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Health Worker Perspectives on the Screening and Management of Hypertensive Disorders and Diabetes in Pregnancy in Uganda: A Cross-Sectional Survey

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Abstract

Background

Hypertensive disorders of pregnancy (HDP) and diabetes in pregnancy (DIP) are leading contributors to maternal and perinatal morbidity and mortality in sub-Saharan Africa, yet effective management depends on health workers having the knowledge, attitudes, and practices to screen, diagnose, and treat these conditions. Evidence on these provider-level factors remains limited in Uganda.

Methods

We conducted a descriptive cross-sectional survey among health workers in Uganda (November–December 2025), disseminating a structured questionnaire on HDP and DIP knowledge, attitudes,

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practices, prescribing, and task shifting via WhatsApp-based Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCAH) networks and professional association platforms, hosted on REDCap. We analysed data in STATA 17 using descriptive statistics and comparisons across health worker groups.

Results

Of the 690 eligible health workers, 577 completed the survey (83.5%). Midwives comprised the largest group (341, 59.1%) and most worked in public facilities (425, 73.7%). Knowledge and protocol integration were substantially stronger for HDP than DIP: CPD attendance was 70.9% for HDP versus 36.4% for DIP, self-reported protocol familiarity was 90.1% versus 38.6%, and routine BP screening was near-universal (538, 93.2%) while only 122 (21.1%) always screened for diabetes in pregnancy. Correct oral glucose tolerance test (OGTT) thresholds were identified by only 186 (32.2%). Attitudes reflected strong support for patient involvement in treatment decisions and consistent treatment targets, with moderate confidence in guideline-based adjustments (279, 48.4%). Prescribing prioritised affordability (438, 75.9%) and reliable drug supply (473, 82.0%). Task shifting was widely accepted for basic functions including BP measurement (538, 93.2%) and lifestyle counselling (514, 89.1%), but less so for algorithm-based prescribing (170, 29.5%). Cadre differences were consistent across domains: for HDP, correct identification of severe preeclampsia features and use of advanced diagnostics were significantly lower among midwives than specialist cadres ($p<0.001$); for DIP, gaps were most pronounced among midwives, with the lowest DIP CPD attendance (105, 30.8%) and OGTT endorsement (186, 54.5%) of all cadres ($p<0.001$). Advanced diagnostic use and OGTT endorsement also increased progressively with facility level ($p<0.001$).

Conclusions

Health workers in Uganda demonstrate substantially stronger knowledge, attitudes, and practices for HDP than for DIP, with consistent cadre-related differences. Under-recognition of DIP likely contributes to missed opportunities for timely intervention. Targeted CPD on DIP, wider protocol dissemination , and system-level support for diabetes screening are urgently needed. Leveraging existing RMNCAH networks offers a practical pathway for integrating DIP into routine antenatal care.

Key words: Hypertensive disorders of pregnancy; Diabetes in pregnancy; Knowledge, attitudes, and practices; Task shifting; Uganda; Maternal health; Health systems

Background

Non‐communicable diseases (NCDs), particularly hypertensive disorders of pregnancy (HDP) and diabetes in pregnancy (DIP), are increasingly recognized as major contributors to maternal and perinatal morbidity and mortality worldwide. Global estimates suggest that the burden of these conditions is rising in parallel with demographic and lifestyle transitions, underscoring the need for robust screening and management strategies [1-4] .

In sub‐Saharan Africa (SSA), reported burdens of NCDs in pregnancy often appear lower than expected compared to global trends. Several studies highlight this discrepancy, attributing it not to true epidemiology but to systemic challenges such as limited access to diagnostic tools,

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inconsistent screening protocols, and weak health information systems [5, 6]. Compounding these challenges, a significant proportion of pregnant women in Uganda and across SSA, particularly in rural settings, do not attend formal antenatal care at the recommended frequency, present late in pregnancy, or deliver outside health facilities with the assistance of traditional birth attendants or unskilled attendants, and therefore remain entirely absent from facility-based screening and surveillance systems [7-10]. For example, gestational diabetes prevalence is frequently reported at <5% despite rising risk factors such as obesity and advanced maternal age, while hypertensive disorders are often under‐documented [5, 6]. While HDP have historically dominated maternal mortality statistics and programmatic attention, undetected or poorly managed DIP carries a distinct and increasingly important morbidity burden, including fetal demise, macrosomia, shoulder dystocia, and impaired postoperative wound healing, outcomes that are expected to worsen as these risk factors continue to rise across sub-Saharan Africa [1, 4, 11].

Our own findings from a review of obstetric admission records at Mbarara Regional Referral Hospital in southwestern Uganda mirror these regional concerns [12]. We observed unexpectedly low numbers of NCDs in pregnancy despite hypertension affecting approximately 26.4% and diabetes 7% of Ugandan adults in the general population, with the majority unaware of their diagnosis [13, 14]. These findings suggested that the apparent low prevalence may not reflect the true epidemiology but rather missed opportunities in screening, diagnosis, and documentation. This under‐recognition, seen both in our setting and across SSA, may delay timely interventions, obscure the true scale of the challenge, and compromise maternal and perinatal outcomes [4-6, 12]. These insights formed the rationale for the present study, which aimed to systematically assess health worker perspectives, including knowledge, attitudes, practices, prescribing behaviors, and task shifting, regarding screening and management of hypertensive disorders and diabetes in pregnancy in Uganda.

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Materials and methods

Study setting and design

We conducted a descriptive cross-sectional survey among health workers involved in the care of pregnant women in Uganda between November and December 2025. Participants were reached through two complementary channels: (1) Local Maternity and Neonatal Systems (LMNS) WhatsApp platforms—regional Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCAH) accountability networks linking 18 regional hospitals with lower-level health facilities across Uganda—and (2) national professional associations, including the Association of Obstetricians and Gynecologists of Uganda (AOGU), the National Midwives Association of Uganda (NMAU), the Uganda Medical Association (UMA), and other national RMNCAH networks. Survey links were shared via WhatsApp groups within all platforms.

Study population and eligibility criteria

We attempted to reach all health workers involved in the care of pregnant women who were active members of the LMNS WhatsApp platforms, national RMNCAH networks, or professional association platforms at the time of the survey. Eligible cadres included midwives and nurses, medical officers and general practitioners, and obstetricians/gynaecologists. Inclusion criteria were: (1) active membership of an LMNS WhatsApp platform, national RMNCAH network, or

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professional association platform at the time of the survey; (2) belonging to an eligible cadre—midwife or nurse, medical officer or general practitioner, or obstetrician/gynaecologist; and (3) provision of electronic informed consent and completion of the survey.

Sample size estimation and sampling

We used a convenience sampling approach, disseminating the survey to all health workers actively enrolled in LMNS platforms, national RMNCAH networks, and professional association platforms at the time of the survey. Because individuals may belong to multiple platforms simultaneously and the survey was administered via a public REDCap link with no unique participant identifier, an unduplicated sampling frame could not be established; all health workers who accessed the link and met eligibility criteria were included.

