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Evaluation Of An Integrated Non-Communicable Diseases Training Program For Ugandan Healthcare Workers

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ABSTRACT

The Uganda Ministry of Health (MOH) is undertaking non-communicable diseases (NCD) training activities for healthcare workers (HCW) as part of its capacity building agenda for addressing NCDs. The MOH is using an integrated, team-based approach to NCD care to routinely screen for and manage NCDs, provide health education, and create an appropriate referral system. This study aimed to evaluate knowledge acquisition resulting from this training. The MOH NCD training curriculum incorporates a participatory and self-directed delivery mechanism. The evaluation was conducted using a pre- and post-, 63-point open-ended and multiple choice test, designed to align with course materials. Paired t-tests between pre- and post-test scores showed highly statistically significant improvements in every demographic category, including overall score for the total sample, age categories, gender, profession, years of experience, and training region ($p<0.001$). The regression model analyzed factors associated with score improvement, and found that baseline score was inversely related to score improvement. Those with the lowest scores at baseline improved the most ($p<0.001$). Sub-group differences were seen for region and profession, as well. The growing burden of NCDs in Uganda is a complex problem requiring a multifaceted approach. This MOH HCW training program is one critical component that begins to address the capacity building need of the country using an integrated, team-based approach to improve patient health outcomes and a participatory delivery method to improve HCW learning and communication skills. There is strong evidence that this training program improved NCD knowledge in Ugandan HCW and that benefits are seen across all demographic groups who received the training. Overall, this training is an important component to address the capacity building needs for NCD care in Uganda.

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BACKGROUND

Non-communicable diseases (NCDs) are responsible for a majority (63%) of deaths globally with most of these (80%) occurring in low and middle-income countries (LMICs).[1] A higher proportion of premature deaths (86%) due to NCDs occur in LMIC, and deaths due to NCDs are more likely to be premature in LMIC (48%) than in high income countries (26%).[1] Across LMICs, NCDs lead to decreased labor supply, decreased labor outputs, and increased absenteeism, contributing to decreased overall country productivity and competitiveness that may exacerbate poverty and inequality.[1,2,3] As urbanization occurs across LMICs, those in already vulnerable regions are placed at even higher risk of NCDs due to risk factors which may accompany urbanization, such as physical inactivity, increased use of tobacco and alcohol, and unhealthier diets.[1] Uganda has one of the highest population growth rates (3.24%) in the world[4], and as such, there is great concern about rapid urbanization leading to a subsequent rise of NCDs throughout the country over the coming years, as well as existing local evidence that these increases are already occurring.[5,6]

Among all causes of mortality in Uganda, the four leading NCD contributors are cardiovascular diseases (9%), cancers (5%), chronic respiratory diseases (2%), and diabetes (1%).[7] There is no national surveillance system for NCDs, and a needs assessment found that only six of the thirteen surveyed regional hospitals were able to provide data on NCDs.[8] Therefore, local data is a critical component to estimating the prevalence for NCDs and their risk factors. Cross-sectional and cohort studies have estimated hypertension prevalence ranging between 20.5% and 34% across five different districts in Uganda.[9,10,11,12,13] Between 1991 through 2006, age-standardized cancer incidence rates increased annually in the Kyandondo

County for males (1.3%) and females (3.2%) between 1991 through 2006.[6] The most common cancers at that time were prostate, Kaposi sarcoma, and esophageal cancers for males and cervical cancer, breast cancer and Kaposi sarcoma for females.[6] A 2013 population study in Eastern Uganda estimated the prevalence of pre-diabetes (8.6%) and diabetes (7.4%) among people ages 35-60 years of age.[14] NCD risk factors have been assessed in different regions; one cohort study estimated overweight for males (7.5%) and for females (16.9%) in the Iganga district,[14] while a cross-sectional study in Kasese estimated overweight for males (14.7%) and for females (16.7%).[11] The same cross-sectional study out of Kasese identified risk factors associated with NCDs and found high rates of physical inactivity (51%) and daily smoking (9.6%).[11] While national level surveillance is unavailable, local data across rural and urban regions of Uganda suggest that NCDs and their risk factors are currently present and that rapid population growth is likely to lead to rapid urbanization which will further exacerbate these issues.

