduction: Management of iron deficiency anaemia (IDA) in pregnancy remainssuboptimal. This study aimed to develop a tool and determine the knowledge, attitude, and practice (KAP) of primary healthcare providers and its associated factors using a newly developed validated questionnaire.

Methodology: A validation study was conducted among 159 Perak government primary healthcare doctors and nurses. Cronbach's alpha, factor analysis, face validation and test-retest were performed. Subsequently, a cross-sectional study was conducted among 435 doctors and nurses in Selangor, Johor, and Terengganu from October to December 2023. Association between socio-demographics, clinical experience, organizational support, and attitude with the knowledge and practices were analyzed using logistic regression.

Results: The final Health Care Providers Knowledge, Attitude and Practice-Iron Deficiency Anaemia(HCPKAP-IDA) questionnaires had 28 items. A good internal consistency was observed; Cronbach's alpha (0.781-0.859), factor loading; attitude (0.490-0.811), and practice (0.444-0.841). Using HCPKAP-IDA, poor knowledge (38.9%), attitude (46.9%), and practice (43%) scores were shown. The significant factors associated with the poor practice were female (OR=0.39, 95% CI 0.15- 0.99, p=0.049), had IDA (OR=0.74, 95% CI 1.34- 1.58, p=0.043), experienced anaemic symptoms (OR=0.71, 95% CI 1.36- 1.40, p=0.032), took iron supplement (OR=0.62, 95% CI 1.70- 2.87, p=0.033), received training (OR=0.29, 95% CI 0.11- 0.74, p=0.010), availability of parenteral iron (OR=0.74, 95% CI 1.03- 1.28, p=0.027) and good attitude (OR=0.40, 95% CI 2.62- 6.01, p=0.001). The significant factors associated with poor knowledge were community nurses (OR=15.49, 95% CI 6.46- 37.11, p<0.001), staff nurses (OR=7.74, 95% CI 3.45- 17.39, p<0.001), and availability of guidelines (OR=0.18, 95% CI 0.05- 0.69, p=0.012).

Conclusion: Improving the knowledge of primary healthcare providers through training and the availability of parenteral iron in all primary care clinics nationwide should be advocated. A national guideline that incorporates quick algorithms and checklists should be considered.

Keywords: knowledge, attitude, practice, anaemia, pregnancy, primary healthcare

1. INTRODUCTION

Anaemia is a major public health problem. In 2019, the prevalence of anaemia in pregnancy worldwide was reported as 37% (32 million) while in Southeast Asia, the prevalence was 48% mainly attributed to low- and middle-income countries' status.(1,2)The most common cause of anaemia in pregnancy in low and middle income countries was iron deficiency

18 anaemia.(3) Anaemia in pregnancy leads to maternal morbidity, impaired quality of life,
19 needing blood transfusions, post-partum haemorrhage, and maternal
20 mortality.(3) Anaemia also poses adverse fetal outcomes such as preterm birth, small for
21 gestational age, and perinatal death.(3)

22 World Health Organization (WHO) defines anaemia in pregnancy as the haemoglobin (Hb)
23 concentration of less than 11 g/dl.(2) A low transferrin saturation (<16%) is indicative of iron
24 deficiency and can be used in the diagnosis of iron deficiency in conditions where iron
25 deficiency is suspected, with normal serum ferritin levels.(4) However in conditions where
26 serum ferritin is low (<30 ng/mL), no other laboratory testing may be necessary to diagnose
27 IDA.(5)

28 In Malaysia, the management of iron deficiency anaemia in pregnancy is based on the
29 National Perinatal Care Manual with individualized management plan based on the severity
30 of anaemia.(6) Severity of iron deficiency anaemia is subdivided ranging from severe
31 (Haemoglobin <7 g/dl), moderate (Haemoglobin 7.0-9.9 g/dl), to mild anaemia (Haemoglobin
32 10.0-10.9 g/dl).(6) Guidelines recommend intermittent or daily iron and folic acid
33 supplementation as a primary prevention to improve iron status and reduce the risk of
34 anaemia in women of reproductive age, depending on pregnancy and postpartum status,
35 menstruation, population-level prevalence, and the diagnosis of chronic disease or
36 infection.(6) The first-line treatment is oral iron with doses of oral elemental iron of 100–200
37 mg daily for the management of established IDA in pregnancy.(5) For patients with iron
38 deficiency anaemia who cannot tolerate, cannot absorb, or do not respond to oral iron,
39 parenteral iron therapy is preferred in the third trimester and sometimes as early as the
40 second trimester.(7) It serves as a valuable second-line therapy in correcting anaemia and
41 replenishing iron stores.(7) It provides more rapid Hb correction and reduces the need for
42 blood transfusions in late pregnancy and peripartum.(7) Parenteral iron therapy may provide
43 a safer alternative to blood transfusion in treating anaemia.(8)

