Establishing a Chronic Kidney Disease (CKD) Surveillance in Cuttack District, Odisha, India

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Abstract

Background: Chronic kidney disease (CKD) is a globalpriority public health concern that accounts for significant morbidity and mortality. Unusual occurrence of CKD was reported from Cuttack district of Odisha. We aim to establish a CKD surveillance system in Cuttack district to estimate the burden of disease and help decision-makers through future epidemiological assessments.

Method: We focused on CKD patients enrolled in the Narsingpur community health clinics and attending the clinics from January to June 2016. We defined a suspected CKD as patientpresenting with any symptoms of loss of appetite, fatigue &weakness, change in urine output, swelling of feet & ankles and blood in urine. A confirmed CKD was defined as a CKD suspect with elevated Serum creatinine (>1.5 mg/dL) and Serum Urea (>40 mg/dL).Besides, we collected relevant data on demography, clinical, laboratory, occupational and family history of patients.

Results: The CKDsurveillance presented over 320 suspected CKD cases, of which 35 cases were laboratory confirmed. The median age was 57 years ranging from 35 -75 years (Mean +SD= 56+9.1), 71% of cases were males and agriculture was the commonest occupation. Laboratory finding shows fasting blood glucose of 147.4 mg/dl (Range 84-249), Serum Creatinine 3.59 mg/dl (Range 2.2-7.9), Serum Urea 76.6 mg/dl (Range 14.1-137), Urine Creatinine 6.0 mg/24 hrs (Range, 4.4-7.3) and Urine Albumin 7.6 mg/dl (Range 7.2-8.4). The majority of patients (57%, 20/35) were in CKD stage 3 (GFR, between 60 and 89 ml/min/1.73m2).

Conclusion: The CKD surveillance system supported CKD patient's analysis by age, gender, geographical distribution and socio-demographic profile. Further, the analysis involved analysing patient's clinical characteristics, CKD staging, associated co-morbidities and treatment modalities.The surveillance system established a scientific platform for primary prevention, early detection, and treatment strategies implementation. The platform eventuallyhelped the decision-makers increase awareness, decrease CKD morbidity & mortality throughmore efficient resource utilization.

Key Words: *CKD, Odisha, Cuttack*

Background

The CKD is a global health challenge. Almost a third of CKD patients live in two countries: India and China. In rural Indian sub-continent, the disease disproportionally affect poor, male farmers, particularly in hot climates. Several countries are undergoing an increased disease prevalence over the past two decades. The countries include El Salvador, Nicaragua, Costa Rica, Egypt, Sri Lanka, and India. As the CKD'saetiology remained unexplained in past decades, the literature mentioned the term "chronic kidney disease of unknown aetiology" since the early 2000s[1].

Compared to 5.21 million projected deaths due to CKD in India in 2008, the estimated deaths in the year 2000 is 7.63 million in 2020 (66.7% of all deaths)[2,3]. In many community-based studies, the CKD prevalence is found between 0.16% and 0.79%. However, these studies mainly focused on stage 3 CKD or worse, and therefore, the real prevalence of CKD is much higher than what these studies noted[4,5,6,7].

Most CKD cases without an exact aetiology (CKDu) are found in adult men aged <60 years from rural areas, especially in those cultivating rice in paddies (in Sri Lanka), vegetables (in Egypt and India) and sugar cane and other crops in Central America[8,9]. In India, epidemics of CKDu affect sharply defined geographic areas that are fertile and swelteringly hot. The victims mostly conduct heavy manual labour, have little formal education, and lack easy medical care access.

A report available from Srikakulam reveals high serum level of Cadmium (Cd) and Molybdenum (Mo) in patients suspected of CKD. CKDu has emerged in in India, and Sri Lanka's geographic pockets, with an estimated more than 20,000 patients diagnosed with late-stage kidney disease. The Countries with large numbers of CKDu patients contributes for major social and economic burden[10]. Multiple factors cause CKDu, likely linked to a combination of environmental factors, diet and nutritional practices, and genetics.

Cuttack district of Odisha, India observed unusual occurrence of CKD since 2010 with clustering of cases in two blocks: Narsingpur and Baramba. Narsingpur reported 780 cases (29% deaths) from 158 villages and Baramba block reported 201 cases (4% deaths) from 20 villages. However, challenges such as inconsistent case definition, poor laboratory capacity, and lack of systematic reporting hindered CKD surveillance system development.