In response to the growing epidemic of NCDs in Uganda, the Ugandan Ministry of Health (MOH) established the Programme for the Prevention and Control of Non-Communicable Diseases in 2006 as a policy priority to address this growing burden.[15,16] This is a comprehensive plan to "improve prevention, detection and control of diabetes and other related NCDs".[16] The plan identifies four priority components including focuses on 1) policy, guidelines and standards; 2) capacity building for improved diagnosis and care; 3) awareness in all population groups, including the nomadic and internally displaced persons; and 4) establishing and strengthening inter-sectoral collaborations with local and international stakeholders.[16] A needs assessment of public sector facilities was conducted in 2013 to identify the areas of greatest need in Uganda for addressing NCDs and one key component identified a current lack of healthcare worker (HCW)

awareness, knowledge, and confidence of NCDs.[8] Increasing HCW awareness and knowledge of NCDs is central to not only identifying and treating NCDs but also to preventing them.[1]

As part of the Ugandan MOH Programme's capacity building agenda, the MOH undertook HCW NCD training activities beginning in 2014 to address these identified service delivery and human capital needs for prevention and treatment. Both the training content and delivery mechanisms were developed using an evidence-based approach to improve patient outcomes and increase HCW knowledge. HCW training content was developed in a way to optimize patient health outcomes using an integrated, team-based approach to NCDs. The integrated approach has many acceptable definitions and has been applied in Uganda most recently to malaria care and childhood illness management; in this MOH HCW training program, it referred to a comprehensive plan for screening, identifying, and managing the most common NCD comorbidities in Uganda, which share risk factors such as physical inactivity, increased use of tobacco and alcohol, and a transition toward unhealthier diets.[15]

While there is limited rigorous academic research on integrated management of NCDs in developing countries, the Chronic Care Model, Integrated Management of Childhood Illness (IMCI), and Integrated Community Case Management of Illness (ICCM) are three integrated approaches which may have transferrable elements. One systematic review of the Chronic Care Model found that four areas make the greatest impact on improving patient health outcomes, including "increasing providers' expertise and skill, educating and supporting patients, making care delivery more team-based and planned, and making better use of registry-based information systems".[17] This improvement in expertise and skills was demonstrated through another systematic review of the IMCI by Nguyen, et al., which found improved provider performance outcomes via correct classification of illnesses (RR=1.93, 95% CI: 1.55-2.24) and appropriate

medication prescription (RR=1.77, 95% CI: 1.53-2.06) compared to those who were untrained in IMCI.[18] In this study by Nguyen, et al., there were limitations in the population level impacts due to limited coverage of IMCI, a fragmented health system, and poor community level promotion.[18] A study of ICCM in Eastern Uganda in children under 5 found a statistically significant improvement ($p<0.001$) in patient adherence to medications (99%) for those in communities randomized to ICCM compared to adherence for those with standard care (96%).[19] This same study found that non-adherence was associated with not understanding provider instructions (OR = 24.5, 95%CI = 2.7–224.5), emphasizing the importance of patient-provider communication.[19] One Cochrane Review of inter-professional care indicated that patient care may be improved in terms of drug use and hospital stay duration.[20] Limitations and recommendations seen in these integrated programs and team-based care models were designated as priority areas for delivering a successful for the Ugandan MOH and their partner organizations.

While training materials focused on providing clinicians with a comprehensive plan for screening, identifying, and managing NCDs, the training delivery was also a critical mechanism for improving provider knowledge. In 1980, Malcolm Knowles' coined the concept of andragogy, the study of how adults learn.[21] Two of the identified components of andragogy included learning that is both self-directed and participatory, aiding in information retention, skills practice, and communication improvement.[21] A more recent realist evaluation of faculty educator development found that engagement through participatory approaches had the greatest influence on learning.[22] These studies help provide the context for how to most effectively deliver trainings. This participatory approach also utilized group work, which further bolstered the team-based care model. The combined training content and training delivery mechanisms are

expected to improve learning outcomes, better reinforcing knowledge acquired and allowing immediate skills application.