44

45 The National Health and Morbidity Survey (NHMS) 2019, showed a prevalence of anaemia
46 among women of the reproductive age group aged 15 to 49 years old in Malaysia was
47 29.9% whilst moderate and severe anaemia comprised 14.0%.(8) In terms of ethnicity,
48 Malaysian Indian pregnant women were at higher risk of iron deficiency anaemia.(9) A
49 systematic review in 2022 of literatures of studies done in Malaysia on anaemia that the
50 overall prevalence of anaemia in pregnancy ranged from 19.3% to 57.4%, while the
51 prevalence of iron deficiency anaemia among pregnant women ranged from 25.9% to
52 34.6%.(9–11) This high prevalence of iron deficiency anaemia among pregnant women
53 renders a need to further scrutinize contributory factors from both the patient and healthcare
54 workers' aspects with contribute to the prevalence of anaemia.(9–11) Existing data mainly
55 focus on the factors from the patient's perspective and there is a dearth of evidence from the
56 healthcare workers' aspect.(9–11)

57 Currently, there is no validated and unified questionnaire to assess the knowledge, attitude
58 and practices (KAP) of primary healthcare doctors and nurses on the management of iron
59 deficiency anaemia among pregnant women attending government primary healthcare
60 clinics in Malaysia. A KAP measured through a structured, standardized questionnaire,
61 would be able to identify the gaps and assist in intervention.(5) Therefore, the present study
62 was done to evaluate the knowledge, attitude and practices among doctors and nurses in
63 management of IDA among pregnant mother in routine clinical practice at government
64 healthcare clinic reflecting a real-life scenario in Malaysia.

65

66 **2.METHODS**

67

68 A cross-sectional study was conducted from October to December 2023 in 28 public primary
69 healthcare clinics providing antenatal care services in the districts of Kuala Langat, Gombak
70 and Klang in the state of Selangor, districts of Johor Bahru, Pontian and Batu Pahat in the
71 state of Johor and district of Setiu in the state of Terengganu. All public primary care doctors

72 and nurses were included in the study. Those working in administration, on long leave of
73 more than a month, less than a month of service and housemen were excluded.

74 Participants were given an online self-administered anonymous questionnaire to ensure
75 confidentiality and mitigate response bias. There were five sections in the questionnaire, i)
76 section one examined the socio-demographic characteristics of the participants: age,
77 gender, years of service, occupation, ii) section two examined the personal experience of
78 participants with IDA, having haemoglobin checked, ferritin checked, diagnosed with IDA,
79 experienced anaemic symptoms, took the iron supplement or received parenteral iron. iii)
80 the third section examined the clinical experience of the participants: cases of IDA seen in a
81 week, performed clinical audits, and confidence in managing IDA. iv) section four examined
82 the organizational support: training, availability of guidelines and parenteral iron at individual
83 clinics. iv) the fifth and last section examined the knowledge, attitude and practices on the
84 management of IDA in pregnancy.

85 A validated questionnaire to assess the knowledge attitude and practice among primary care
86 providers on the management of iron deficiency anaemia in pregnant women (HCPKAP-IDA)
87 was made available in English and Bahasa Melayu language. (Refer Appendix) The Bahasa
88 Melayu option was made available as it is the official national language in Malaysia and to
89 facilitate administration among nursing staff who are usually more fluent in Bahasa Melayu.
90 There was a total of 28 items: 13 items in the knowledge domain, 9 items in the attitude
91 domain, and 6 items in the practice domain. In the knowledge domain by the single-based
92 answer, a score is given for the correct option and a score for the incorrect option. In the
93 attitude domain, the scores were measured using a five-point Linkert scale with responses
94 ranging from “1=strongly disagree”, “2=disagree”, “3=neutral”, “4=agree”, and “5=strongly
95 agree” while in the practice domain: “1=never practised”, “2=rarely practised”,
96 “3=occasionally practised”, “4=frequently practised”, and “5=very frequently practised”. The
97 factor analysis in the attitude and practice domains had a high value of Kaiser-Meyer-Olkin
98 measure of sampling adequacy (0.877) and highly significant Bartlett’s Test of Sphericity (<

99 0.001). In the attitude domain, the factor loading value ranged from 0.490-0.811 and
100 Cronbach's alpha was 0.722 while in the practice domain, the factor loading value ranged
101 from 0.444-0.841 and Cronbach's alpha was 0.845.

