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NCDs Made Easy Program: A Web-Based Telehealth Platform for Early Detection and Management of Chronic Kidney Diseases and Related Chronic Non-Communicable Diseases

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Abstract

Background: The "NCDs Made Easy" program is a web-based telehealth platform designed to facilitate early detection, management, and research of chronic kidney disease (CKD) and related chronic non-communicable diseases (NCDs) such as diabetes mellitus, hypertension, obesity, and cardiovascular diseases. This study evaluates the platform's effectiveness in a resource-limited setting in Africa. **Methods:** We conducted a prospective observational cross-sectional study involving 600 adult participants from a remote village near Damanhur city, Egypt. The study utilized telemedicine for data entry, physical measures, and blood and urine sampling, performed by trained paramedical staff and community volunteers under supervision by nephrologists. Data were collected, coded, and uploaded automatically by the program into an Excel file, then statistically analyzed using Stata/SE © version 14.2. The primary outcomes were the incidence of CKD, diabetes mellitus, hypertension, obesity, and cardiovascular disease. Secondary outcomes included CKD/NCD risk factors and participants' NCDs literacy. **Results:** The study included 600 participants, with 65.5% being female. The mean age was 42.22 ± 12.05 years. Hypertension was prevalent in 19.67% of participants, with 27 new cases identified, and 50% of hypertensive participants had uncontrolled blood pressure. Obesity was assessed in 571 participants, with a mean BMI of 31.69 ± 7.84 kg/m^2 and 38% showing visceral obesity. Diabetes mellitus was present in

11.33% of participants, with 6 new cases and 20 prediabetic cases identified. CKD evidence was assessed through urine albumin/creatinine ratio (ACR) and estimated glomerular filtration rate (eGFR) by CKD Epi equation, with proteinuria detected in 8.54% of participants. Serum creatinine and eGFR were measured, classifying CKD stages according to Kidney disease improving global outcome (KDIGO) CKD guidelines. **Discussion:** The "NCDs Made Easy" program effectively identified undiagnosed cases of hypertension, diabetes, and CKD, highlighting the importance of regular screening and early intervention. The platform's integration of evidence-based guidelines into a digital format allows for standardized management, optimizing pre-ESRD care and addressing workforce shortages by enabling non-specialist personnel to implement professional guidelines. The automatic data extraction and coding into Excel files support comprehensive data analysis and public health strategy development. **Conclusion:** The "NCDs Made Easy" program represents a scalable, innovative solution for improving CKD and NCD management in low-resource settings. Further large-scale studies are necessary to evaluate long-term impacts on disease prevalence, progression, healthcare costs, and patient quality of life.

Keywords

Chronic Kidney Disease, Non-Communicable Diseases, Telehealth, Early Detection, Primary Care, Africa, KDIGO, ISN, Digital Health

1. Introduction

Africa faces significant health disparities, with less than half of its population accessing essential health services, and most countries allocating less than 10% of gross domestic product (GDP) to healthcare [1]. The rising prevalence of CKD and NCDs—such as diabetes, hypertension, obesity, and cardiovascular diseases—poses a substantial public health challenge, leading to increased morbidity, mortality, and economic burden [2].

Effective CKD management requires early detection, primary care engagement, and timely specialist intervention. However, barriers such as geographic inaccessibility, workforce shortages (**Figure 1**), low disease awareness, and inadequate screening hinder optimal care delivery. The Global Kidney Health Atlas (GKHA) 2019 highlights the need for expanded registries and early detection programs, particularly in low-income settings [3].

Emerging telehealth solutions offer promise for overcoming these barriers. The "NCDs Made Easy" platform was developed over a decade to leverage telemedicine for improving CKD/NCDs management [4]-[7]. It supports primary care providers with evidence-based guidelines in a user-friendly digital interface. This cloud-based program was tested in the Egypt Information Prevention and Treatment of CKD (EGIPT-CKD) project, funded by the International Society of Nephrology [8]-[10].

In this manuscript, we validate the platform through a cross-sectional study con-

ducted in a remote, underserved village in Damanhur city, Egypt, demonstrating the role of telemedicine in bridging gaps in CKD/NCDs care in a low-resource country.