Through this HCW training, the MOH aimed to educate HCW about NCD concerns in Uganda, using an integrated approach to common risk factors, screening and early detection, integrated management, and appropriate referrals throughout the health system. As a way to evaluate the program and assess providers' knowledge about NCDs, each 5-day training session begins and ends with a test. In this study, we report on the pre-post test results of the first 169 clinicians who have completed the training. Our objectives were to assess whether and how much knowledge improved as a result of the training and to identify factors associated with change in knowledge. The results of this study are expected to help the MOH identify how to better tailor the training to different groups.

METHODS

Study Sample

In June 2014, a team of two clinicians from the Uganda MOH began a series of six NCD provider trainings for 169 participants in the Ugandan regions of Kampala, Kabale, Jinja, Lira, Mbale, and Soroti. The first training session was held in the capital city of Kampala. Participants were an interdisciplinary group of 34 HCWs (nursing officers, clinical officers, medical officers, and consulting physicians) from across the country. In subsequent trainings, the MOH team went to the regions (Kabale, Jinja, Lira, Mbale, and Soroti). In these regional trainings, 20-30 participants were selected from health centers, district hospitals or regional hospitals by the District Health Officer, the Regional Referral Hospital Director, and the Region's Health Facility

Directors due to their likelihood of involvement in NCD care. The trainings are ongoing. In this outcome evaluation, we are analyzing knowledge acquisition measured by pre- and post- test data for the 169 HCWs who participated in the first six trainings.

Healthcare Worker Training Curriculum Development

The training program was developed by an interprofessional team of 15 physicians and medical officers, two nursing officers, one clinical officer, one nutritionist, and one health educator from the Ugandan MOH, Ugandan Diabetes Association, Mulago Hospital, and Makerere University. The curriculum content was developed using recommendations from the World Health Organization (WHO) Package of Essential Non-communicable Disease Interventions for Primary Health Care,[23] WHO's Cardiovascular Disease (CVD)-Risk Management Package for Low and Medium Resource Settings,[24] the International Diabetes Federation (IDF)'s Global Guidelines for Type 2 Diabetes,[25] and the WHO Integrated Management of Child and Adolescent-Adult Illness (IMCI, IMAI).[26] In addition, material was drawn from the Uganda Clinical Guidelines (UCG) to ensure grounding in the Ugandan context.[27]

The training materials were adapted using an integrated, team-based approach and were ultimately intended to be scaled-up as a train-the-trainer program. (See Figure 1). Detailed information about conducting the training sessions was given in the Facilitator's Guide for NCD Training.[28] Prior to the training, the NCD Case Management and Health Education Desk Guide,[29] which was also prepared by the Ugandan MOH, was distributed to participants; it was intended to provide background information on the training content, as well as to serve as a reference guide after the training. Over the course of five consecutive days, the training covered six disease-specific modules, including hypertension, diabetes, cancer, sickle cell disease,

chronic obstructive pulmonary disease, and asthma. Using three key participatory modalities (group reading, role playing, and group discussion), the focus was on developing HCWs' competencies in the following areas: provider-patient communication skills, NCD assessment and testing, knowledge of complications and referral procedures, use of NCD recording tools, providing lifestyle advice, medications and patient adherence, addressing patient concerns and questions, scheduling follow-up appointments, and health education.

The training delivery method incorporated a participatory approach and a focus on communication. On the first day, participants were divided into groups of three. Each group ideally represented one member from each cadre. These groups worked together on the exercises throughout the training. During the group reading, guided by a trainer, each group read through a module section and then engaged in a role-play as a Patient, a Clinician, and an Observer. The Observer then reported back to the large group to foster a discussion about the role-play. This sequence of activities was repeated throughout the five days of training, which allowed for group members to alternate roles. (See Appendix 1).