Data collection

We designed a structured questionnaire adapting items from the World Hypertension League KAP survey framework [15], previously implemented in primary care settings in low- and middle-income countries [16-18], and extended to include items on diabetes in pregnancy drawing on the clinical domains identified in the literature as relevant to midwives and nurses caring for pregnant women with gestational diabetes and hypertensive disorders[16, 19]. The questionnaire was adapted to the Ugandan clinical context based on national guidelines, facility-level realities and the research team's clinical experience. It was built in REDCap and pretested among 20 participants, comprising five obstetrician/gynecologists, five midwives, five medical officers, and five postgraduate residents; items were revised based on their feedback. The final survey took approximately 10–15 minutes to complete.

The questionnaire comprised six sections: (1) informed consent, (2) demographic and professional background, (3) continuing professional development, (4) clinical knowledge of HDP and DIP, (5) clinical practice—including screening, counselling, monitoring, prescribing, and task shifting—and (6) barriers and treatment beliefs. Attitude items were distributed across sections to reduce response bias: items on patient involvement in treatment decisions and treatment targets appeared in the clinical knowledge section (Q20–Q21), while items on drug use beliefs and clinical confidence appeared in the treatment beliefs section (Q30). Task shifting items assessed acceptability of delegating clinical functions to trained non-doctor health workers, defined in this survey as nurses, midwives, and clinical officers, consistent with Uganda's recognised mid-level cadre structure. The full questionnaire is provided as **Supplementary Appendix 1.**

The survey link was disseminated via WhatsApp to all platform members every three days, twice weekly, for four weeks. As no unique participant identifier was collected, potential duplicate records were screened during data cleaning by flagging responses with identical combinations of cadre, sex, facility type, facility level, department, and years of experience; no duplicates were identified. Respondents completed the survey online and REDCap captured responses in real time [20].

Informed consent was obtained electronically; participants were presented with study information, ethics approval details, and contact information for the principal investigator and ethics committee

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chair prior to the survey and were required to indicate consent before proceeding (MUST-2021-143; HS1734ES).

Data management and analysis

We exported data from REDCap to STATA software (Version 17.0, StataCorp, College Station, Texas, USA) for cleaning and analysis. We summarized continuous variables as means ± standard deviations (SD) or medians with interquartile ranges (IQR), and categorical variables as frequencies and percentages. We compared knowledge, attitudes and practices across clinical cadres using Chi-squared or Fisher's exact tests. We summarized and visualized the Likert-scale responses as bar charts generated in Microsoft Excel [21].

Results

Survey Reach and Response

The survey was disseminated across 18 LMNS WhatsApp platforms and national professional association platforms across Uganda. Of the health workers who accessed the survey link and met eligibility criteria, 690 were identified; of these, 27 (3.9%) declined consent, 86 (12.5%) did not submit a complete response, and 577 completed the survey fully (completion rate 83.5% among those eligible). Given the overlapping nature of the dissemination platforms and the use of a public survey link, a population-level response rate could not be calculated and is not reported.

Participant background characteristics

Among the 577 respondents, the median age was 35 years (IQR: 30–40), with nearly half aged 30 to under 40 (283, 49.0%) and two-thirds female (377, 65.3%). Midwives formed the largest cadre (341, 59.1%), followed by medical officers and general practitioners (76, 13.2%), postgraduate OB/GYN residents (56, 9.7%), OB/GYN specialists (48, 8.3%), and other cadres including clinical officers and anaesthetists (56, 9.7%). Most worked in public or government-funded facilities (425, 73.7%). In terms of professional training, 209 (36.2%) held post-secondary diplomas equivalent to mid-level nursing or clinical training, 199 (34.5%) held bachelor's degrees, and 99 (17.2%) held master's qualifications. The majority were based in obstetrics and maternity departments (401, 69.5%), with a median of 9 years of professional experience (**Table 1**).

Table 1: Background characteristics of respondents

Characteristics		**Frequency (%), N=577**
Median age in years (IQR)		35 (30-40)
Age in years		
	<30	126 (21.8)
	30-<40	283 (49.0)
	>40	168 (29.1)
Gender		
	Female	377 (65.3)
	Male	200 (34.7)

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Clinical Cadre		
	Midwife/Nurse	341 (59.1)
	Postgraduate OB/GYN trainee	56 (9.7)
	Medical officer/General practitioner	76 (13.2)
	Obstetrician/Gynecologist	48 (8.3)
	Other[#]	56 (9.7)
Clinical setting of current work		
	Public/ Government-funded facility	425 (73.7)
	Private facility	77 (13.3)
	Private not for Profit (PNFP)	55 (9.5)
	Both public and private	9 (1.6)
	Other health facility type	11 (1.9)
Level of current health facility*		
	Health Centre II	23 (4.0)
	Health Centre III	144 (25.0)
	Health Centre IV	122 (21.1)
	District/General Hospital	110 (19.1)
	Regional Referral Hospital	147 (25.5)
	National Referral Hospital	9 (1.6)
	Other level of Health facility	22 (3.8)
Highest health-related level of training attained		
	Certificate	68 (11.8)
	Diploma in health-related field	209 (36.2)
	Bachelor's degree	199 (34.5)
	Master's degree	99 (17.2)
	PhD	2 (0.3)
Department		
	Obstetrics/maternity	401 (69.5)
	ANC clinic	133 (23.1)
	Intensive care	13 (2.3)
	Emergency room	30 (5.2)
Years of Professional Experience, mean (SD)		10.0±7.4

OB/GYN: obstetrician/gynecologist, PNFP: private not-for-profit, ANC: antenatal care, IQR: interquartile range, SD: standard deviation, CPD: continuing professional development, [#]Other cadre included clinical officers and anesthetists, *Uganda's health facility levels range from Health Centre II (village level, basic preventive care) through Health Centre III (parish level, outpatient and maternity care), Health Centre IV (sub-county level, surgical capacity), District/General Hospital, Regional Referral Hospital, to National Referral Hospital. Diagnostic and specialist capacity increases progressively with facility level.

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Knowledge, Training, and Protocol Use in HDP and DIP

For HDP, 409(70.9%) had attended CPD in the past 12 months, 520 (90.1%) had self-reported familiarity with HDP care protocols, and 340 (58.9%) had used them. CPD attendance and

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protocol familiarity differed significantly by cadre: attendance was highest among postgraduate trainees and medical officers (85.7% and 82.9% respectively) and lowest among midwives (66.3%) and other cadres (58.9%) (p<0.001), while protocol familiarity was universal among OB/GYN specialists (100%) but lower among other cadres (p<0.001). Most respondents correctly identified hypertension thresholds (≥140/90 mmHg) and recognised that HDP screening should begin before 12 weeks of gestation 436(75.6%). Correct identification of the preeclampsia definition and severe features was reported by 397 (68.8%) and 325 (56.3%) respectively, with significantly higher correct responses among medical officers, postgraduate trainees, and specialists compared to midwives (p<0.001 for both). Dipstick proteinuria was the most commonly used diagnostic test (432, 74.9%), while use of advanced investigations including complete blood count (CBC) (273, 47.3%), serum creatinine (174, 30.2%), and liver function tests (199, 34.5%) varied significantly by cadre, with specialists and postgraduate trainees most likely to use these tests (p<0.001 for all three). Use of advanced diagnostics also increased with facility level, from 16.8% for CBC at HC II/III to 69.2% at regional and national referral hospitals (p<0.001) **(Table 2; Supplementary Tables S5**).