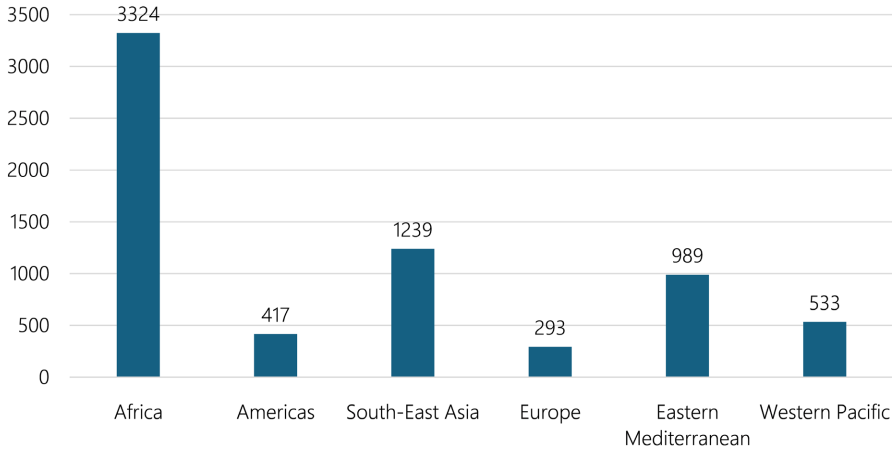


Figure 1. The global number of people for every single medical doctor according to the world health statistics 2020.

2. Study Aim and Objectives

2.1. Aim

To evaluate the effectiveness of the "NCDs Made Easy" web-based telehealth platform: http://www.telencds.com/ in promoting early detection, prevention, management, and research of CKD and related NCDs in underserved populations in Africa.

2.2. Specific Objectives

Early Detection: To leverage telemedicine for identifying CKD/NCDs, and associated cardiorenal risk factors, especially in remote and underserved areas. Hypothesis: There is a higher prevalence of CKD/NCDs and their risk factors among participants, many of whom are unaware due to limited primary healthcare access.

Prevention: To provide a simple, effective tool for early identification and management, enabling timely intervention that can improve outcomes. Hypothesis: Early detection facilitates interventions that favorably impact disease progression.

Optimise pre-end stage renal disease (ESRD) care: The platform aims to improve pre-ESRD care by enabling early detection of CKD complications. Hypothesis: Many patients start renal replacement therapy with advanced issues and unplanned vascular access. The system optimizes low-clearance clinics by timely identifying complications and applying evidence-based recommendations.

Workforce Support: To address healthcare worker shortages by enabling non-specialist personnel to implement guideline-based management through automated, participant-centered reports and visit action plans.

Health Literacy: To raise awareness among participants about CKD/NCDs and their long-term consequences via automated reports, educational outreach, and guidelines implemented by trained non-professional personnel. Hypothesis: Awareness levels will improve through these interventions.

Data Collection and Public Health: To build a comprehensive database of CKD/NCDs in primary healthcare and deprived areas, facilitating data-driven public health strategies and research. Hypothesis: Automated data extraction and coding will support analysis and inform health policies.

3. Methodology

3.1. Study Design

This study will employ a prospective observational cross-sectional design, including 600 adult participants in a remote village.

3.2. Primary and Secondary Outcome

Primary outcomes: Incidence of CKD, diabetes mellitus, hypertension, obesity and cardiovascular disease.

Secondary outcomes: all CKD/NCDs risk factors and participants NCDs literacy.

3.3. Inclusion and Exclusion Criteria

Inclusion criteria: Any adult person ≥18 years old and residing in the target village regardless of gender, religion, or ethnicity and signed informed consent for participation.

Exclusion criteria: Any adult person <18 years old, any person not residing in the target village, or known ESRD patient, or refuse to sign the informed consent.

- **Confounders and covariates:** Several potential confounders and covariates will be accounted for in our study, given its telemedicine-based design and the involvement of paramedical staff and community volunteers for data entry, physical measures, blood, and urine sampling. Measures to address these include:

- **Training:** Detailed and instructive training for the assigned team on information technology, including login procedures and using the online program for data registry.
- **Data Validation:** All entry fields have validations to ensure correct data entry.
- **Equipment:** Automated blood pressure manometers (Omron M6 Comfort) and digital weight and height scales were used to minimize personal errors.
- **Questionnaire Training:** Dedicated training on how to administer the questionnaire and a course on the natural history, diagnosis, and management of CKD/NCDs.
- **Infection Control:** Paramedical staff received training on infection control measures and standard precautions for blood and urine sampling.

3.4. Recruitment and Sampling Methods

- **Community Engagement:**

A community-based meeting was held with the village leaders, where the principal investigator discussed the benefits of the project and its positive impact on the village inhabitants. The discussion included details on the participation pro-

cess, associated risks and benefits, the signing of informed consent, and the right to withdraw at any time.

- **Sample Size Collection:**

The village has a total population of approximately 1,000 individuals. The study included the adult population (≥18 years old), resulting in a total sample size of 600 participants.

3.5. Data Collection and Laboratory Methods

- **Volunteer Assignment:**

The village consists of 22 main families. We assigned 10 motivated volunteers to cover the total number of participants, with 2 volunteers designated as team leaders. Each volunteer was responsible for 50-70 participants. The team included 2 nursing staff from the village for blood and urine sampling.

- **Sample Handling:**

Blood and urine samples were collected daily identified by barcode and transported in an incubator to the headquarters laboratory of the Damanhur Medical National Institute (DMNI) for chemical analysis on daily bases. Tests included fasting blood glucose, serum creatinine, urinalysis, and urine albumin/creatinine ratio.