Evaluation

The HCW training program was evaluated using a pre- and post- test. The test was created by the course's curriculum developers to align with the course materials. Questions assessed knowledge about common NCDs, their risk factors, their signs and symptoms, and their complications. The questions were both open-ended and multiple choice. Upon starting the training, the test was administered to each participant for individual completion. Answers were reviewed during the training, as part of course materials. The test was then completed again at the conclusion of the training. Facilitators were given a Marking Guide to allocate points

uniformly based on the individual's responses. Any unclear responses were discussed by all of the facilitators to decide how points should be allocated. There were 63 total points possible, which was the score denominator, and the percentage correct was reported out and recorded. (See Appendix 2).

Data Management and Analysis

The analyses for this study proceeded in three steps. First, descriptive statistics were used to summarize participant demographic characteristics (i.e. age, gender, profession, years of experience, and region). Second, we analyzed participants' pre- and post- test scores, both overall and by subgroup. Pre-post differences were assessed using the paired t-test. In addition, between-subgroup differences for both pre-test scores and post-test scores were examined using analysis of variance (ANOVA) or Student's t-test as appropriate. Third, we used multiple linear regression to identify factors associated with change in test score, adjusting for baseline (pre-test) score. Reference groups were selected based on pre-post difference. To ensure the validity of the model, we performed regression diagnostics and checked for multicollinearity.[30] Statistical analyses were considered significant at the 0.05 level. All analyses were performed using SAS 9.3.

Ethics Statement

Ethical approval for this study was obtained by the Yale University Institutional Review Board. Informed consent was obtained to participate in a research study. Local IRB approval in Uganda was not deemed necessary by the MOH. Funding for training activities was provided through a grant from the World Diabetes Foundation to the MOH NCD Programme.

RESULTS

Description of the Training Participants

In total, there were 169 HCWs who participated in the NCD trainings. Nine participants (5.3%) were excluded from analysis due to missing data on one or more variables (years of experience, post-test scores, age). One participant (0.6%) was excluded from analysis due to discordant data (reported similar number of years of experience and age). Thus, the final analytic sample included 159 participants. Table 1 summarizes the demographic characteristics of the sample. Participant ages ranged from 23 to 65 years, with the average being 37.3 years. The majority of participants were male (66.0%). The trainings included physicians and medical officers, henceforth identified collectively as doctors (22.6%), nursing officers (31.5%), and clinical officers (45.9%). The average number of years of experience was 10.9 years (range from 0.5 to 40 years).

Pre- and Post-Test Scores

As the results in Table 2 show, the average pre-test score for all participants was 60.7%, and their average post-test score was 76.0%. The overall average improvement of 15.2 percentage points was statistically significant ($p<0.001$). In addition, significant improvements in NCD knowledge score were observed among all demographic subgroups ($p<0.001$ for all comparisons).

Table 2 also shows that, although significant improvements were achieved by both male and female participants, men had significantly higher scores than women at baseline (63.2% vs. 55.7%, $p=0.005$) and continued to have significantly higher scores after the training (77.3% vs.

73.3%, p=0.029). With respect to profession, doctors had the highest scores and nursing officers had the lowest scores both at baseline (p<0.001) and after the training (p<0.001). Consistently lower test scores were also observed among individuals aged 40+ years and those with 15+ years of experience. Across regions, the highest scores before and after the training (p<0.001 for both) were among participants from Kampala and Soroti.

Factors Associated with Change in Test Score

Table 3 displays the unadjusted and adjusted results of the linear regression analyses. In unadjusted analyses, compared with doctors, the average improvement in NCD knowledge score was significantly higher among both nurses (8.9 percentage points, p<0.001) and clinical officers (6.6 percentage points, p=0.005). In addition, although not statistically significant at the 0.05 level, average improvement was 3.5 percentage points higher among women than among men (p=0.076). Significant differences were also found across regions; Jinja and Mbale had the lowest average pre-test scores and demonstrated the greatest gains. After adjustment, significantly lower improvements were observed in nursing officers compared with doctors (-5.1 percentage points, p=0.027) and in participants aged 40+ years compared with those aged <30 years (-5.2 percentage points, p=0.051). Regional differences persisted, but now the greatest gains were found to be in Soroti, Mbale, and Kampala compared with Kabale. Finally, in both unadjusted and adjusted analyses, baseline (pre-test) score was inversely associated with improvement.