Table 2: Knowledge, Training, and Protocol Use in Hypertensive disorders in Pregnancy

Variable	Total	Midwife /Nurse	Medical officer/GP	Postgraduate OB/GYN	OB/GYN Specialist	Other	p-value
	N=577	N=341	N=76	N=56	N=48	N=56	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
1. Training and protocols							
Attended CPD (past 12 months)	409 (70.9)	226 (66.3)	63 (82.9)	48 (85.7)	39 (81.3)	33 (58.9)	<0.001*
Familiar with HDP care (screening, prevention, and management) protocols	520 (90.1)	312 (91.5)	70 (92.1)	49 (87.5)	48 (100)	41 (73.2)	<0.001*
Used HDP protocols in the past 12 months	340 (58.9)	226 (66.3)	40 (52.6)	26 (46.4)	20 (41.7)	28 (50.0)	<0.001*
Reading frequency of HDP book and journal articles							<0.001*
Very often	55 (9.5)	29 (8.5)	7 (9.2)	4 (7.1)	12 (25.0)	3 (5.4)	
Often	111 (19.2)	59 (17.3)	20 (26.3)	15 (26.8)	12 (25.0)	5 (8.9)	
Sometimes	339 (58.8)	212 (62.2)	34 (44.7)	29 (51.8)	24 (50.0)	40 (71.4)	
Rarely	68 (11.8)	38 (11.1)	15 (19.7)	8 (14.3)	0 (0.0)	7 (12.5)	
Never	4 (0.7)	3 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.8)	
2. Knowledge of definitions and thresholds							
Selected correct preeclampsia definition	397 (68.8)	211 (61.9)	63 (82.9)	48 (85.7)	39 (81.3)	36 (64.3)	<0.001*
Correctly selected severe features of preeclampsia	325 (56.3)	170 (49.9)	57 (75.0)	39 (69.6)	38 (79.2)	21 (37.5)	<0.001*
Selected correct systolic threshold (≥140mmHg)	518 (89.8)	299 (87.7)	74 (97.4)	51 (91.1)	46 (95.8)	48 (85.7)	0.11
Selected correct diastolic threshold (≥90 mmHg)	508 (88.0)	293 (85.9)	73 (96.1)	51 (91.1)	46 (95.8)	45 (80.4)	0.095

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Selected correct timing of HDP screening during ANC (<12 weeks)		436 (75.6)	260 (76.2)	50 (65.8)	41 (73.2)	38 (79.2)	47 (83.9)	0.23
3. Routinely used screening and diagnostic tests for HDP								
	Dipstick proteinuria	432 (74.9)	249 (73.0)	61 (80.3)	47 (83.9)	39 (81.3)	36 (64.3)	0.072
	24-hour urine protein	103 (17.9)	59 (17.3)	19 (25.0)	7 (12.5)	9 (18.8)	9 (16.1)	0.41
	Urinary protein/creatinine ratio	136 (23.6)	90 (26.4)	17 (22.4)	8 (14.3)	13 (27.1)	8 (14.3)	0.12
	Complete blood count (CBC)	273 (47.3)	129 (37.8)	56 (73.7)	39 (69.6)	39 (81.3)	10 (17.9)	<0.001*
	Serum creatinine	174 (30.2)	63 (18.5)	38 (50.0)	33 (58.9)	36 (75.0)	4 (7.1)	<0.001*
	LFTs (ALT/AST/ LDH)	199 (34.5)	74 (21.7)	46 (60.5)	35 (62.5)	38 (79.2)	6 (10.7)	<0.001*

HDP: hypertensive disorders in pregnancy, CBC: complete blood count, LFTs: liver function tests, ALT: alanine aminotransferase, AST: aspartate aminotransferase, LDH: lactate dehydrogenase, GP: general practitioner, OB/GYN: obstetrician/gynecologist, CPD: continuing professional development, Other cadre included clinical Officers and anesthetists, * p-values reflect cadre comparisons using chi-square or Fisher's exact tests; *p<0.05*

For DIP, 210 (36.4%) had attended CPD in the past 12 months, 223 (38.6%) had self-reported familiarity with DIP protocols, and 172 (29.8%) had used them. CPD attendance, protocol familiarity, and protocol use all differed significantly by cadre: attendance was highest among OB/GYN specialists and postgraduate trainees (60.4% and 57.1% respectively) and lowest among midwives (30.8%) and other cadres (28.6%) (p<0.001); protocol familiarity ranged from 75.0% among specialists to 29.6% among midwives (p<0.001); and protocol use followed a similar gradient, from 56.3% among specialists to 22.9% among midwives (p<0.001). Over half (306, 53.0%) reported rarely engaging with diabetes literature. Nearly all correctly defined gestational diabetes mellitus (560, 97.1%), though correct identification of GDM risk factors and timing of GDM development differed significantly by cadre, with specialists and postgraduate trainees performing consistently better than midwives (p=0.045 and p<0.001 respectively). Only 186 (32.2%) identified the correct OGTT diagnostic thresholds, with no significant cadre difference (p=0.47), while 378 (65.5%) identified OGTT as the preferred screening method, with higher endorsement among specialists and postgraduate OB/GYNs (63/76, 82.9% and 45/56, 80.4%, respectively) than among midwives (186/341, 54.5%) (p<0.001). OGTT endorsement also increased with facility level, from 52.1% at HC II/III to 81.8% at regional and national referral hospitals (p=0.001) (**Table 3; Supplementary Table S5**).