- **Data Entry:**

Laboratory data were coded and results were entered into the online program by the headquarters team at DMNI into the participants' electronic medical record through the unique barcode system.

3.6. Statistical Analysis

The program was adjusted to perform all necessary calculations and classify categorical variables. All obtained measures were extracted and coded into an Excel file. This data was then fed into an IBM/PC compatible computer and statistically analyzed using Stata/SE © version 14.2. Simple descriptive statistics included frequency distributions, cross-tabulations, means, and standard deviations for each of the obtained parameters. Multivariate logistic regression analysis for adjusted odds ratio.

Statistically significant results were considered if $p < 0.05$ and were marked by "*" in tables.

3.7. Ethical Considerations

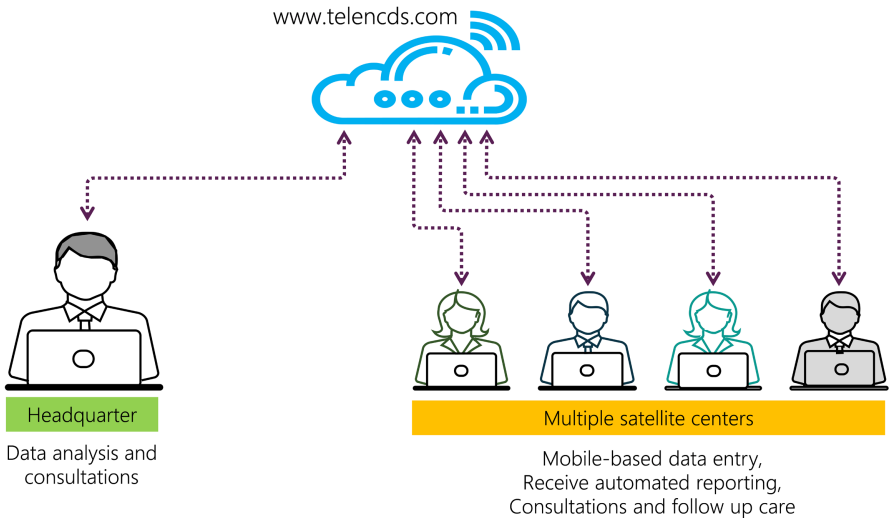
This study was designed in adherence to ethical standards and underwent review and approval by the institutional Ethics Review Board at General organization of teaching hospitals and institutes (GOTHI), Egypt under registration number. All participants provided informed consent after receiving a thorough explanation of the study procedures, potential risks, and benefits. Data privacy and confidentiality were strictly maintained; all data was stored in a secure, encrypted database, and participants were identified by study IDs rather than personal information.

Participants were informed that they could withdraw from the study at any time without affecting their standard care.

3.8. NCDs Made Easy Program:

- *Overview*

The "NCDs Made Easy" program is a web-based telehealth tool designed to facilitate the early identification, prevention, and management of CKD and related NCDs. Aligned with the international society of nephrology (ISN) screening and intervention toolkit and and KDIGO CKD guidelines/2024, it provides an electronic portal for entering demographic, clinical, and laboratory data to assess individual renal and cardiovascular risk (**Figure 2**).



Abbreviations: NCDs, Chronic non-communicable diseases.

Figure 2. Telemedicine diagramatic representation of "NCDs Made Easy Program".

- *Integration of Guidelines*

The platform integrates definitions, risk assessments, diagnosis, follow-up care, referrals, and management protocols through coded messages linked to specific variable values within the database. This ensures standardized, guideline-based management.

- *Pilot Studies*

Pilot studies funded by the ISN Clinical Research Program have demonstrated the platform's effectiveness in community screening programs. The program aims to bridge the gap between primary care and specialists, particularly in resource-limited settings, by enabling non-specialist healthcare workers to implement standardized, evidence-based protocols [10] [11].

- *Data Entry and Risk Assessment*

Data entry is conducted via a secure, web-based interface where healthcare workers input patient demographic, clinical, laboratory, and lifestyle data. Embedded algorithms assess individual risk levels for CKD and other NCDs based on

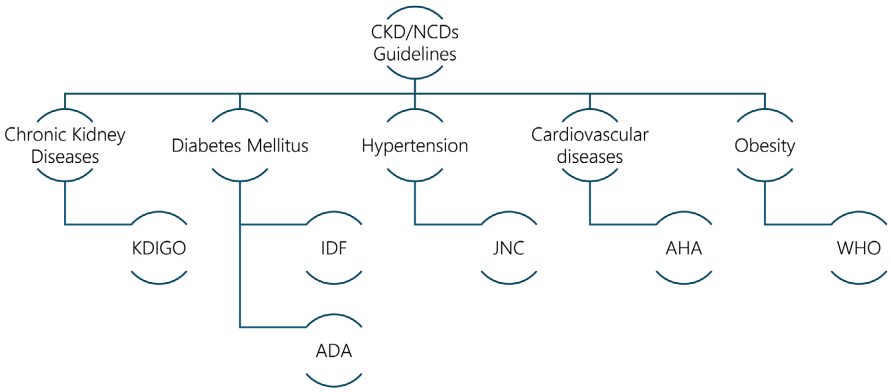
the integrated guidelines, informing personalized management plans that include lifestyle modifications, pharmacotherapy, and follow-up scheduling.