102 **DATA ANALYSIS**

103 The data was collected using the IBM SPSS statistic version 26.0. There were two outcomes
104 in this study: the level of knowledge and practice of primary healthcare doctors and nurses
105 on the management of IDA among pregnant women attending government primary
106 healthcare clinics. The median score of these outcome variables was reported as the data
107 was not normally distributed. The knowledge, attitude and practice were reclassified into two
108 groups, the good group for those who scored equal to or higher than the median score and
109 the poor group for those who scored less than the median score.

110 To examine the associated factors with the knowledge and practice of primary healthcare
111 doctors and nurses on the management of IDA among pregnant women attending
112 government primary healthcare clinics, the Pearson Chi-Square/Fisher exact test was used
113 for bivariate analysis and multiple logistic regression was used for multivariate analysis.
114 From the bivariate analysis, factors with p-values equal to or less than 0.25 were included in
115 the multiple logistic regression.

116 Testing for multicollinearity and assumption was also carried out before multiple logistic
117 regression analysis. Testing for multicollinearity of the independent variables was carried out
118 by examining the variance inflation factor (VIF). There was no multicollinearity detected and
119 the VIF ranged from 1.00 to 2.29. The tolerance level of 0.1 (=VIF 10) was used. The
120 statistical significance in the final model was accepted at p-values equal to or less than 0.05.
121 The model fitness was assessed using the Goodness-of-fit and Hosmer-Lemeshow
122 goodness-of-fit tests. The analysis with the Hosmer-Lemeshow test showed a p-value of
123 more than 0.05, indicating an adequate model fit.

124

125 3. RESULTS AND DISCUSSION

126

127 RESULTS

128 The response rate was 96.7% (435/450). Most of the participants (37.3%) were aged more
129 than 40 years, (94.3%) were female, (47.1%) had more than 10 years of service and (38.9%)
130 were community nurses. The majority (97.7%) had self haemoglobin checked. However,
131 more than half (66.4%) did not have their serum ferritin checked, (84.4%) did not have IDA,
132 (81.1%) never experienced anaemic symptoms, (76.3%) did not take iron supplements and
133 (97.7%) did not receive parenteral iron. Looking into their clinical experience, most of the
134 participants (54.5%) reported seeing less than 5 cases of IDA in a week, (70.3%) performed
135 clinical audits and (64.8%) were fairly confident in managing IDA in pregnancy. The majority
136 (93.6%) received training, (54.5%) of training was by continuous medical education, (96.6%)
137 reported availability of guidelines and (82.1%) parenteral iron. (Refer Table 1)

138 **Table 1:** Sociodemographic characteristics, clinical experience and availability of
139 organisational support in the management of IDA in pregnancy of primary healthcare
140 providers

	N (435)	%
Sociodemographic characteristics:		
Age		
< 30 years	122	28.0
30-40 years	151	34.7
> 40 years	162	37.3
Gender		
Male	25	5.7
Female	410	94.3
Years of service		
< 5 years	84	19.3
5-10 years	146	33.6
>10 years	205	47.1
Occupation		
Community nurse	169	38.9
Staff nurse	126	29.0
Doctors	140	32.1
Self-reported		

Had self-Haemoglobin level checked		
No	10	2.3
Yes	425	97.7
Had self-serum ferritin checked		
No	289	66.4
Yes	146	33.6
Had iron deficiency anaemia		
No	367	84.4
Yes	68	15.6
Experienced anaemic symptoms		
No	353	81.1
Yes	82	18.9
Took iron supplement		
No	332	76.3
Yes	103	23.7
Received parenteral iron		
No	425	97.7
Yes	10	2.3
Clinical experience:		
Number of anaemia in pregnancy cases seen in a week		
< 5 cases	237	54.5
5-10 cases	131	30.1
>10 cases	67	15.4
Performed clinical audit		
No	129	29.7
Yes	306	70.3
Confidence in managing IDA in pregnancy		
Not	7	1.6
Slightly	22	5.1
Somewhat	62	14.3
Fairly	282	64.8
Completely	62	14.2
Organisational support:		
Received training		
No	28	6.4
Yes	407	93.6
Training received		
Medical or nursing school	30	6.9
Post-basic training	15	3.4
Continuous medical education	237	54.5
Workshop or course	128	29.4
Others	25	5.8
Availability of guidelines		
No	15	3.4
Yes	420	96.6
Availability of parenteral iron		
No	78	17.9
Yes	357	82.1