DISCUSSION

The MOH NCD training was designed for Ugandan HCW by combining various elements demonstrated to improve both HCW learning and patient outcomes. The trainings were participatory and focused on practicing communication skills to improve HCW learning, while also utilizing a team based approach and an integrative care model demonstrated to improve patient health outcomes. The training had a strong impact on HCW knowledge acquisition, showing highly statistically significant differences between pre- and post- test scores in every demographic category that was analyzed ($p<0.001$).

The regression model analyzed factors associated with score improvement, using the group with the smallest score difference (post- test score minus pre- test score) as the referent group. After adjusting for age, gender, cadre, training region, and years of experience, baseline score made a highly statistically significant impact on test score difference. This shows that those with the highest scores at baseline had the least room for growth in their scores ($p<0.001$). This is an important finding for implementation in other settings, as it shows that the training is the most beneficial for those who begin with the lowest scores.

There were statistically significant subgroup differences in test score improvement including among nursing officers and regions. After adjusting, nursing officers improved 5.106 percentage points less than doctors ($p=0.027$), which may indicate that training materials could be better tailored to that role in NCD care. There were also regional differences, which may have resulted from unmeasured differences on the facilities in each of those locations. Part of the training delivery is contingent upon self-learning, and there may have been differences in previous exposures to NCDs, making it difficult to incorporate those exposures into the training.

These differences are important because they may indicate that modifications to the training could improve its effectiveness for groups who benefitted less.

Limitations

This study is not without limitations, including the provision of the post-test immediately upon conclusion of the training. This would limit the assessment to only measure short term knowledge acquisition. However, due to the practical nature of the training and the coupling of equipment from the MOH, this knowledge would be immediately applicable following the training. Furthermore, participants were provided with a reference guide for future use.

Selection bias is also possible with this training, as they represented a highly motivated group of people and were not chosen at random. This was a purposeful sample of individuals, selected because of their likelihood of involvement with NCD care in the future. However, these participants were not necessarily currently involved in NCD care, and by purposefully selecting individuals, the program can be more readily scaled-up as a train-the-trainer program using these participants as future training leaders.

Finally, there is a limitation in that there was likely regression to the mean, which prohibits us from seeing the full growth potential for participants. In looking at the average post-test score of 76.0, however, there is an even more demonstrable need to continue with this training.

The growing burden of NCDs in Uganda is a complex problem requiring a multifaceted approach. This MOH HCW training program is one critical component that begins to address the capacity building need of the country using an integrated, team based approach to improve patient health outcomes and a participatory delivery method to improve HCW learning and

communication skills. There is strong evidence that this training program improved NCD knowledge in Ugandan HCW and that benefits are seen across all demographic groups who received the training. Overall, this training is an important component to address the capacity building needs for NCD care in Uganda, and may serve as a model for other developing countries faced with rising NCDs.