- *Deployment and Multilingual Support*

Designed for deployment in primary care settings, community screening events, and remote clinics, the system supports multilingual input to serve diverse populations. Data privacy and security are maintained in compliance with international standards like The General Data Protection Regulation (GDPR).

- *Adherence to ISN Algorithms*

The program adheres to the ISN algorithm for CKD and NCDs screening and management, incorporating the latest KDIGO guidelines, including updates on CKD-related anemia and mineral and bone disorders [8]. This structured, evidence-based approach facilitates early detection, risk stratification, and comprehensive management tailored for resource-limited settings (**Figure 3**).



Abbreviations: CKD, Chronic kidney diseases; NCDs, Chronic non-communicable diseases; KDIGO, Kidney diseases improving global outcome guidelines; IDF, International diabetes federation; ADA, American diabetes association; JNC, Joint national committee for hypertension; AHA, American heart association; WHO, World health organization.

Figure 3. The CKD/NCDs guidelines used in the in "NCDs Made Easy Program" database.

- *CKD Diagnosis and Management*

For CKD diagnosis, the platform automatically identifies CKD based on input data, evaluating estimated GFR, proteinuria status, and radiological assessments according to KDIGO criteria. It then generates appropriate management plans aimed at delaying progression of kidney and cardiovascular health.

- *Data Entry*

During participation in the "NCDs Made Easy" program, individuals undergo a comprehensive assessment through simplified questionnaires designed for early detection and prevention of NCDs. Data collection spans multiple domains:

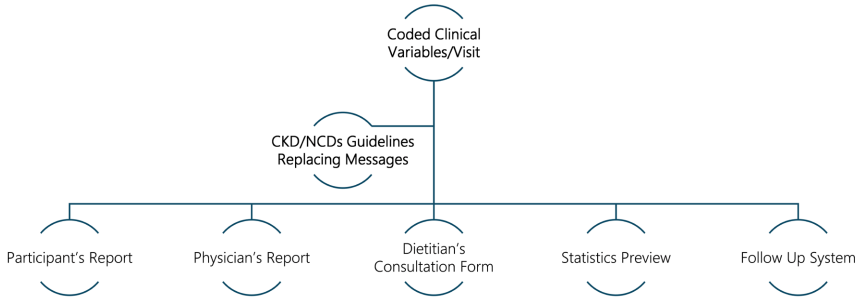
- **Personal and Demographic Data:** Includes name, age, gender, race, education, occupation, insurance status, and location.
- **Lifestyle and Medical History:** Covers smoking, diet, physical activity, and history related to CKD, diabetes, hypertension, cardiovascular disease, and other risk factors.

- **Physical Measures:** Records blood pressure, weight, height, waist, and hip circumference.
- **Investigations:** Comprises laboratory tests such as urine dipstick, serum creatinine, urine albumin/creatinine ratio, urine protein/creatinine ratio, lipid profile, complete blood count, electrolytes, nutritional markers, bone profile (calcium, phosphorus, iPTH), and additional tests like abdominal ultrasound, ECG, echocardiography, fundus examination, renal biopsy, or histopathology as needed.

These forms include validation checks to ensure data accuracy and completeness and support multilingual input to accommodate diverse user populations. All collected data are automatically linked to a coded database aligned with KDIGO and NCDs evidence-based management guidelines.

- *Medical Reports*

The "NCDs Made Easy" program produces comprehensive, coded output reports for participants, physicians, and dietitians after each visit as shown in Figure 4. Each participant receives a unique international code, and all data—including physical measurements, point-of-care tests, and lab results—are automatically coded and stored in a centralized database. The number of messages in each report varies according to patient-specific variables such as risk factors, kidney function level, and visit details, without altering the overall structure or narrative of the report.



Abbreviations: CKD, Chronic kidney diseases; NCDs, Chronic non-communicable diseases.

Figure 4. Display of "NCDs Made Easy Program" outcome reports.