141

142 The median score for knowledge was 54, attitude was 96 and practice was 93 respectively.

143

More than a quarter (38.9%) of the participants had poor knowledge scores. Almost half

144 (46.9%) of the participants had poor attitudes and (43%) had poor practice scores. (Refer
 145 Table 2)

146 **Table 2:** Descriptive statistics of primary healthcare providers knowledge (K), attitude (A)
 147 and practice (P) in the management of IDA in pregnancy

Variables	Median	Min	Max	N (435)	%
Knowledge score					
Overall	54	38	69		
Poor (<54)				169	38.9
Good (≥54)				266	61.1
Attitude score					
Overall	96	89	100		
Poor (<96)				204	46.9
Good (≥96)				231	53.1
Practice score					
Overall	93	87	100		
Poor (<93)				187	43.0
Good (≥93)				248	57.0

148
 149 Seven factors: (1) female gender (2) had IDA (3) experienced anaemic symptoms
 150 (4) took iron supplements (5) training (6) availability of parenteral iron (7) attitude
 151 were statistically associated with the poor practice in the management of IDA in
 152 pregnancy. (Refer Table 3). Female gender was 61% less likely to have poor
 153 practice (OR=0.39, 95% CI 0.15- 0.99, p=0.049) compared to male. Those who had
 154 IDA were 26% less likely to have poor practice (OR=0.74, 95% CI 1.34- 1.58,
 155 p=0.043) compared to those who did not have IDA while those who experienced
 156 anaemic symptoms were 29% less likely to have poor practice (OR=0.71, 95% CI
 157 1.36- 1.40, p=0.032) compared to those who did not experience anaemic
 158 symptoms. Those who took iron supplements were 38% less likely to have poor
 159 practice (OR=0.62, 95% CI 1.70- 2.87, p=0.033) compared to those who were not
 160 on supplements. Doctors and nurses who received training were 71% less likely to
 161 have poor practice (OR=0.29, 95% CI 0.11- 0.74, p=0.010) compared to those who
 162 did not receive training while those who reported availability of parenteral iron were

163 26% less likely to have poor practice (OR=0.74, 95% CI 1.03- 1.28, p=0.027)
 164 compared to those without the availability of parenteral iron. Doctors and nurses
 165 with good attitude scores were 60% less likely to have poor practice (OR=0.40, 95%
 166 CI 2.62- 6.01, p=0.001) compared to those with poor attitude scores.

167 **Table 3:** Binary logistic regression: Independent factors influencing the poor practice (P) in
 168 the management of IDA in pregnancy among primary healthcare providers

	Preliminary model Simple Logistic Regression				Final model Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
		Lower	Upper			Lower	Upper	
Sociodemographic characteristics:								
Age								
< 30 years	1.00							
30-40 years	0.98	0.61	1.58	0.948				
> 40 years	0.92	0.59	1.44	0.707				
Gender								
Male	1.00				1.00			
Female	0.57	0.25	1.29	0.181	0.39	0.15	0.99	0.049
Years of service								
< 5 years	1.00				1.00			
5-10 years	0.67	0.39	1.16	0.150	0.64	0.34	1.20	0.163
>10 years	0.81	0.48	1.34	0.805	0.87	0.42	1.77	0.695
Occupation								
Doctors	1.00				1.00			
Staff nurse	1.50	0.92	2.44	0.102	1.75	0.93	3.29	0.085
Community nurse	1.01	0.64	1.60	0.966	1.24	0.63	2.45	0.534
Self-reported								
Had self Haemoglobin level checked								
No	1.00							
Yes	0.75	0.65	0.75	0.640				
Had self-serum ferritin checked								
No	1.00				1.00			
Yes	0.93	0.62	0.89	0.030	0.90	0.56	1.45	0.066
Had iron deficiency anaemia								
No	1.00				1.00			
Yes	0.85	1.05	1.44	0.014	0.74	1.34	1.58	0.043
Experienced anaemic symptoms								
No	1.00				1.00			
Yes	0.93	1.07	1.51	0.013	0.71	1.36	1.40	0.032