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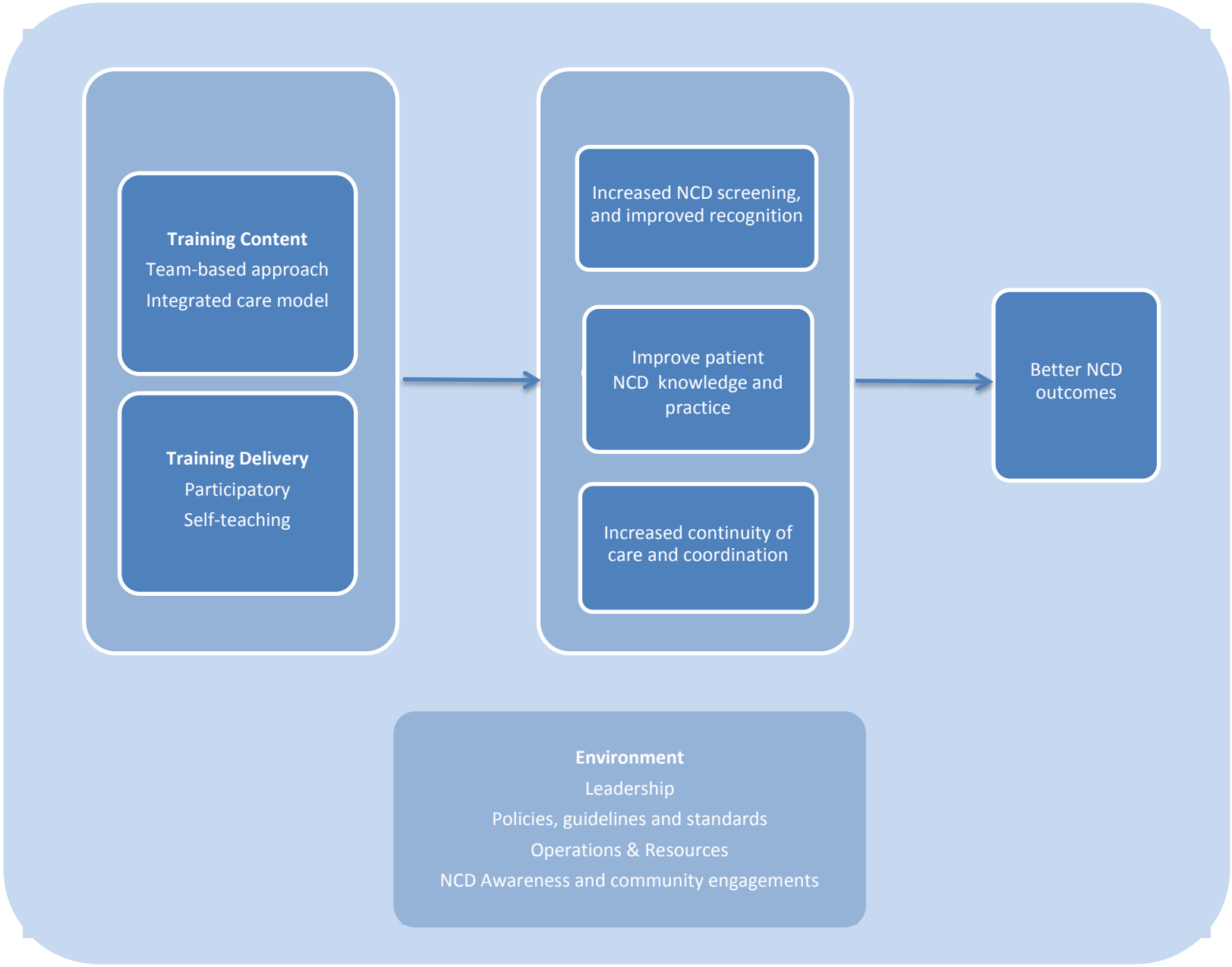
Figure 1. Ministry of Health NCD Healthcare Worker Theory of Change



Appendix 1. Training Excerpt

Role play 1

(Ask the facilitator if you have any questions).

The patient: You are Sam, a 58 year old man who has never been to the clinic before. You have had chest pain for the last week and now have some shortness of breath. Your chest pain comes on during exercise and also when you are sitting at home with your family. You have never had these symptoms before but are worried as your father used to get chest pain. You are not currently taking any tablets or drugs. You smoke about 25 cigarettes a day and have smoked since you were 25.

The health worker: You are seeing Sam in the clinic. This is the first time that you have met him but you have looked after his father before who had angina (chest pain). As he walks into the clinic you notice that he looks flushed and is overweight.
Start your consultation using page 10-14 of the desk guide.

The observer: The health worker should ask about Sam about his chest pain and other symptoms, and make an assessment as to whether he needs urgent referral. If the health worker asks to examine the patient tell them the following results: Sam's blood pressure (BP) is 87/50 mmHg and his RR is 28.
Consider the following when observing the role play:

- Did the health worker ask the patient the correct questions?
- Was the patient appropriately referred if they had symptoms or signs of severe illness on examination?
- If the patient was over 50, did the health worker take the blood pressure and measure and calculate his BMI and Waist Hip ratio?