Table 3: Knowledge, Training, and Protocol Use in Diabetes in Pregnancy

Variables	Total	Midwife /Nurse	Medical officer/GP	Postgraduate OB/GYN	OB/GYN Specialist	Other	p-value
	N=577	N=341	N=76	N=56	N=48	N=56	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
1. Training and protocols							
Attended diabetes in pregnancy CPDs in the past 12 months	210 (36.4)	105 (30.8)	28 (36.8)	32 (57.1)	29 (60.4)	16 (28.6)	<0.001*
Familiar with diabetes in pregnancy protocols	223 (38.6)	101 (29.6)	31 (40.8)	33 (58.9)	36 (75.0)	22 (39.3)	<0.001*

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(screening, prevention, and management)							
Used diabetes in pregnancy protocols in the past 12 months	172 (29.8)	78 (22.9)	26 (34.2)	28 (50.0)	27 (56.3)	13 (23.2)	<0.001*
Reading frequency of diabetes in pregnancy books and journal articles							<0.001*
Very often	28 (4.9)	14 (4.1)	3 (3.9)	2 (3.6)	6 (12.5)	3 (5.4)	
Often	51 (8.8)	24 (7.0)	5 (6.6)	10 (17.9)	10 (20.8)	2 (3.6)	
Sometimes	179 (31.0)	101 (29.6)	23 (30.3)	22 (39.3)	15 (31.3)	18 (32.1)	
Rarely	306 (53.0)	189 (55.4)	45 (59.2)	22 (39.3)	17 (35.4)	33 (58.9)	
Never	13 (2.3)	13 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
2. Knowledge of definitions and thresholds							
Selected correct definition of GDM	560 (97.1)	329 (96.5)	76 (100.0)	56 (100.0)	46 (95.8)	53 (94.6)	0.54
Correctly selected the GDM risk factors	413 (71.6)	233 (68.3)	59 (77.6)	47 (83.9)	39 (81.3)	35 (62.5)	0.045*
Correctly selected the typical symptom of GDM	474 (82.1)	266 (78.0)	66 (86.8)	50 (89.3)	46 (95.8)	46 (82.1)	0.22
3. Screening and Diagnostic Tests							
Selected the correct timing of GDM development (second half)	414 (71.8)	216 (63.3)	66 (86.8)	51 (91.1)	46 (95.8)	35 (62.5)	<0.001*
Selected the correct preferred GDM screening test (OGTT)	378 (65.5)	186 (54.5)	63 (82.9)	45 (80.4)	45 (93.8)	39 (69.6)	<0.001*
Selected the correct OGTT diagnostic thresholds for GDM	186 (32.2)	104 (30.5)	27 (35.5)	18 (32.1)	17 (35.4)	20 (35.7)	0.47

GP: general practitioner, OB/GYN: obstetrician/gynecologist, CPD: continuing professional development, GDM: gestational diabetes mellitus, OGTT: oral glucose tolerance test, Other included clinical officers and anesthetists, * p-values reflect cadre comparisons using chi-square or Fisher's exact tests; *p<0.05*

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Attitudes

Attitudes toward patient involvement in treatment decisions, treatment targets, pharmacotherapy, and confidence in clinical adjustments are summarised in **Figure 1**, with cadre comparisons detailed in **Supplementary Table S1**.

For blood pressure targets, 457 (79.2%) strongly agreed and 104 (18.0%) agreed that patients should be involved in and concur with decisions about their blood pressure target and treatment plan; endorsement was slightly lower for blood sugar targets (361 (62.6%) strongly agreed; 167 (28.9%) agreed). Most respondents supported consistent treatment targets across health worker groups for both blood pressure (385 (66.7%) strongly agreed) and blood sugar (387 (67.1%) strongly agreed). Confidence in adjusting treatment plans, including intensifying or stepping down therapy based on clinical guidelines, was moderate: 279 (48.4%) strongly agreed and 201 (34.8%) agreed they felt confident making such adjustments. Medical officers reported

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the highest confidence among cadres, while OB/GYN specialists were least likely to strongly agree (**Supplementary Table S1**).

Views on pharmacotherapy were mixed: nearly half endorsed using fewer drugs despite uncontrolled blood pressure or reserving pharmacotherapy until lifestyle changes had failed, while escalation was more widely accepted (192 (33.3%) strongly agreed for blood pressure; 143 (24.8%) for blood sugar). Midwives were more likely to favour drug minimisation, while OB/GYN specialists were more likely to support escalation (**Supplementary Table S1**).