A surveillance system comprehensively captures and tracks all critical manifestations of a disease, providing essential information on disease activity, including persons affected, timing, magnitude, severity and location to guide implementation of medical and public health measures to control or contain the disease[11]. What is highly significant for overall CKDdisease control, in addition to the enumeration of cases, is to track information on the disease burden, its complications and outcomes of the disease management.

We aim to establish and demonstrate a robust CKD surveillance system in Cuttack district to estimate the burden of disease and help decision-makers through future epidemiological assessments. The specific elements of the CKD Surveillance System were to establish a standardized case definition, an algorithm for testing and reporting, a standardized case reporting form, a systematic approach to reporting and data collection and regular analysis of surveillance data to stakeholders.

Methodology

Setting: Narsingpur and Baramba blocks in Cuttack district, Odisha

Target population: All suspect CKD cases in Narsignpur, expectedly, visited the community health clinic for urinalysis and serum creatinine. When elevated serum creatinine (>1.5 mg/dL) and serum urea (>40 mg/dL) level with urine proteinuria the patient weredetected, the concerned patient was registered under the surveillance system. These tests were repeated every month for the next three months. The mentioned abnormalities in the serum creatinine and urine formed the basis to declare patient with CKD. Such confirmed CKDs were then referred to the Nephrology Department of SCB Medical College, Cuttack for registration and clinical management.

Period: January to June 2016.

Case Definition:

Suspect CKD: Any patient residing in CKD endemic area presents with any of the following symptoms:loss of appetite, fatigue andweakness, change in urine output, swelling of feet and ankles, and blood in urine.

Confirmed CKD: A CKD suspect with elevated Serum creatinine (>1.5 mg/dL) and Serum Urea (>40 mg/dL) level with urine proteinuria and three repeated tests in consecutive month with the elevated urine parameter.

Data Collection: The patient data was collected in the CKD registry at Narsingpur CHC laboratory. A line-list was prepared by the trained Supervisor for all confirmed CKD patients. The trained health worker visited the patient house and collected detailed data of the patients in a pre-designed data collection tool. The collected data were compiled at CHC Narsingpur and CHC Baramba by the trained data entry operator identified for the purpose.

Data Validation: The supervisor cross-checked the CHC laboratory register to compare the number of CKD suspects examined in the laboratory and the number of confirmed CKD patients recorded in the line-list. The validation further detailedthe line-list in the SCB medical college and the patient treatment card at block program management unit. The principal investigator conducted triangulation of the data available in laboratory register, line list and treatment card, and ensured correctness of data entered in the electronic database.

Data-entry & Analysis: Trained data entry operators entered the data. Epi Info 7.1.4 software was used for data entry.All discrepancies in data entry were resolved, referringto the original data collection formats, and the database was finalized. The surveillance team securely locked the final database for safety. After removing personal identifiers, a duplicate version of the finalized database wasstatistically analysis using Epi Info 7.1.4 software.

Consent and Data Confidentiality: Informed consent was taken from the participants in a prescribed format after providing accurate information through patient information form. Patients' confidentiality was maintained, and only the study investigators and the field staff of the programme had accessto the data. Names of the patients were not included in the electronic database. Each of the concerned staff wereguided to maintain confidentiality. Simultaneously, the electronic data file was password secured, and only those on the data team had an access to open the file and enter data. While disseminating the study findings to the external audience, only pooled results are shared. No references were made to any individual study participant.

CKD Patient Identification & Referral: A one-day training of medical and paramedical staff including, the field staffs, wasconducted in both Narsingpur and Baramba blocks. Any suspected CKD patients attending the Government or private clinic, with the defined symptoms, was referred to the CHC laboratory, Narsingpur to evaluate CKD. The confirmed CKD patients furtherwere referred to the SCB medical college, Cuttack,Department of Nephrology. The department assessed every patient for GFR after which the patient wereregistered as the CKD patients. A treatment card was opened for each registered patient at the BPMU of the respective blocks

Indicators: The CKD surveillance system will estimate the burden of CKD (both incidence and prevalence)

Health Institutes Involved:

1. CHC, Narsingpur and CHC Baramba of Cuttack district
2. Directorate of Health Services. Odisha
3. SCB Medical College Cuttack, Dept. of Nephrology
4. Centre for Disease control & Prevention, India
5. National Centre for Disease Control, New Delhi, India

Laboratory:

1. CHC, Narsingpur Laboratory (Routine urine and serum Creatinine/ Urea)
2. SCB Medical College Cuttack, Dept. of Pathology (Confirmation for CKD
3. Regional Medical & Research Centre, Bhubaneswar, Odisha (For Human Specimen)
4. Institute of Mineral & Material Technology, Bhubaneswar, Odisha (For Heavy Metals)

Core-committee for CKD Surveillance: As part of the study process, a core committee was formed which comprised comprising of the principal investigator (EIS

Officer, NCDC, Delhi) , Members from Directorate Health Services & Directorate of Medical Education, Odisha, Nephrologist from SCB medical college , Chief District Medical Officer, Cuttack and the Block Medical Officer. An advisory group further supported the core committee from National Centre for Disease Control, Delhi and Centre for Disease Control and Prevention, India. The core committee members met every month to share information, discuss options, gather input, and make decisions. The Principal Investigator was connected to the advisory group weekly by teleconference. The role of the Advisory Group was to provide input on various issues, including the importance of individual topics and measures and the evaluation of data sources.

Ethics considerations: The protocol was reviewed and approved by the core committee, Directorate of Health Services, Government of Odisha who agreed to collaborate for the establishment of CKD surveillance system. Every patient participated and provided an informed consent before collecting the data.

Results

During March 1- June 30, 35 CKD cases were reported from 21 villages in Baramba and Narsingpur blocks of Cuttack district, Odisha. The median age was 57 years ranging from 35 -75 years (Mean +SD= 56+9.1), 71% of cases were males. All patients were enrolled in the surveillance system, and initiated with treatment at SCB medical college, Cuttack and no deathwerereported.

Geographical Location: Twenty-one villages from both the blocks reported CKD cases. Three villages (Godibandha, Jhajia & Jodum) reported 12 cases, each reporting 4 cases. Mahurakhia village reported 3 cases, Paikapadapatna and Balijhari villages reported 2 cases each and rest of the villages reported 1 case each.

Clinical Feature: The most common clinical presentation was fatigue and illness (71%) followed by swelling of foot and ankle (54%), loss of appetite (43%), recurrent urinary symptoms (40%) and change in urine output (30%) **(Table 2).** Out of 35 reported CKD patients, 46% (16/35) has history of chronic illness (arthritis, kidney stone, hypertension, and diabetes) and of them, 63% (10/16) were under medication for the illness **(Table 3).**

Occupational History: Agriculture was the most common occupation (34%) among the cases, and of them, 75% (9/12) has cultivated rice. We found that 23% (8/35) of cases have used pesticides (Jailo & Sabin) and of them only 25% (2/8) have used personal protection during pesticide use. Agrochemical usage (DAF & Urea) was reported in 20% (7/28) of cases and of them, only 14 % (1/7) reported use of personal protection **(Table 4).**

Deep bore well water (54%) was found as the common drinking water source among the reported cases. Among the cases, 14% (5/35) reported alcohol consumption, 26% (9/35) were smokers, and 23 % (8/35) reported chewing tobacco products. Non-steroid anti-inflammatory drugs (NSAID) usage was reported among 43% (15/35) of cases and of them, 27% (4/15) reported daily usage of NSAID**(Table 5).**

Laboratory Analysis: The median blood pressure was reported 141.1 mm of Hg (Range 100-220 mm of Hg). The fasting blood glucose was 147.4 mg/dl (Range 84-249 mg/dl), Serum Creatinine 3.59 mg/dl (Range 2.2-7.9 mg/dl), Serum Urea 76.6 mg/dl (Range 14.1-137mg/dl), Urine Creatinine 6.0 mg/24 hrs (Range, 4.4-7.3mg/24 hrs) and Urine Albumin 7.6 mg/dl (Range 7.2-8.4mg/dl)**(Table 6).**