- **Participant Report:** Provides detailed diagnoses for NCDs and CKD, including target blood pressure, weight, waist measurements, metabolic syndrome, and cardio-renal risk scores (e.g., Framingham). It offers personalized risk assessments, lifestyle and management recommendations, CKD progression delay strategies, and guidance on preventing complications. For CKD patients, it includes pre-ESRD education, vaccination advice, renal replacement therapy planning, referral notes, and dietary instructions. It consists of more than 300 replacing message based on the clinical situation and laboratory data/visit.
- **Dietitian Consultation Form:** Based on visit's data, this form offers tailored dietary guidance addressing NCDs, eGFR levels, proteinuria, electrolytes, min-

eral and bone disorders, and anemia, supporting personalized dietary prescriptions.

- **Physician Report:** Summarizes diagnoses, risk scores, and treatment plans aligned with evidence-based guidelines (KDOQI, KDIGO, ISN), facilitating routine CKD screening and management.
- **Additional Modules:**

Includes drug prescription tools (available in English and Arabic), laboratory follow-up reports, and modules for NCDs special events such as:

- CKD/NCDs e-health risk assessment,
- World Kidney Day,
- World Hypertension Day,
- World Diabetes Day,
- Heart Failure Awareness Day.

All reports are generated automatically, ensuring standardized, guideline-based management and efficient data utilization for research and health planning.

- *Supporting CKD/NCDs research:*

The "NCDs Made Easy" program enhances research efforts by streamlining data collection, study management, and analysis. All participant visit's data, investigations, and calculations are automatically coded and exported into Excel files, reducing manual errors, saving time, and lowering costs. The platform allows principal investigators to add multiple study topics and enroll participants into various predefined subgroups—such as CKD, proteinuria, low GFR, or mineral and bone disorder (MBD)—with the flexibility to include participants in multiple categories. Study data are accessible exclusively to the investigator, who can extract datasets at any time for interim analyses. This facilitates ongoing comparison between groups at baseline and follow-up, supporting robust statistical evaluation and advancing research on CKD and NCDs.

- *IT Architecture*

The platform adopts a cloud-based architecture, utilizing scalable servers to handle large datasets across multiple sites. Key IT features include:

- User Authentication: Secure login systems with role-specific dashboards.
- Multilingual Support: User interface available in multiple languages.
- Offline Functionality: Data entry can be performed offline by local networks.
- Interoperability: API integrations with laboratory and hospital information systems (Option).
- Audit Trails: Detailed logs of data access and modifications.
- User Management & Training: Role-specific access controls and training modules.
- Responsiveness & Device Compatibility
- SSL/HTTPS Enforcement
- Using Microsoft SQL Server 2016

- *Data Security and Privacy:*

To ensure the security and privacy of participant data, several concrete measures have been implemented. Data is encrypted both in transit and at rest using Ad-

vanced Encryption Standard and stored on a secured dedicated server with robust access controls. Access is restricted to authorized personnel through role-based access controls. The data was audited by the research department and ethical committe, Damanhur medical national institute. Participant data is anonymized to protect privacy, with identifiable information separated and securely stored. Compliance with the General Data Protection Regulation includes obtaining explicit consent, ensuring the right to access and rectify data, and implementing data minimization principles. These measures uphold the highest standards of data security and privacy, safeguarding participants' sensitive information.

- *Future Enhancements*

Plans include developing mobile app versions for smartphones and tablets to increase accessibility, and deploying AI-driven analytics for predictive CKD/NCDs risk modeling.

4. Results

The study included 600 adult participants residing in a remote village near Damanhur city, Egypt, with 397 female participants (65.5%). The mean age of all participants was 42.22 ± 12.05 years (Table 1). The personal history of NCDs among participants included diabetes mellitus (11.3%), hypertension (19.67%), obesity (24.7%), and chronic kidney disease (2.83%) as shown in Table 1 and Table 2. Additionally, risk factors for the development and progression of CKD were identified: 30.33% of participants reported using over-the-counter medicines, 6.17% used herbal medications, 7.1% had a history of renal stones, and 4.1% had history of treated hepatitis C virus infection.

Table 1. Descriptive data of physical measures and laboratory investigations.

Variable Name	Number	Minimum	Maximum	Mean ± SD
Age (Year)	600	18	90	42.22 ± 12.05
SBP (mmHg)	584	61	195	115.76 ± 17.92
DBP (mmHg)	584	50	121	77.15 ± 35.27
MAP	584	60	131	92.58 ± 26.36
FBG (mg/dl)	208	51	420	90.40 ± 38.17
RBG (mg/dl)	263	55	266	92.56 ± 26.31
Weight (Kg)	582	43	186	80.81 ± 16.17
Height (cm)	582	100	188	161.69 ± 09.75
BMI (Kg/m^2)	582	17.8	57.4	31.69 ± 07.84
Waist circumference (cm)	571	60	159	109.42 ± 14.84
Hip circumference (cm)	571	61	155	109.44 ± 14.83
WHR	571	0.61	02.07	0.88 ± 0.14

Continued

uACR (mg/g)	397	1.1	1315	20.92 ± 92.77
Serum Creatinine (mg/dl)	441	0.04	4.13	0.84 ± 0.27
estimated GFR (ml/min/1.73 m^2)	441	17.2	233	127.57 ± 20.78

Abbreviations: SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure, FBG: Fasting blood glucose, BMI: Body mass index, WHR: Waist/hip ratio, ACR: urine Albumin/creatinine ratio.