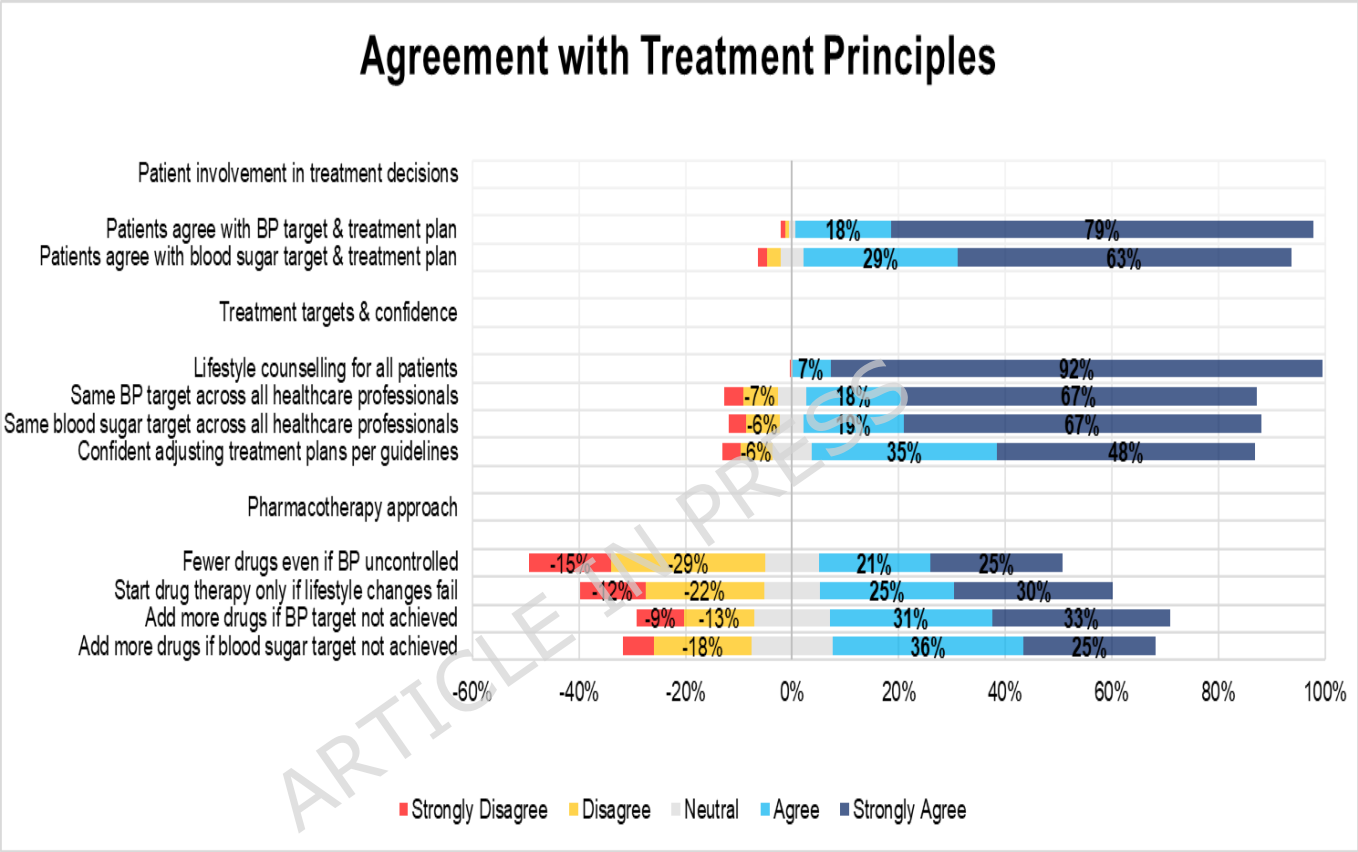


Figure 1. Health-Worker Attitudes Toward HDP and DIP

Practices

Across all respondents, validated electronic blood pressure devices were used by 260 (45.1%) and manual machines by 164 (28.4%), with only 3 (0.5%) reporting none. Registries for HDP were predominantly paper-based (388, 67.2%), with fewer computerized (45, 7.8%) or mixed systems (74, 12.8%), and 70 (12.1%) reported having no HDP registry at all. For screening and counselling, 538 (93.2%) always measured BP at antenatal visits, 479 (83.0%) always counselled on hypertension risks, and 462 (80.1%) always counselled on lifestyle changes. Monitoring was similarly reported, with 464 (80.4%) always assessing drug adherence and 452 (78.3%) always monitoring BP postpartum.

For diabetes-related practices, only 122 (21.1%) always screened for diabetes in pregnancy and 125 (21.7%) always educated on fasting glucose testing, though 416 (72.1%) always recommended early ANC for women with pregestational diabetes. Self-monitoring education for

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both BP and blood sugar was always provided by 378 (65.5%) (**Figure. 2**). DIP registries were predominantly paper-based (375, 65.0%), with few computerised (39, 6.8%) or mixed systems (68, 11.8%), and 95 (16.5%) reported having no diabetes in pregnancy registry at all. Cadre comparisons are detailed in **Supplementary Table S2**.

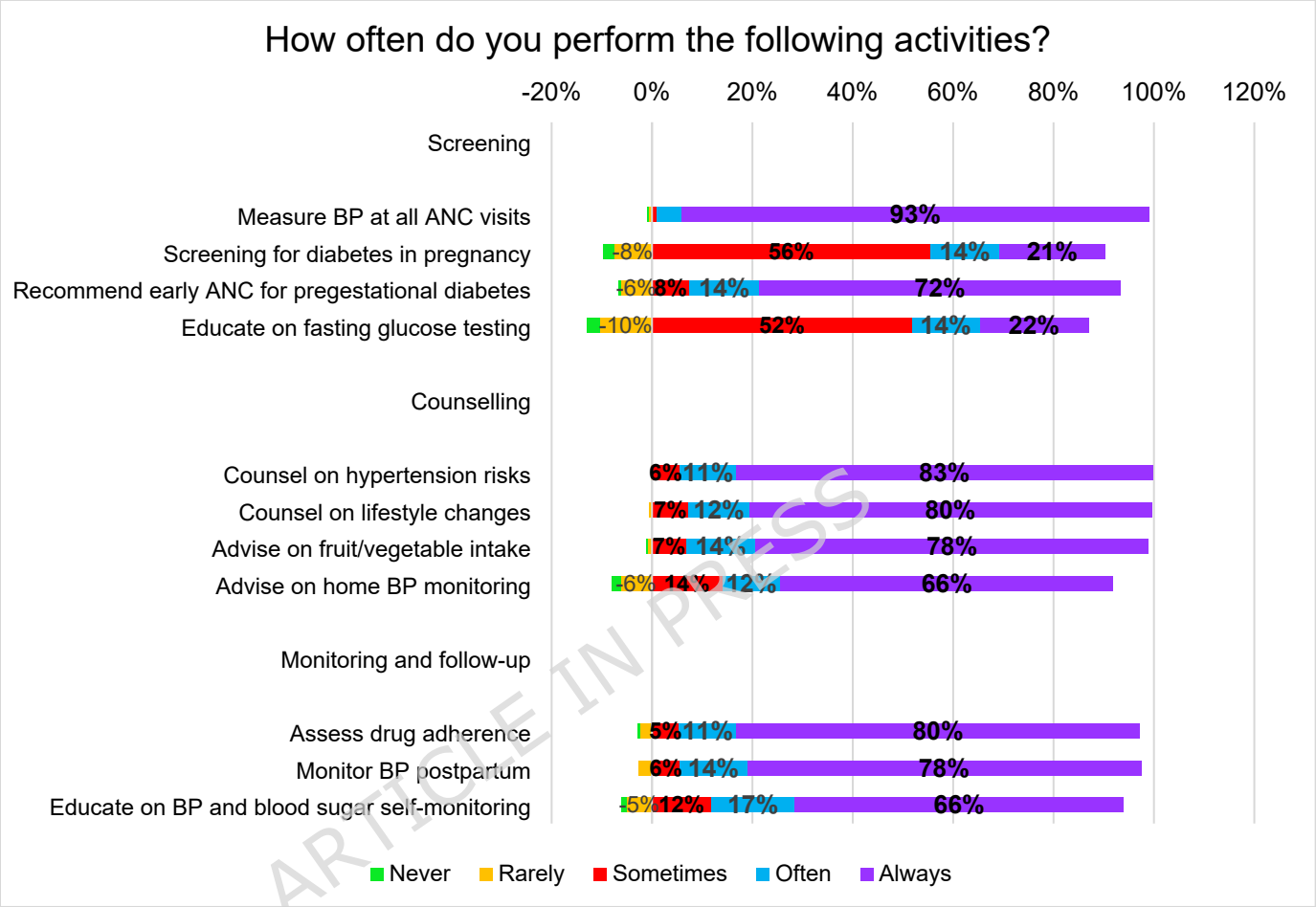


Figure 2. Health-Worker Clinical Practices for HDP and DIP

Task-Shifting

Acceptability of task shifting to trained non-doctor health workers varied by task complexity. Acceptance was high for basic clinical functions: 538 (93.2%) strongly agreed and 24 (4.2%) agreed that non-doctor cadres could measure blood pressure, and 514 (89.1%) strongly agreed and 39 (6.8%) agreed that lifestyle counselling was acceptable. Acceptance was somewhat lower for cardiovascular risk assessment, with 414 (71.8%) strongly agreeing and 36 (6.2%) disagreeing. For algorithm-based prescribing, 170 (29.5%) strongly agreed and 141 (24.4%) agreed for antihypertensives, and 167 (28.9%) strongly agreed and 143 (24.8%) agreed for antidiabetic drugs, with 86 (14.9%) and 94 (16.3%) disagreeing respectively (**Figure 3**). Acceptability of algorithm-based antihypertensive prescribing via task shifting differed significantly by cadre (p=0.003), with midwives most likely to strongly agree (109/341, 32.0%) and OB/GYN specialists least likely (5/48, 10.4%); no significant cadre differences were observed for basic clinical tasks including BP measurement and lifestyle counselling. Full cadre comparisons are detailed in **Supplementary Table S3**.