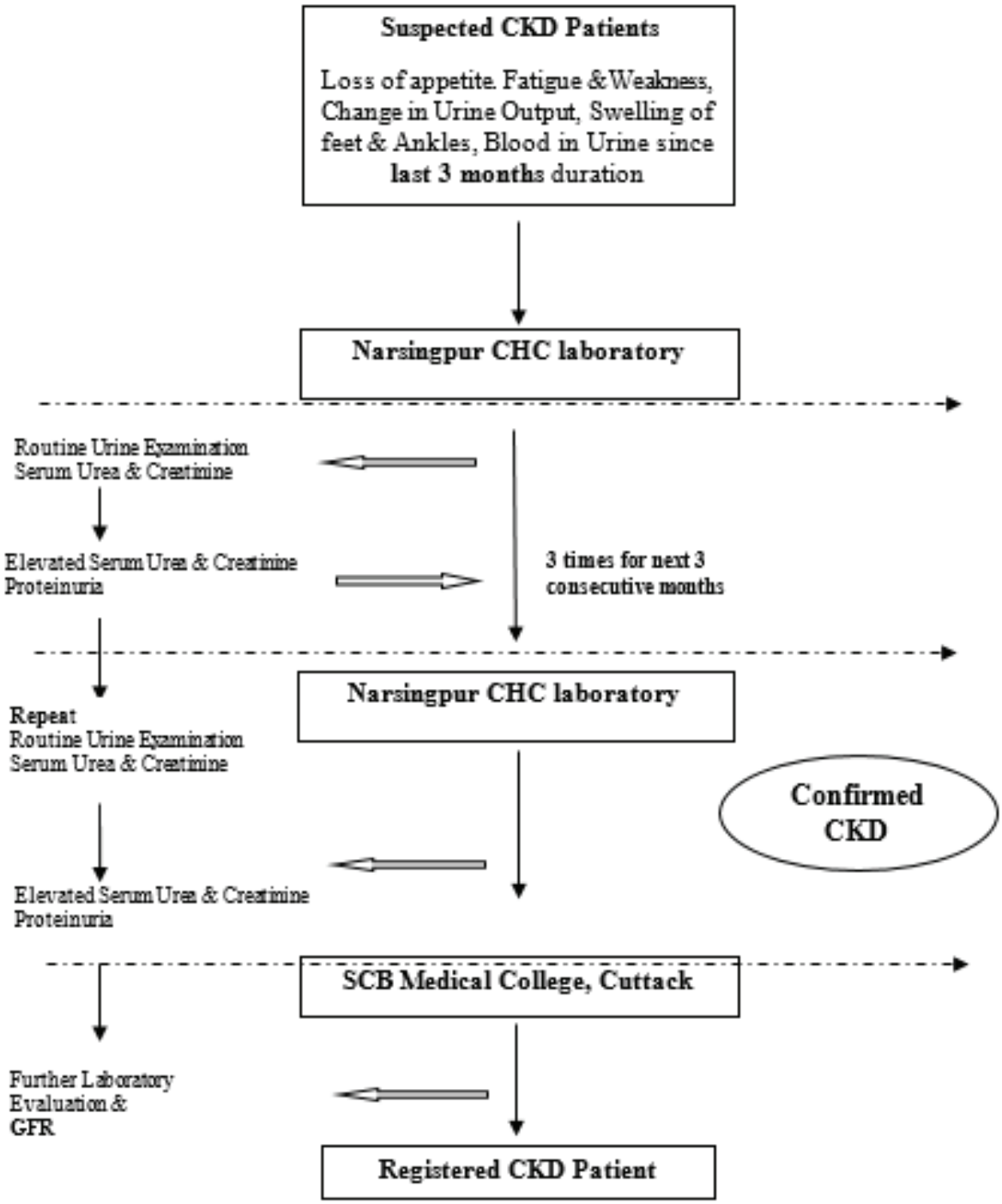

Figure 1; Flow Chart for CKDu Suspects in Cuttack district, Odisha

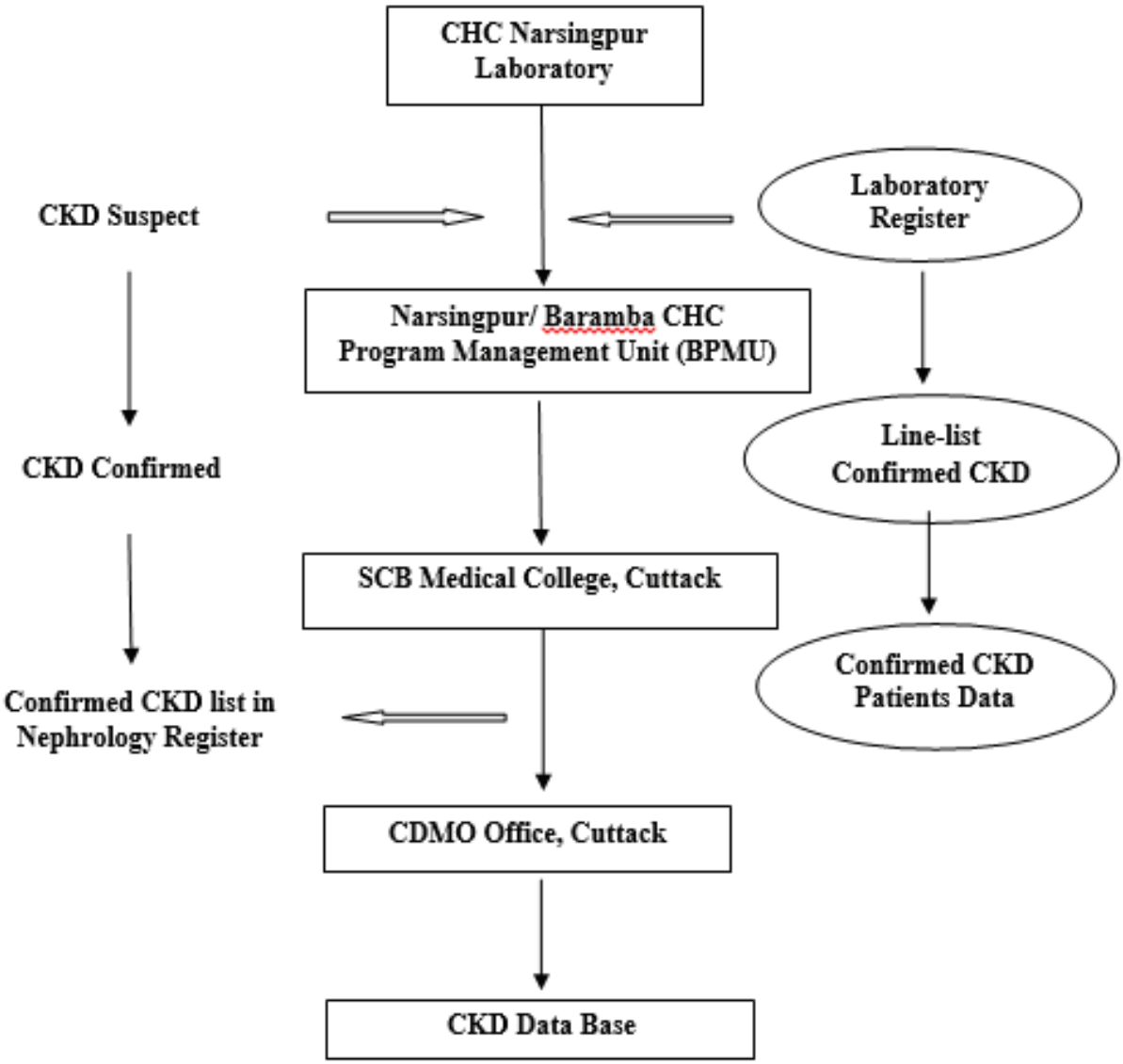

Figure 2: Data Flow in CKD Surveillance System

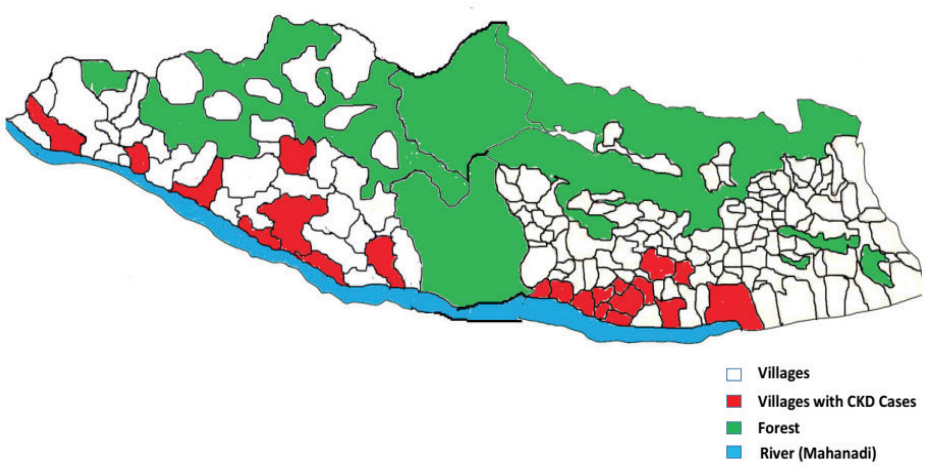

Figure 3: Geographical distribution of villages with CKDu cases in Cuttack district, Odisha

Table 1: CKDu Staging

Stage	Description	GFR (ml/min//1.73 mt^2)
Stage 1	Kidney damaged with Normal or increased GFR	≥ 90
Stage 2	Kidney damaged with mild decreased GFR	60-89
Stage 3	Kidney damaged with moderate decreased GFR	30-59
Stage 4	Kidney damaged with severe decreased GFR	15-29
Stage 5	Kidney Failure	< 15

Table 2: Clinical features of CKDu cases in Cuttack district, Odisha

Clinical Features	Number	Percentage
Loss of Appetite	15	42.8
Recurrent Urinary Symptoms	14	40
Fatigue & Weakness	25	71.4
Change in Urine Output	10	28.6
Swelling Feet & Ankle	19	54.3

Table 3: Chronic Illness History of CKDu cases in Cuttack district, Odisha