Took iron supplement									
No	1.00					1.00			
Yes	0.75	1.02	1.62	0.009		0.62	1.70	2.87	0.033
Received parenteral iron									
No	1.00					1.00			
Yes	0.75	1.38	4.68	0.033		1.33	0.31	5.82	0.070
Clinical experience: Number of anaemia in pregnancy cases seen in a week									
< 5 cases	1.00								
5-10 cases	0.93	0.60	1.43	0.725					
>10 cases	0.92	0.53	1.59	0.761					
Performed clinical audit									
No	1.00								
Yes	0.89	0.59	1.35	0.590					
Confidence in managing IDA in pregnancy									
Not	1.00					1.00			
Slightly	3.38	0.53	21.42	0.197		3.86	0.49	30.21	0.198
Somewhat	0.62	0.13	2.99	0.550		0.70	0.12	4.16	0.693
Fairly	0.50	0.11	2.28	0.372		0.62	0.11	3.52	0.593
Completely	0.47	0.47	2.30	0.355		0.76	0.13	4.55	0.757
Organisational support: Received training									
No	1.00					1.00			
Yes	0.23	0.10	0.55	0.001		0.29	0.11	0.74	0.010
Training received									
Medical or nursing school	1.00								
Post-basic training	0.87	0.25	3.08	0.831					
Continuous medical education	1.01	0.47	2.16	1.005					
Workshop or course	0.73	0.33	1.65	0.734					
Others	4.14	1.29	13.31	4.141					
Availability of guidelines									
No	1.00								
Yes	0.86	0.31	2.41	0.770					
Availability of parenteral iron									
No	1.00					1.00			
Yes	0.59	0.36	0.96	0.034		0.74	1.03	1.28	0.027
Knowledge score									
Poor (<54)	1.00					1.00			
Good (≥54)	0.65	0.98	2.13	0.064		0.93	0.91	2.14	0.098
Attitude score									
Poor (<96)	1.00					1.00			

Good (≥96)	0.40	2.65	5.92	<0.001	0.40	2.62	6.01	<0.001
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169 ¶¶p-value <0.05

170 *COR crude odds ratio

171 *AOR adjusted odds ratio

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173 Two factors: (1) occupation (staff and community nurse) and (2) availability of guidelines
 174 were statistically associated with poor knowledge in the management of IDA in pregnancy.
 175 (Refer Table 4). Community nurses had 15.49 times higher odds of poor knowledge
 176 (OR=15.49, 95% CI 6.46- 37.11, p<0.001) while staff nurses had 7.74 times higher odds of
 177 poor knowledge (OR=7.74, 95% CI 3.45- 17.39, p<0.001) compared to doctors. Those who
 178 reported the availability of guidelines were 82% less likely to have poor knowledge
 179 (OR=0.18, 95% CI 0.05- 0.69, p=0.012) compared to those without the availability of
 180 guidelines.

181 **Table 4:** Binary logistic regression: Independent factors influencing the poor knowledge (K)
 182 in the management of IDA in pregnancy among primary healthcare providers

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
	Lower	Upper			Lower	Upper		
Sociodemographic characteristics:								
Age								
< 30 years	1.00							
30-40 years	0.98	0.61	1.58	0.948				
> 40 years	0.92	0.59	1.44	0.707				
Gender								
Male	1.00				1.00			
Female	4.99	1.47	16.94	0.010	1.19	0.28	4.98	0.817
Years of service								
< 5 years	1.00				1.00			
5-10 years	1.65	0.92	2.96	0.093	1.24	0.61	2.50	0.557
>10 years	2.08	1.19	3.61	0.010	0.71	0.35	1.46	0.353
Occupation								
Doctor	1.00				1.00			
Staff nurse	6.20	3.31	11.62	< 0.001	7.74	3.45	17.39	< 0.001
Community nurse	10.44	5.71	19.09	< 0.001	15.49	6.46	37.11	< 0.001
Self-reported								
Had self Haemoglobin level checked								
No	1.00							

guidelines								
No	1.00				1.00			
Yes	0.41	0.14	1.17	0.097	0.18	0.05	0.69	0.012
Availability of parenteral iron								
No	1.00							
Yes	1.25	0.75	2.08	0.398				
Attitude score								
Poor (<96)	1.00				1.00			
Good (≥96)	0.41	0.95	2.07	0.085	0.50	0.81	2.08	0.281
Practice score								
Poor (<93)	1.00				1.00			
Good (≥93)	0.45	0.98	2.13	0.064	0.48	0.92	2.40	0.107

183 ††p-value <0.05

184 *COR crude odds ratio

185 *AOR adjusted odds ratio

186

187 DISCUSSION

188 Our findings show healthcare providers (HCPs) managing Iron Deficiency Anaemia (IDA) in
 189 pregnancy still have suboptimal knowledge, attitude, and practice scores despite training
 190 and local guidelines. Notably, community nurses, demonstrated the lowest knowledge
 191 scores, indicating a knowledge gap. Female HCPs with personal experience of IDA, positive
 192 attitudes, training, and access to parenteral iron were associated with optimal management
 193 practices.