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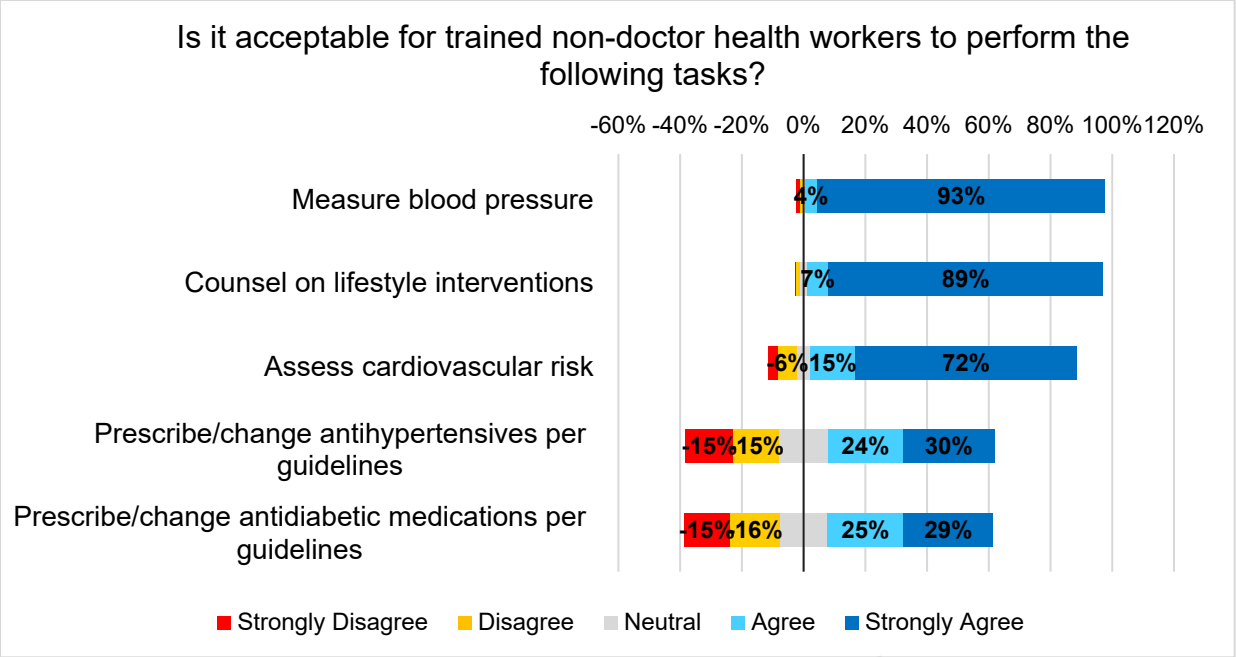


Figure 3. Acceptance of Task-Shifting Roles in HDP and DIP Care

Prescribing considerations

When prescribing antihypertensive or antidiabetic drugs, patient affordability, reliable drug supply, and patient concordance with the prescribed regimen were prioritised across all respondents. Affordability was rated very important by 438 (75.9%) and important by 104 (18.0%), while reliable drug supply was very important for 473 (82.0%) and important for 85 (14.7%). Patient concordance was rated very important by 433 (75.0%) and important by 98 (17.0%) (**Figure 4**). Cadre differences in prescribing considerations were not statistically significant (**Supplementary Table S4**).

Most respondents felt one antihypertensive drug was sufficient for most pregnant patients (311, 53.9%), while 260 (45.1%) reported that two or more were needed. Specialists and medical officers were more likely to report that patients needed two or more drugs (28/48, 58.3% and 32/76, 57.1% respectively) compared to midwives (151/341, 44.3%) and other cadres (13/56, 23.2%) (p=0.011). Confidence in prescribing was highest for dual therapy (367, 63.6%), with fewer confident prescribing three or more agents (97, 16.8%) (**Supplementary Table S4**).

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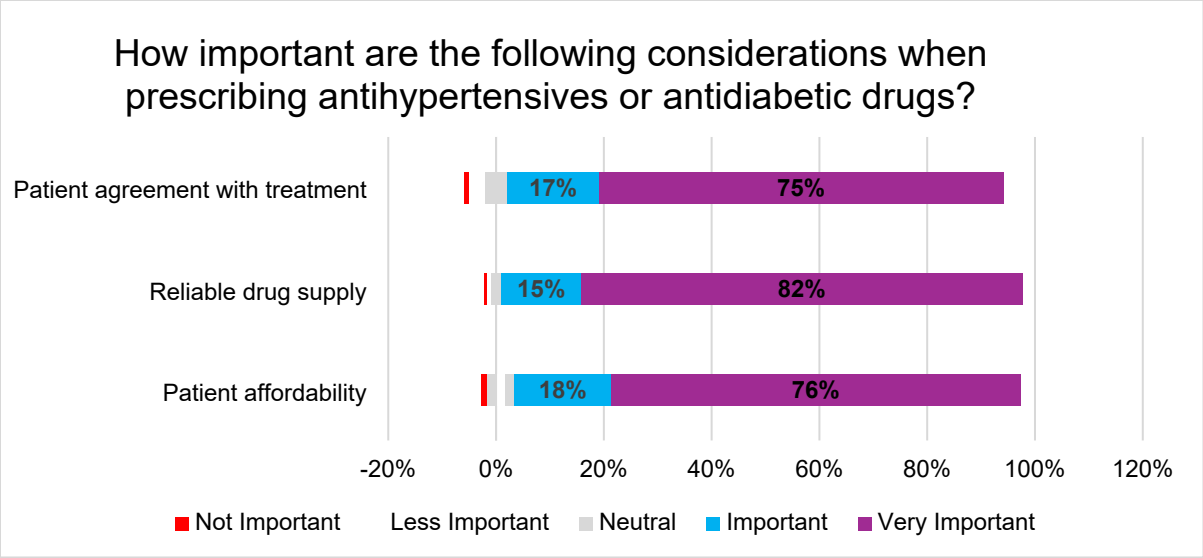


Figure 4. Health-Worker Prescribing Considerations in HDP and DIP Care

Discussion

This study systematically assessed the knowledge, attitudes, practices, prescribing behaviours, and task shifting perspectives of health workers across Uganda regarding hypertensive disorders and diabetes in pregnancy. Four main findings emerge. First, knowledge, self-reported protocol familiarity, and clinical practices were substantially stronger for HDP than for DIP across all cadres, reflecting longstanding RMNCAH programmatic priorities in which hypertension has historically received greater training investment, guideline development, and accountability emphasis than diabetes in pregnancy [22] [7]. Second, cadre-related differences were consistent across domains, reflecting differences in training exposure, clinical scope, and facility-level diagnostic availability rather than individual-level knowledge gaps alone. Third, attitudes toward patient involvement and task shifting were broadly positive, though more conservative among lower cadres, shaped by scope-of-practice boundaries and prescribing authority constraints. Fourth, prescribing decisions were influenced by drug affordability, supply chain reliability, and limited confidence in multi-drug regimens, particularly among non-physician cadres. Together, these findings illuminate the system-level, training-related, and cadre-specific factors shaping integration of both conditions into routine maternal care in Uganda.