Variable	Type	Number	Percentage
Any Chronic Illness	Yes	16	45.7
	No	29	54.3
Type of Chronic Illness (16)	Arthritis	6	37.5
	Kidney Stone	5	31.3
	Hypertension	3	18.7
	Diabetes	2	12.5
Taking medicine for Chronic Illness	Yes	10	62.5
	No	6	37.5

Table 4: Occupational history of CKDu cases in Cuttack district, Odisha

Variable	Type	Number	Percentage
Occupation	Agriculture	12	34.3
	Housewife	9	25.7
	Daily Labourers	10	28.6
	Office Worker	4	11.4
Type of Agriculture (12)	Rice	9	75
	other	3	25
Pesticide Use (Jailo & Sebin)	Yes	8	22.9
	No	27	77.1
Use of Personal Protection during Pesticide use (8)	Yes	2	25
	No	6	75
Use other Agrochemicals (DAF & Urea)	Yes	7	20
	No	28	80
Use of Personal Protection during Agrochemical Use (7)	Yes	1	14.2
	No	6	85.8

Table 5: Habit & Customs of CKDu cases in Cuttack district, Odisha

Variable	Type	Number	Percentage
Drinking Water Source	Deep bore Well	19	54.3
	Community Well	7	20
	Pipe Water	5	14.3
	Private Well	4	11.4