Table 2. Descriptive data of lifestyle issues and medical history.

Variable Name	Categories	
	Number	%
Gender	Male: 207/600	34.50%
	Female: 397/600	65.50%
History of kidney disease	17/600	2.83%
History of diabetes	68/600	11.33%
New Diabetic participants	6/419	1.4%
Prediabetics participants	20/419	4.8%
Prediabetic participants	20/287	6.5%
Total number of diabetic participants	61/310	16.44%
History of hypertension	118/600	19.67%
New hypertensive participants	27/482	5.6%
Total hypertensive participants	145/600	25.4%
History of cardiovascular disease (CVD)	39/600	6.50%
Over-the-counter medicines	182/600	30.33%
Herbal medications	37/600	6.17%
History of renal stones	43/600	7.1%
Hepatitis-C virus treatment	25/600	4.17%
Family history of kidney disease	82/600	13.67%
Family history of diabetes mellitus	264/600	44.00%
Family history of hypertension	311/600	51.83%
Family history of CVD	43/600	7.16%

Hypertension was prevalent in 118 participants (19.67%), with mean systolic blood pressure of 115.76 ± 17.92 mmHg, diastolic blood pressure of 77.15 ± 35.27 mmHg, and mean arterial pressure of 92.58 ± 26.36 mmHg. The total number of

hypertensive participants after screening increased to 145, with 27 newly discovered cases, constituting 18.6% of the total hypertensive participants. Among those with a history of hypertension, 50% had uncontrolled blood pressure according to the 10th Joint National Committee on Hypertension classification. Specifically, 33 participants (29%) were in stage 1 hypertension, and 24 participants (21%) were in stage 2 hypertension (Table 2 and Table 3).

Table 3. Percentage distribution of participants according to: body mass index (BMI), estimated glomerular filtration rate (eGFR), arterial blood pressure control according to 10th JNC, and American Diabetes Association (ADA) based on blood glucose measurement.

	Category	Number	%
BMI classification of participants (n = 582)	Underweight (<18 kg/m^2)	2	0.35%
	Normal (18 - <25 kg/m^2)	101	17.44%
	Overweight (25 - <30 kg/m^2)	161	29.71%
	Obese (30 - <35 kg/m^2)	98	16.93%
	X-obese (≥35 kg/m^2)	45	7.77%
eGFR categories (n = 441): (ml/min/1.73 m^2)	Stage 1	349	79.14%
	Stage 2	84	19.05%
	Stage 3	6	1.36%
	Stage 4	1	0.23%
	Stage 5	1	0.23%
Stage of Arterial blood pressure (n = 114) hypertensive participants	Controlled ABP	57	50%
	Stage 1 hypertension	33	29.0%
	Stage 2 hypertension	24	21.0%
ADA classification of participants (n = 418) by blood glucose	Normal	392	93.8%
	Prediabetes	20	4.8%
	Diabetes	6	1.4%

ADA classification: Fasting blood glucose: Normal < 100 mg/dl, Prediabetes 125 - 100 mg/dl, and Diabetes ≥ 126 mg/dl. 2 hours post prandial blood glucose: NORMAL < 140 mg/dl, Prediabetes: 140-199 mg/dl, and Diabetes ≥ 200 mg/dl.

Obesity was assessed in 571 participants using body mass index (BMI) and waist/hip ratio (WHR). The mean BMI was 31.69 ± 7.84 kg/m^2. Participants were categorized based on BMI as follows: underweight 2 (0.35%), normal weight 101 (17.44%), overweight 161 (29.71%), obese 98 (16.93%), and extremely obese (X-obese) 45 (7.77%) as shown in Table 3. The mean WHR was 0.88 ± 0.14, indicating visceral obesity in 217 participants (38%). Obesity is highly prevalent among diabetic and hypertensive participants (Table 3).

A history of diabetes mellitus was present in 68 participants (11.33%). Among the 419 participants with no history of diabetes, fasting or 2-hour postprandial blood glucose tests identified 6 new cases of diabetes and 20 participants (6.5%) in the prediabetic stage (Table 3).

Regarding CKD evidence, we noted a history of renal stones in 43 participants (7.1%), which is a strong indicator of CKD. However, due to the lack of documentation at the time of screening, these cases could not be definitively classified as CKD, and participants were referred for further reassessment. CKD evidence was assessed through urine ACR and eGFR calculated using the CKD-EPI equation. Serum creatinine analysis was adjusted to the Isotope Dilution Mass Spectrometry technique (Table 3).