Appendix 2. Sample of pre- and post- test questions from the marking guide

NCDs Regional training, June 2014

PRE & POST-TEST MARKING GUIDE

1. List six common non communicable diseases (any of) 1 mark per answer (6 marks)

a)	CVD (any of the CVDs e.g., angina, heart attack, Transient Ischaemic Attack (TIA), stroke, peripheral vascular disease, Congenital Heart Diseases and Rheumatic Heart Disease.
b)	Hypertension
c)	Diabetes
d)	COPD
e)	Asthma
f)	Cancer
g)	Sickle cell disease
h)	Any Mental Health condition (e.g., depression, BAD, Schizophrenia)
i)	Injuries
j)	Any other NCDs not listed

2. List the five non communicable diseases prioritised by WHO in Uganda
1 mark per answer (5 marks)

a)	CVD
b)	Diabetes
c)	Chronic respiratory disease (COPD, Asthma)
d)	Cancer
e)	Sickle cell disease

3. Define hypertension: Sustained elevation of blood pressure of ≥140/90
½ mark per underlined section (1 mark)

4. List four complications of hypertension (any of)
1 mark per answer (5 marks)

a)	Heart; arrhythmia, heart failure,
b)	Brain; Stroke, hypertensive encephalopathy
c)	Eye; Retinopathy, blindness
d)	Kidney; nephropathy, kidney failure
e)	Blood vessels; CAD, peripheral vascular disease

5. Mention four common symptoms of heart failure (any of) 1 mark per answer (4 marks)

a) **Resulting from low cardiac output**
- Fatigue
- Weakness
- Exercise intolerance
- Anorexia
- Palpitations

b) **Resulting from congestion of the lungs;**
- Dyspnea
- Orthopnea
- Paroxysmal nocturnal dyspnea
- Wheezing

c) **Resulting from congestion of peripheral tissues;**
- Peripheral edema (legs)
- Right upper quadrant discomfort (liver).

6. Mention five ways to prevent cardiovascular disease? 1 mark per answer (5 marks)

a)	Weight control
b)	Physical activity
c)	Avoid alcohol abuse
d)	Healthy eating (avoid fatty foods, ↑fruits and vegetables)
e)	No tobacco use

7. What is cancer?
Uncontrolled proliferation/growth/spread of abnormal cells in any part of the body
½ mark per underlined section (1 mark)

8. Mention one cancer associated with excessive alcohol intake? Hepatocellular carcinoma or liver cancer 1 mark

9. Mention four general signs or symptoms that may indicate cancer (any of) 4 marks

- Prolonged fever, weight loss and excessive sweating
- Swellings/ lumps anywhere on/ in the body (e.g. neck, armpit, abdomen, skin, breast)
- Persistent cough/ hoarse voice
- Progressive difficulty in swallowing
- Change in bowel habits, loss of appetite, feeling full (early satiety)
- Abdominal distension, pain
- Abnormal bleeding e.g. in stool, urine, sputum or vomit
- Abnormal vaginal discharge (may be blood stained or foul smelling)
- Abnormal vaginal bleeding: post-coital, inter-menstrual cycles, post- menopausal
- Urinary urgency, frequency or obstruction

Table 1. Description of the training participants*

Characteristic	N=159
Age (years)	37.3 ± 9.7
<30	44 (27.7)
30-39	52 (32.7)
40+	63 (39.6)
Gender	
Male	105 (66.0)
Female	54 (34.0)
Profession	
Doctor	36 (22.6)
Nursing Officer	50 (31.5)
Clinical Officer	73 (45.9)
Years of Experience	10.9 ± 9.0
<5	49 (30.8)
5-14	66 (41.5)
15+	44 (27.7)
Training Region	
Kabale	25 (15.7)
Kampala	30 (18.9)
Jinja	29 (18.2)
Lira	20 (12.6)
Mbale	29 (18.2)
Soroti	26 (16.4)

*Table values are mean ± SD for continuous variables and n (%) for categorical variables.