Knowledge, CPD and Protocol use

The results reveal a clear imbalance between HDP and DIP in terms of knowledge, training, and protocol integration. HDP appear well embedded in routine practice, with high levels of CPD attendance, strong self-reported protocol familiarity, and correct identification of screening timing and diagnostic thresholds, reflecting the sustained programmatic emphasis that hypertension has received within Uganda's RMNCAH accountability infrastructure [23]. This integration demonstrates that structured protocol dissemination supported by facility-level accountability mechanisms can achieve high provider familiarity, a lesson with direct relevance for accelerating DIP integration into routine ANC.

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In contrast, DIP showed weaker integration across all indicators, including lower CPD attendance, limited self-reported protocol familiarity, inconsistent screening knowledge, particularly around OGTT thresholds and preferred screening methods. These gaps mirror evidence from Ethiopia, Tanzania, Uganda, Ghana, and Nigeria, which consistently report low provider awareness, inconsistent diagnostic criteria, and weak incorporation of DIP into routine ANC workflows [4, 24-26], suggesting a systematic rather than individual-level challenge.

Cadre differences were evident across both conditions, with specialists and postgraduate OB/GYNs more likely to apply advanced diagnostics and demonstrate guideline-consistent knowledge than midwives and lower cadres. While training gaps contribute to these differences, facility-level comparisons (**Supplementary Table S5**) indicate that differential diagnostic resource availability is at least an equally important driver, as advanced diagnostics and OGTT endorsement increased markedly with facility level, reflecting the concentration of resources at tertiary centres where specialists practice. Prior literature similarly notes weaker familiarity with GDM protocols among midwives compared to specialists [19, 27]. These findings point to the need for screening protocols tailored to facility-level diagnostic capacity, with particular attention to lower-level facilities where both diagnostic access and DIP training exposure are most limited.

Attitudes

Attitudinal findings showed strong support for patient involvement and consistent treatment goals across cadres. High endorsement of patient concordance with treatment targets (Q20) likely reflects a commitment to patient-centred care [28, 29], though whether this reflects shared decision-making or provider-directed concordance cannot be determined from the survey item alone. Specialists' stronger emphasis on patient agreement aligns with evidence that higher-trained cadres receive more structured exposure to counselling frameworks and communication skills [30].

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Most respondents supported uniform treatment targets, consistent with Uganda's national guidelines which establish defined thresholds while permitting clinical judgment in individual circumstances. Divergent attitudes toward pharmacotherapy, specifically whether to withhold additional agents despite uncontrolled targets, or delay pharmacotherapy until lifestyle measures fail mirror patterns documented across LMICs, where concerns about polypharmacy, fetal safety, and cadre-specific prescribing authority shape provider preferences [31]. The more conservative escalation responses among midwives and lower cadres most likely reflect prescribing authority constraints rather than clinical disagreement, consistent with evidence from similar settings [32-35].

Practices

Blood pressure screening and counselling were well established across cadres, supported by widespread use of validated devices and registries. High proportions reporting routine BP measurement, hypertension counselling, and postpartum monitoring indicate that hypertension management is well integrated into antenatal and postnatal care. Midwives reported the highest consistency in routine BP practices, reflecting their central role in frontline antenatal care delivery. These patterns have been observed in Ghana and other LMICs where HDP protocols

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have benefited from more operationalised guideline emphasis and stronger provider familiarity compared to DIP guidance [33, 34, 36, 37].

In contrast, diabetes-related practices were markedly weaker. Low rates of routine diabetes screening and fasting-glucose education mirror gaps documented across sub-Saharan Africa and South Asia, where limited diagnostics, inconsistent supplies, and weaker guideline visibility constrain diabetes detection and follow-up [38-42]. Specialists were less consistent in lifestyle and dietary counselling for DIP, while engagement in diabetes-related tasks was low across all cadres, reflecting broader challenges in embedding DIP within routine ANC. Similar patterns have been documented in Tanzania, Uganda, and India, where diabetes screening is not prioritized due to resource constraints, limited training exposure, and unclear operational guidance [24, 41-43]. A further challenge is that a substantial proportion of pregnant women in Uganda attend fewer ANC visits than recommended or present late, limiting opportunities for facility-based GDM screening; integrating point-of-care testing and community-based screening approaches, supported by task-shifting frameworks, may offer practical pathways to reach women outside formal ANC attendance patterns [7, 10, 44]. These findings underscore that embedding DIP into routine ANC will require not only increased training volume but a structured approach replicating the protocol-based model that has driven HDP integration.

Prescribing

Prescribing patterns differed not only across cadres but also between conditions: confidence in antihypertensive prescribing was generally higher than for antidiabetic agents, consistent with the broader pattern of stronger HDP integration observed across all domains. Patient affordability, reliable drug supply, and patient concordance with the prescribed regimen were prioritised across both conditions, though the relative weight placed on each factor varied by cadre. This emphasis reflects persistent challenges of out-of-pocket costs and stock-outs in maternal NCD care, consistent with evidence from Uganda, Nigeria and other LMICs [45-50].

Cadre□specific differences were evident: medical officers placed the greatest weight on affordability, specialists emphasized reliable supply and treatment escalation, and respondents in the “other” category most strongly endorsed patient agreement. Variation in experience and confidence with antihypertensive therapy was also notable. While most providers felt a single drug was sufficient, a substantial proportion reported needing two or more agents. This cadre difference in perceived drug burden is consistent with differences in patient clinical complexity: specialists and postgraduate OB/GYNs manage a higher proportion of severe and refractory cases referred from lower-level facilities, which would naturally require more intensive pharmacotherapy. This case-mix effect cannot be excluded from the observed cadre differences and should be considered when interpreting prescribing patterns. Confidence was highest for dual therapy but more limited for triple therapy, patterns consistent with global surveys showing hesitancy around polypharmacy and fetal safety in pregnancy [31, 32, 51] and with findings from primary care physicians in Mongolia, where fewer than half reported confidence prescribing three or more antihypertensive agents [16], suggesting that prescribing confidence gaps among non-specialist physicians may be a common feature across diverse health system contexts. Strengthening guideline dissemination, ensuring equitable access to affordable medicines, reinforcing shared decision-making, and providing targeted training on safe escalation—

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supported by robust supply chains—could harmonize prescribing approaches and reduce undertreatment across cadres.

Across all domains, cadre-specific patterns underscore how professional roles, clinical authority, facility-level resource availability, and patient clinical complexity collectively influence provider behaviour, resulting in variable application of guideline-recommended screening, counselling, and pharmacotherapy for both conditions. These patterns point to a health system in which the determinants of care quality extend well beyond individual provider knowledge, with implications for how training, guideline dissemination, and system strengthening efforts are designed and targeted.