Proteinuria was assessed in 398 participants by measuring second morning mid-stream urine ACR with standard precautions. The mean ACR was 0.88 ± 0.14 mg/g, with proteinuria being positive in 34 participants (8.54%) (Table 1). These positive cases were referred for further confirmation with their healthcare providers.

Serum creatinine was measured in 441 participants, with a mean value of 0.84 ± 0.27 mg/dL. The eGFR was assessed and classified according to KDIGO guidelines: Stage 1 (79.14%), Stage 2 (19.05%), Stage 3 (1.36%), Stage 4 (0.23%), and Stage 5 (0.23%) as shown in Table 3. Proteinuria is corrolated with age, history of diabetes, history of hypertension, and obesity.

Table 4 shows division of the cohort in two groups. The proteinuria group included 34 patients while patients without proteinuria (n = 364) were grouped in the non-proteinuria group. No statistically significant difference was found between proteinuria group and non-proteinuria group regarding the gender, prevalence of obesity, abdominal obesity and cardiovascular diseases (p = 0.696, 0.458, 0.116, and 0.227 respectively). There was a statistically significant difference between the two groups regarding the age. The mean age in proteinuria group was 49.9 years compared to 42.4 years in non-proteinuria group (p = 0.001). The mean Glomerular filtration rate was 89.7 and 113.6 mL/min in both groups respectively (p = 0.001). Hypertension and diabetes mellitus were more common in proteinuria group than the non-proteinuria group (p = 0.030 and 0.007 respectively).

Furthermore, we divided screened people in two groups as shown in Table 5: (Group 1) Reduced eGFR (<90 ml/min/1.73m^2) and (Group 2) normal eGFR group (≥90 ml/min/1.73m^2). Males were more common in group 1 (68.5%) compared to group 2 (30.1%). Patients in group 1 showed statistically significant more age than patients in group 2. The mean age was 48.95 years in group 1 compared to 40.49 years in group 2 (p = 0.001). Hypertension, diabetes mellitus, and abdominal obesity were significantly more common in group 1 compared to group 2 (p = 0.005, 0.016, and 0.009 respectively).

Finally, we screened this remote village with segregation of participants with NCDs from all the village without the need of professional personnel to screen all

the village. They visit them to see only about 1/5th of the studied population with positive data.

Table 4. Comparison between proteinuria group (n = 34) and non-proteinuria group (n = 364) regarding other risk factors.

Characteristics	All (n= 398)	Proteinuria Group (n = 34)	Non-proteinuria Group (n = 364)	p
	Frequency (%)	Frequency (%)	Frequency (%)	
Gender:				
Male	140 (35.2%)	13 (38.2%)	127 (34.9%)	0.696
Female	258 (64.8%)	21 (61.8%)	237 (65.1%)	
Age (Years): mean (SD)	43.06 (11.92)	49.91 (14.30)	42.41 (11.49)	0.001*
GFR (mL/min): Median (IQR)	112.4 (93.1 - 139.6)	89.7 (68.75 - 118.4)	113.6 (94.5 - 140.3)	0.001*
Comorbidities:				
Hypertension	102 (25.63%)	14 (41.18%)	88 (24.18%)	0.030*
Diabetes Mellitus	56 (14.07%)	10 (29.41%)	46 (12.64%)	0.007*
Obesity (n = 385)	319 (82.86%)	25 (78.13%)	294 (83.29%)	0.458
Abdominal obesity (n = 377)	157 (41.64%)	18 (54.55%)	139 (40.41%)	0.116
CVD	27 (6.78%)	4 (11.76%)	23 (6.32%)	0.227

Table 5. Comparison between Low estimated glomerular filtration rate (eGFR) group (n = 92) and Normal eGFR group (n = 394) regarding CKD/CVD risk factors.

Characteristics	All (n= 441)	Low eGFR Group (n = 92)	Normal eGFR Group (n = 394)	p
	Frequency (%)	Frequency (%)	Frequency (%)	
Gender:				
Male	168 (38.1%)	63 (68.5%)	105 (30.1%)	0.001*
Female	273 (61.9%)	29 (31.5%)	244 (69.9%)	
Age (Years): mean (SD)	42.25 (12.34)	48.95 (13.45)	40.49 (11.42)	0.001*
ACR (mg/gm): Median (IQR)	5.42 (3.1 - 9.8)	5.9 (3.07 - 11.0)	5.3 (3.1 - 9.4)	0.308
Comorbidities:				
Hypertension	109 (24.72%)	33 (35.87%)	76 (21.78%)	0.005*
Diabetes Mellitus	54 (12.24%)	18 (19.57%)	36 (10.32%)	0.016*
Obesity (n = 433)	349 (80.60%)	72 (80.00%)	277 (80.76%)	0.871
Abdominal obesity (n = 425)	157 (36.94%)	43 (48.86%)	114 (33.83%)	0.009*
CVD	30 (6.80%)	7 (7.61%)	23 (6.59%)	0.730

Normal eGFR: ≥90 ml/min/1.73m^2, Low eGFR: <90 ml/min/1.73m^2.