194 Adherence to oral haematinics among pregnant women is integral in preventing and treating
 195 IDA in pregnancy.(1–4) Studies show that poor knowledge of IDA among pregnant women
 196 results in non-adherence to oral haematinics and highlight the importance of increasing
 197 knowledge among these groups.(1–4)Doctors and nurses play an important role not only in
 198 diagnosing and managing IDA but are also directly involved in providing health education
 199 and increasing awareness of IDA among pregnant mothers. Findings from this study show a
 200 median knowledge score of 54% highlighting that knowledge among HCPs in this study
 201 remains suboptimal which could lead to suboptimal knowledge transfer during consultation.
 202 Similar findings of suboptimal knowledge were also found among Obstetricians and
 203 gynaecologists in India and HCPs in rural India in managing pregnant women with
 204 anaemia.(4,10)

205 Our findings show that knowledge alone does not affect HCPs' attitudes and practice in
206 managing IDA. We found that 19% of HCPs in this study had experienced symptoms of
207 anaemia and 31% received treatment for IDA(oral or parental). HCPs' personal experience
208 with IDA could have contributed to the good knowledge, attitude, and practice in the
209 management of IDA. The same findings were seen among nurses in Australia who reported
210 personal experience of symptoms of anaemia and showed good knowledge in identifying
211 symptoms of anaemia among patients.(8)Future studies should explore how HCPs' personal
212 experience influenced their management and relationship with patients with IDA and if it was
213 a motivator to improve their knowledge, attitude, and practice.

214 Training of HCPs on the management of IDA plays a significant role in ensuring good
215 knowledge attitude and practice as evidenced by our results. Most CME and workshops
216 conducted are aimed at increasing knowledge of HCPs rather than empowering them with
217 skills to address local barriers to diet or treatment adherence. Evidence shows that HCPs
218 often need training to improve their consultation skills and clinical skills as well as engaging
219 family members in antenatal care compounded with regular supervision can improve
220 medication adherence among pregnant women with IDA.(11) The training of dedicated
221 nurses to act as anaemia counsellors or champions should be considered. Their role would
222 involve not only increasing community awareness about IDA during pregnancy but also
223 providing consultations, especially in cases where non-adherence to recommended
224 treatments poses a challenge.

225 Another key finding is that the availability of guidelines ensures good knowledge and
226 practice among HCPs. Existing guidelines in Malaysia are based on recommendations made
227 in the Perinatal care manual or management protocols developed by individual healthcare
228 clinics or hospital.(6) The availability of a National Clinical practice guideline (CPG) or toolkit
229 could further improve the knowledge and practices of HCPs.(6) However it is important to
230 ensure that the newly developed CPG or toolkit be user friendly especially to nurses with
231 clear and simplified algorithms on screening and treatment of IDA.(12) The newly developed

232 CPG and toolkit should also provide detailed guide on screening, testing , treatment
233 escalation and the usage of parenteral iron to reduce the prevalence of IDA in
234 pregnancy.(13)The CPG should consider the racial, ethnical, socioeconomic factors of
235 patients as well as resources and cost prior to implementation.(14)

236 Our study is the first to assess the management practices of IDA in pregnancy among HCPs.
237 HCPs play an important role in managing patients with IDA in pregnancy and identification of
238 gaps in practices can guide further quality improvement interventions.(15,16)We also has
239 acceptable response rate for an online survey.(17)

240 Our findings should be considered with some limitations. This study mainly focused on
241 HCPs in public primary healthcare clinics, however cases of IDA in pregnancy are also
242 managed by private HCPs and public hospital which were not explored in this study. Being
243 an online survey there is the possibility that participants could have looked for the answers
244 online, we attempted to reduce this possibility in our study design by allowing anonymous
245 and no time restriction in completion of the questionnaire.

246 Our study has important policy implications as it shows that knowledge of nurses and
247 community nurses still remain suboptimal despite existence of guideline and training.
248 Policymakers should consider training workshops that identify areas of knowledge gap and
249 increase confidence of nurses in management of IDA. A National strategy in managing IDA
250 in pregnancy is needed encompassing strategies pre conception, during antenatal care and
251 the post-partum care.