Task shifting

Task shifting acceptability was high for basic clinical functions across all cadres, consistent with Uganda's established mid-level cadre practice and the WHO global recommendations for task shifting as a strategy to extend health service delivery in resource-constrained settings [52] . In practice, midwives operating at lower-level facilities, particularly HC III, administer a magnesium sulphate loading dose for eclampsia stabilization prior to referral, as stipulated in Uganda's Essential Maternal and Newborn Clinical Care Guidelines [53]. The finding that midwives were most accepting of algorithm-based antihypertensive prescribing should therefore be interpreted within this context: midwives already operate at the boundary of pharmacological management and may perceive algorithm-guided prescribing as a natural extension of their existing clinical role. The more conservative responses among OB/GYN specialists likely reflect awareness of clinical complexity and the limitations of algorithm-based approaches in high-risk cases rather than opposition to task shifting in principle. Notably, Uganda currently lacks a formal task shifting policy framework [54], meaning that such clinical responsibilities are governed by clinical guidelines rather than explicit legal authorization. Formalizing algorithm-based prescribing within a dedicated task shifting policy, supported by structured training and clinical decision support tools, could strengthen the role of midwives and other mid-level cadres in managing both HDP and DIP at lower-level facilities where specialist support is unavailable.

Strengths and Limitations

This study has several notable strengths. The large and diverse sample (N=577) spans multiple cadres including midwives, medical officers, obstetricians/gynaecologists, and postgraduate residents, and covers a broad range of facility levels across Uganda, enhancing the representativeness of findings within the country. The structured, pretested questionnaire systematically captured five domains—knowledge, attitudes, practices, prescribing, and task shifting—across both hypertensive disorders and diabetes in pregnancy simultaneously, enabling direct HDP-versus-DIP comparisons that are rarely reported in the literature. The Uganda-wide reach through LMNS platforms and national professional associations further strengthens the generalisability of findings within the Ugandan context.

Several limitations must be acknowledged. First, the cross-sectional design provides a snapshot of knowledge, attitudes, and practices at a single point in time; findings may not reflect subsequent changes following training interventions, guideline updates, or shifts in clinical experience. Second, self-reported practices may be subject to social desirability bias, with

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respondents potentially overstating adherence to recommended guidelines. Third, the survey was disseminated via a public REDCap link shared across WhatsApp platforms; as is inherent to public-link survey designs, an unduplicated sampling frame could not be established and individual-level duplicate submissions cannot be fully excluded, as no unique participant identifier was collected. During data cleaning, records were screened for likely duplicates based on identical combinations of cadre, sex, facility type, facility level, department, and years of experience; no duplicates were identified on this basis, though residual duplication remains an acknowledged limitation. Fourth, the WhatsApp-based dissemination strategy likely over-represents health workers who are digitally engaged and active in professional networks including those who participate in professional associations and accountability platforms and may under-represent those with limited digital access, limited connectivity, or those who are too busy to engage with professional platforms, potentially introducing selection bias toward more informed and engaged respondents. Fifth, the questionnaire was pretested for clarity and feasibility but not formally validated against existing psychometric instruments, which may limit the robustness of some attitudinal and self-efficacy measures; future surveys in this area should consider validated shared decision-making and self-efficacy scales. Sixth, while attitudes and confidence were assessed quantitatively, qualitative exploration was limited, restricting deeper understanding of the contextual and systemic drivers behind observed practices. Seventh, the analytical approach was descriptive; regression-based analyses to identify independent determinants of knowledge and practice outcomes were beyond the scope of this study. Finally, findings should be interpreted within the Ugandan context and may not be directly generalisable to other low- and middle-income settings with different health system structures, cadre configurations, or epidemiological profiles. This study focused exclusively on formal health worker perspectives; the complementary patient and population perspective, including ANC attendance, facility delivery rates, and women's awareness of HDP and DIP risks remains an important gap for future research.

Conclusions and Recommendations

Health workers in Uganda demonstrate stronger knowledge, attitudes, and practices for HDP than for DIP, with significant cadre-related differences across domains. Under-recognition of DIP likely contributes to missed opportunities for timely intervention and obscures the true burden of disease. Prescribing practices are shaped by systemic constraints including drug costs, supply chain gaps, and limited prescribing authority among non-physician cadres, while attitudes toward task shifting reveal both opportunity and the need for structured supervision frameworks.

The stronger integration of hypertensive disorders into routine antenatal care offers a proven operational model that should be explicitly leveraged to accelerate DIP integration into the same care pathways. We recommend five priority actions: expanding CPD on diabetes in pregnancy targeting midwives and general practitioners, where training gaps were most pronounced; disseminating national DIP guidelines with facility-adapted decision tools, given documented gaps in protocol familiarity and use; strengthening diabetes screening capacity at lower-level facilities through pragmatic point-of-care options where OGTT is not feasible; strengthening NCD documentation systems, given the predominance of paper-based registries and absence of any diabetes registry in a significant proportion of facilities; and formalising task-shifting frameworks with defined supervision and prescribing scope for non-physician cadres. Implementation of these recommendations will require dedicated investment. Expanding CPD and disseminating facility-adapted DIP guidelines can be integrated within Uganda's existing

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RMNCAH accountability infrastructure at relatively low marginal cost, while strengthening diabetes screening capacity and formalising task-shifting frameworks will require targeted capital investment through the Ministry of Health budget and development partner support. Longitudinal studies and intervention evaluations are needed to determine whether improvements in training and system strengthening translate into better maternal and perinatal outcomes.

Declarations

Abbreviations

AOGU: Association of Obstetricians and Gynecologists of Uganda, **IQR**: Interquartile Range, **KAP**: Knowledge, Attitudes, and Practices, **LMNS**: Local Maternity and Neonatal Systems, **MRRH**: Mbarara Regional Referral Hospital, **MUST**: Mbarara University of Science and Technology, **NCDs**: Non-Communicable Diseases, **NMAU**: National Midwives Association of Uganda, **RMNCAH**: Reproductive, Maternal, Newborn, Child, and Adolescent Health, **SD**: Standard Deviation, **SSA**: Sub-Saharan Africa, **UMA**: Uganda Medical Association, **WHO**: World Health Organization

Ethics approval and consent to participate

The study was approved by the Mbarara University Research Ethics Committee (MUST-2021-143) and the Uganda National Council for Science and Technology (HS1734ES). We obtained individual informed consent from all participants. The principles of data transfer and the protection of human research participants as outlined in the Declaration of Helsinki were strictly followed.

Consent for publication: Not applicable

Availability of data and materials: The datasets used during this study are available from the corresponding author upon reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: This study did not receive any specific funding.

Authors' contributions

LT, JPV, JN and YJ contributed to the conception and design of the study. LT performed formal data analysis and drafted the original manuscript. LT and PAK contributed to study implementation and data acquisition. JN, HML, GRM, JPB, PAK, RM, AAB, ECA, LTM, LMB, YJ, and JPV critically reviewed and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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