Drinks water / Day	<5 glass	12	34.3
	>5 glass	13	38.5
	>10 glass	10	28.6
Consume Alcohol	Yes	5	14.3
	No	30	85.7

Cont... **Table 5: Habit & Customs of CKDu cases in Cuttack district, Odisha**

Currently Consume Alcohol (5)	Yes	1	20
	No	4	80
Do you Smoke	Yes	9	25.7
	No	26	74.3
Currently Smoke(9)	Yes	5	55.5
	No	4	44.5
Consume Tobacco product	Yes	8	22.9
	No	27	77.1
Consume NSAID	Yes	15	42.9
	No	20	57.1
Use of NSAID (15)	Daily	4	26.6
	Weekly	3	20
	Occasionally	8	53.4

Table 6: Laboratory Analysis of CKDu cases in Cuttack district, Odisha

Variable	Month 1	Month 2	Month 3
Blood Pressure (mm of Hg)	141.1 (100-220)	138.7 (110-180)	151 (118-190)
Fasting Glucose (mg/dl)	147.4 (84-249)	103.8 (43-141)	110 (100-120)
Serum Creatinine (mg/dl)	3.59 (2.2-7.9)	4.05 (1.4-10.5)	3.58 (1.6-6.7)
Serum Urea (mg/dl)	76.6 (14.1-137)	65.3 (14.0-136)	58.3 (14.1-126)
Urine Creatinine (mg/24 hrs)	6.0 (4.4-7.3)	5.8 (4.4-6.2)	6.6 (4.9-7.4)
Urine Albumin (mg/dl)	7.6 (7.2-8.4)	7.4 (7-8.2)	7.4 (7-8.2)