252

253 **4. CONCLUSION**

254

255 This study highlights that training, guidelines, and personal experiences contribute to optimal
256 management practices of IDA among HCPs. The importance of tailored training for nurses,
257 the availability of parenteral iron, and the development of a comprehensive national
258 guidelines are crucial steps toward improving the overall care for pregnant women with IDA.

259

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261

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265

266 **COMPETING INTERESTS**

267

268 The authors declare that they have no conflicts of interest

269

270 **AUTHORS' CONTRIBUTIONS**

271 BJNL and MA were involved in the study conceptualization. All authors drafted the
272 manuscript, involved with data collection, manuscript editing, and revisions. All authors
273 approved the final version

274

275 **ETHICAL APPROVAL**

276 This study obtained ethical approval from the Medical Research Ethics Committee of
277 Malaysia (RSCH ID-23-00527-9LD) and followed current regulations on the protection of
278 personal data.

279

280 Consent

281 As per international standards or university standards, respondents' written consent has
282 been collected and preserved by the author(s).

283

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344

345 **APPENDIX**

346

347 **Table 5:** Exploratory factor analysis (EFA) and reliability analysis for the attitude and practice
 348 domain in the management of iron deficiency anaemia among pregnant women attending
 349 primary healthcare clinics.

Items	EFA Retest	Cronbach's alpha	Test-
	Factor loading	p-value	p-value
Attitude domain			
A1. It is important to recognise and treat iron deficiency anaemia early among	0.497	0.722 p= <0.001	0.565 p= <0.001

pregnant women to improve maternal and foetal outcome			
A2. It is important to counsel pregnant women to increase their consumption of iron-rich food and food rich in vitamin C throughout their pregnancy.	0.706		
A3. Prescribing haematinics in pregnant women with Hb > 11g/dl is necessary in pregnancy to prevent iron deficiency anaemia	0.673		
A4. Assessing and counselling pregnant women's adherence to iron supplements during each antenatal visit will aid in improving their compliance with treatment and follow-ups	0.811		
A5. Assessing pregnant women's iron supplement tolerability profile is of comparative importance to its efficacy, as it largely determines adherence to treatment and ultimately treatment success or failure in iron deficiency anaemia	0.792		
A6. Oral iron preparations should be changed if there is no increment in haemoglobin level after assessing adherence, time and way of iron supplement intake.	0.673		
A7. Parenteral iron should be offered and given to the patient with iron deficiency anaemia who does not achieve the haemoglobin increment of ≥ 1.0 g/dL in 14 days after assessing adherence to the iron supplement.	0.539		
A8. Providing postnatal haematinics in pregnant women with anaemia is an important step to reduce the incidence of iron deficiency anaemia in future	0.490		
A9. Healthcare providers play an important role in the management of pregnant women with iron deficiency anaemia.	0.744		
Practice domain			
P1. I prescribe haematinics to my pregnant patients even if their Hb > 11g/dl to prevent IDA.	0.663	0.845 p= <0.001	0.732 p= <0.001
P2. During every antenatal visit, I ask for adherence and counsel my pregnant patients on iron supplementation.	0.741		
P3. During every antenatal visit, I reinforce the importance of correct dosage, frequency and timing of iron supplementation to my pregnant patients.	0.841		

P4. During every antenatal visit, I provide information and advice on the importance of increasing the amount and frequency of iron-rich and vitamin C-rich diets to my pregnant patients.	0.762
P5. In pregnant patients with Hb < 11g/dl, I immediately order serum peripheral blood film and ferritin.	0.440
P6. In pregnant patients with good adherence and tolerability but with no increment of Hb of more than 1.0 g/dl after 2 weeks, I discuss the cases with medical officers/family medicine specialists for treatment escalation.	0.547
P7. I provide pregnant women with IDA 3 months of haematinics during their post-natal period	0.293

350

351 **Table 6:** Components of the knowledge domain in the management of iron deficiency