Table 2. Pre- and post- test scores*

Characteristic	Pre-Test Score	Post-Test Score	Difference in Test Score	P for Paired T-Test
Overall	60.7 ± 15.8	76.0 ± 11.0	15.2 ± 11.7	<0.001
Age (years)				
<30 (n=44)	63.3 ± 15.6	77.8 ± 12.0	14.5 ± 10.6	<0.001
30-39 (n=52)	61.9 ± 16.4	78.0 ± 9.4	16.0 ± 12.8	<0.001
40+ (n=63)	57.8 ± 15.3	73.0 ± 11.0	15.1 ± 11.5	<0.001
P for ANOVA	0.173	0.022		
Gender				
Male (n=105)	63.2 ± 15.2	77.3 ± 11.2	14.1 ± 11.6	<0.001
Female (n=54)	55.7 ± 16.0	73.3 ± 10.1	17.5 ± 11.6	<0.001
P for T-Test	0.005	0.029		
Profession				
Doctor (n=36)	71.9 ± 15.9	81.3 ± 11.0	9.4 ± 11.0	<0.001
Nursing Officer (n=50)	52.5 ± 14.7	70.8 ± 9.8	18.3 ± 11.1	<0.001
Clinical Officer (n=73)	60.8 ± 13.0	76.8 ± 10.4	16.0 ± 11.5	<0.001
P for ANOVA	<0.001	<0.001		
Years of Experience				
<5 (n=49)	65.0 ± 14.5	77.6 ± 11.6	12.6 ± 9.9	<0.001
5-14 (n=66)	60.6 ± 15.9	76.9 ± 10.1	16.3 ± 12.9	<0.001
15+ (n=44)	56.0 ± 16.1	72.6 ± 11.2	16.7 ± 11.3	<0.001
P for ANOVA	0.022	0.063		
Training Region				
Kabale (n=25)	63.2 ± 15.4	71.5 ± 11.7	8.3 ± 9.2	<0.001
Kampala (n=30)	68.9 ± 12.9	80.0 ± 10.6	11.1 ± 10.7	<0.001
Jinja (n=29)	49.6 ± 11.7	68.9 ± 8.5	19.3 ± 10.9	<0.001
Lira (n=20)	61.7 ± 17.7	75.7 ± 10.5	14.0 ± 10.2	<0.001
Mbale (n=29)	50.8 ± 11.9	75.3 ± 8.7	24.6 ± 11.3	<0.001
Soroti (n=26)	71.4 ± 12.0	84.1 ± 9.4	12.7 ± 9.8	<0.001
P for ANOVA	<0.001	<0.001		

* Table values are mean ± SD

Table 3. Multiple linear regression model of factors associated with change in test score*

	Unadjusted		Adjusted**	
Characteristic	**β (SE)**	**P**	**β (SE)**	**P**
Age (years)				
<30 (n=44)	1.000	-	1.000	-
30-39 (n=52)	1.506 (2.403)	0.532	-0.459 (2.000)	0.819
40+ (n=63)	0.592 (2.305)	0.798	-5.200 (2.644)	0.051
Gender				
Male (n=105)	1.000	-	1.000	-
Female (n=54)	3.464 (1.942)	0.076	0.329 (1.547)	0.832
Profession				
Doctor (n=36)	1.000	-	1.000	-
Nursing Officer (n=50)	8.850 (2.463)	<0.001	-5.106 (2.290)	0.027
Clinical Officer (n=73)	6.583 (2.295)	0.005	-2.157 (1.778)	0.227
Years of Experience				
<5 (n=49)	1.000	-	1.000	-
5-14 (n=66)	3.658 (2.189)	0.097	2.130 (2.015)	0.293
15+ (n=44)	4.095 (2.411)	0.091	4.361 (2.917	0.137
Training Region				
Kabale (n=25)	1.000	-	1.000	-
Kampala (n=30)	2.853 (2.820)	0.313	5.443 (2.141)	0.012
Jinja (n=29)	11.061 (2.842)	<0.001	2.843 (2.261)	0.211
Lira (n=20)	5.720 (3.124)	0.069	4.209 (2.319)	0.072
Mbale (n=29)	16.306 (2.642)	<0.001	8.897 (2.175)	<0.001
Soroti (n=26)	4.405 (2.917)	0.133	9.370 (2.248)	<0.001
Baseline Score	-0.530 (0.041)	<0.001	-0.594 (0.055)	<0.001

*Change in test score is defined as the difference between post-test score and pre-test score

**Adjusted for age, gender, cadre, training region, years of experience, and baseline test score