Discussions

The impact of CKDu is growing, and its prevalence is underestimated. Absence of a functional surveillance system is the bottleneck for gaps in data collection, diagnosis and recording & reporting of CKD cases. The symptoms of CKDu appear very slow, and only appears in stage 3 and 4, which accounts for not being diagnosed

at early stages. With the absence of a mechanism to capture early-stage patients, CKDu grossly remained underdiagnosed. Studies from high- income countries such as the U.S[12], Spain[13], and Japan[14] the prevalence of CKD generally between 10 and 13% of the adult population.

Our CKD surveillance system has established CKDu cases with most cases having agricultural occupation and exposure to pesticides and fertilizers. It was also found that deep bore wellswere the commonest drinking water sources indicating possible heavy metal (cadmium, Arsenic and mercury) contamination of water. Several studies from Sri Lanka has explained environmental risk factors as potential triggers for CKDu. The WHO study has hypothesized that chronic exposure to cadmium and Arsenic from pesticides and phosphate fertilizers is a potential risk factor to develop CKDu. Besides, elevated levels of minerals (hard water), fluoride, or heavy metals (e.g., cadmium, uranium, and lead) in groundwater wells were also suspected environmental risk factors for CKD[15].

Expanded CKDu education access and coverage is needed to address fears and aid in early detection. Programs to reach high-risk and endemic communities are now under-resourced, and far too many patients are unable to access care and treatment. Global health research collaborations are needed to exchange data across countries impacted by CKDu. In India, CKDu is a growing problem, and efforts needed to establish commonalities and prevent CKDu(10). A robust surveillance system will address the burden, geographical distribution, and time trends of CKDu in India. The surveillance system should be linked to monitoring potential toxins in food, water and the environmentand providing a platform for long-term research to understand the role of potential risk factors and document the usefulness of ongoing interventions[1].

The major challenge identified to integrating the CKD Surveillance System with IDSP and allowing the long-term monitoring of CKD patients. The system also seeks to be sensitive and flexible to new advances in the field being adaptive to developing newer evidence-based surveillance strategies. CKDu is a complex disease, and there is a need for sharing expertise across disciplines and countries to accelerate knowledge dissemination, guide the research agenda and help solve the mystery of "u" (unknown) in CKDu. Strengthen the early detection and management of CKDu in the early stages, and dialysis in the late stages will prevent CKD morbidity and mortality. Besides, prioritizing safe drinking water and food in the affected areas and ensuring sustainable agricultural practices evidence will certainly help.

Dissemination of the findings: This surveillance system's finding is intended to increase awareness of CKD and its importance as a major public health problem. It will also stimulate multiple stakeholders to develop a comprehensive action plan for health improvement. Data on incidence, prevalence, and risk factors collected by the CKD Surveillance System will prompt the health care providers to screen those at risk for CKD This information will be useful to evaluate the risk factors for CKD and to make appropriate recommendations for primary and secondary prevention.

Conclusion

We have established a CKD surveillance system in the Cuttack district of Odisha. The signficant component including the prevalence and the risk factors for CKD was prioritized for CKD surveillance. ThisCKD Surveillance System was found to be a readily available and useful resource for health care providers, public health authorities, and policymakers alike. In the future, this passive surveillance can be strengthened and replicated in other CKD endemic regions.

Advances in health information technology are very likely to have a major impact on the future surveillance system. We believe that this CKD Surveillance System will be vital for an ongoing assessment of the CKD burden in the district and its impact on the population and the health care system. We hope that it will lay the foundation for widespread efforts toward primary prevention, earlier detection, and implementation of optimal disease management strategies, with resultant decreased rates of CKD progression and lowered morbidity and mortality.

Ethical Clearance: Taken from State Ethics Committee

Source of Funding: Self-Funded

Conflict of Interest: Nil

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