352 anaemia among pregnant women attending primary healthcare clinics

Items		Test-retest p= value
Knowledge domain		
K1 What is the level of haemoglobin in a pregnant mother that is defined as anaemia of moderate severity according to the Malaysian Perinatal Care Manual?	A) 10.9 – 12.0 g/dl B) 10.0 – 10.9 g/dl C) 7.0 – 9.9 g/dl D) 6.0 – 6.9 g/dl E) 8.0 -11.0 g/dl	0.339 p= 0.031
K2 What is the most common cause of anaemia among pregnant women?	A) Iron deficiency anaemia B) Anaemia of chronic disease C) Beta Thalassaemia D) Folate or/and vitamin B12 deficiency E) Alpha Thalassaemia	
K3 Which of the following are common clinical scenarios for pregnant women who are at risk of iron deficiency anaemia? 1. Gravida 4 Para 3 late booking at 15 weeks, with her last childbirth one year ago. 2. A Primigravida of the aboriginal community attending your clinic at 20 weeks pregnancy who often walks barefoot in her village. 3. Gravida 2 Para 1 with a BMI of 42, comes for booking at 9 weeks 4. Gravida 8 Para 7 with a history of low Haemoglobin in the past 4 pregnancies with	A) 1, 2, 4, 5 B) 1, 2, 3, 4 C) 2, 3, 4 D) 1, 2, 3 E) 3, 4, 5	

no history of blood transfusion.

5. A 16-year-old Indian single unmarried girl who is seen at 18 weeks pregnancy.

K4 The symptoms of anaemia include the following:
(1) fatigue (2) weakness (3) shortness of breath (4) dizziness (5) chest pain

A) All of the above
B) 1, 2, 3, 4
C) 2, 3, 4
D) 1, 2, 3
E) 3, 4

K5 Which of the following clinical signs may be present in a pregnant woman with iron deficiency anaemia?
(1) pallor (2) coarseness of hair (3) nail defects (4) tachycardia (5) angular stomatitis

A) All of the above
B) 1, 2, 3, 4
C) 2, 3, 4
D) 1, 2, 3
E) 3, 4

K6 A primigravidae at 11 weeks of gestation presented with Hb < 11.0g dl MCH 26 and MCV 70. What are the initial bloods to be ordered?

A) Peripheral blood film
B) Serum ferritin
C) Hb electrophoresis and peripheral blood film
D) Serum ferritin and Hb electrophoresis
E) Serum ferritin and peripheral blood film

K7 A primigravidae at 11 weeks of gestation presented with Hb < 11.0g dl MCH 26 and MCV 70. Her initial bloods done showed serum ferritin of 28 mcg/L, and iron deficiency anaemia on peripheral blood film. She was initiated on T. Ferrous sulfate I/I OD. What is the expected level of haemoglobin increment?

A) ≥ 0.5 g/dL in 14 days
B) ≥ 1.0 g/dL in 14 days
C) ≥ 1.5 g/dL in 14 days
D) ≥ 2.0 g/dL in 14 days
E) ≥ 2.5 g/dL in 14 days

K8 Which of the following foods is NOT recommended for an iron-rich diet?

A) Green leafy vegetable
B) Egg yolk
C) Bean curd
D) Chicken thigh and breast
E) Sardine

K9 Various iron combinations and their dosage are shown in the table below, pick the correct treatment dose of elemental iron for iron deficiency anaemia.

A) All of the above
B) 1,3,4,5,6
C) 2,3,4,5,6
D) 2,3,4,5,
E) 4,5,6

Iron preparation	Elemental iron
1. Ferrous fumarate	30 mg
2. Ferrous gluconate	30 mg
3. Ferrous Fumarate	60 mg
4. Ferrous fumarate	115 mg
5. Ferrous sulphate	105 mg
6. Iron polymaltose	100 mg

K10 The common side effect of iron preparation includes 1) nausea and vomiting 2) blackish stool 3) constipation 4) heartburn 5) Dizziness

A) All of the above
B) 1,2,3
C) 1,2,3,4
D) 2,3,4,5
E) 2,3,4

K11 Factors that reduce iron absorption

A) All of the above

include 1) Antacids 2) calcium supplementation 3) Milk and cheese 4) Tea 5) Lime juice	B)1,2,3,4 C)1,2,3,5 D)2,3,4 E)1,2,3
K12 Intravenous iron can be administered in the following conditions; 1) Oral iron is not tolerated 2) Not adherent to oral iron 3) <1g/dL increment of haemoglobin in 2 weeks 4) <2g/dL increment of haemoglobin in 4 weeks 5) First trimester of pregnancy	A) All of the above B) 1, 2, 3, 4 C) 2, 3, 4 D) 1, 2, 3 E) 3, 4, 5
K13 In the postnatal period, pregnant women with IDA should be provided the following care 1) contraception advice 2) iron supplementation for 4 weeks 3) iron supplementation for 6 weeks 4) iron supplementation for 2 months 5) iron supplementation for 3 months 6) high iron diet with no haematinics	A)1,2 B)1,3 C)1,4 D)1,5 E)1,6

353