5. Discussion

The "NCDs Made Easy" program demonstrates significant potential in addressing the healthcare gaps associated with CKD and related NCDs in resource-limited settings. This study, conducted in a remote village near Damanhur city, Egypt, validates the effectiveness of the platform in early detection, prevention, and management of CKD and NCDs. The results highlight several key findings and implications for future healthcare strategies.

Hypertension was prevalent in 19.67% of the participants (118/600), with the mean SBP at 115.76 ± 17.92 mmHg, DBP at 77.15 ± 35.27 mmHg, and MAP at 92.58 ± 26.36 mmHg. After screening, 27 participants were newly diagnosed with hypertension, constituting 18.6% of the total hypertensive participants. Among those with a history of hypertension, 50% had uncontrolled blood pressure, classified as stage 1 (29%) and stage 2 (21%) hypertension according to the 10th Joint National Committee on Hypertension. These findings underscore the importance of regular screening and monitoring to identify and manage undiagnosed or uncontrolled hypertension, reducing the risk of cardiovascular complications [7] [12].

Obesity was assessed in 571 participants using BMI and WHR. The mean BMI was 31.69 ± 7.84 kg/m^2, with participants categorized as underweight (0.35%), normal weight (17.44%), overweight (29.71%), obese (16.93%), and extremely obese (7.77%). The mean WHR was 0.88 ± 0.14, indicating visceral obesity in 38% of participants. These results highlight the high prevalence of obesity and its associated risks, emphasizing the need for targeted interventions to promote healthy lifestyles and reduce obesity-related health issues [7] [13].

A history of diabetes mellitus was present in 11.33% of participants (68/600). Among the 419 participants without a history of diabetes, fasting or 2-hour postprandial blood glucose tests identified 6 new cases of diabetes and 20 participants (6.5%) in the prediabetic stage. This underscores the utility of the program in identifying undiagnosed diabetes and prediabetes, facilitating timely intervention and management to prevent disease progression [2] [14].

The study identified a history of renal stones in 7.1% of participants (43/600), which is a strong indicator of CKD. However, due to the lack of documentation at the time of screening, these cases were referred for further reassessment. CKD evidence was assessed through urine ACR and eGFR calculated using the CKD-EPI equation. Proteinuria was detected in 8.54% of participants (34/398), with a mean ACR of 0.88 ± 0.14 mg/g. Age, eGFR level, history of diabetes and hypertension was a predictor for development og proteinuria.

Serum creatinine was measured in 441 participants, with a mean value of 0.84 ± 0.27 mg/dL. The eGFR was classified according to KDIGO guidelines: Stage 1 (79.14%), Stage 2 (19.05%), Stage 3 (1.36%), Stage 4 (0.23%), and Stage 5 (0.23%). These findings emphasize the effectiveness of the program in early CKD detection and classification, allowing for timely intervention and management to slow disease progression [8] [12].

The program's integration of evidence-based guidelines into a digital platform allows for the early identification of CKD complications, optimizing pre-ESRD care. Training non-specialist personnel to use the platform effectively addressed workforce shortages and improved disease management. The educational components and automated reports raised awareness among participants about CKD/NCDs and their long-term consequences [8] [13].

The automatic data extraction and coding into Excel files facilitated comprehensive data analysis, supporting public health strategies and research. The integration of detailed data collection into routine practice can inform health policies and improve care delivery in underserved areas [3] [4].

6. Limitations and Future Research

While the study demonstrates the feasibility and effectiveness of the "NCDs Made Easy" program, limitations include the reliance on a well trainned volunteer and paramedical staff for data collection, which may introduce variability although considering all confounders and covariates in this issue. This point is considered one of stengths in our model of NCDs screening. Future research should focus on larger-scale studies to evaluate long-term impacts on disease prevalence, progression, healthcare costs, and patient quality of life. Additionally, implementing more robust training and quality control measures for data collection can further enhance the reliability of the findings.

7. Conclusions

The "NCDs Made Easy" program considered one step toward the solutions for improving CKD and NCD management in low-resource settings and preESRD care. Also, it has the potential to significantly impact primary healthcare and pre-ESRD care. By integrating evidence-based guidelines into a user-friendly digital platform, it enables early detection, prevention, and ongoing care, this may contribute to better health outcomes and health system resilience.

Further large-scale studies are needed to confirm these findings and explore the program's broader applicability and impact.

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Statements and Declarations

The "NCDs Made Easy Program" is a proprietary product developed by the primary author. The platform is registered with the Egyptian Information Technology Industry Development Authority under registration number 3752/2021. The dedicated program website is http://www.telencds.com/.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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