An EHR-Based Population Assessment of Chronic Kidney Disease in Rural Communities of Northern Michigan

PRESENTED BY

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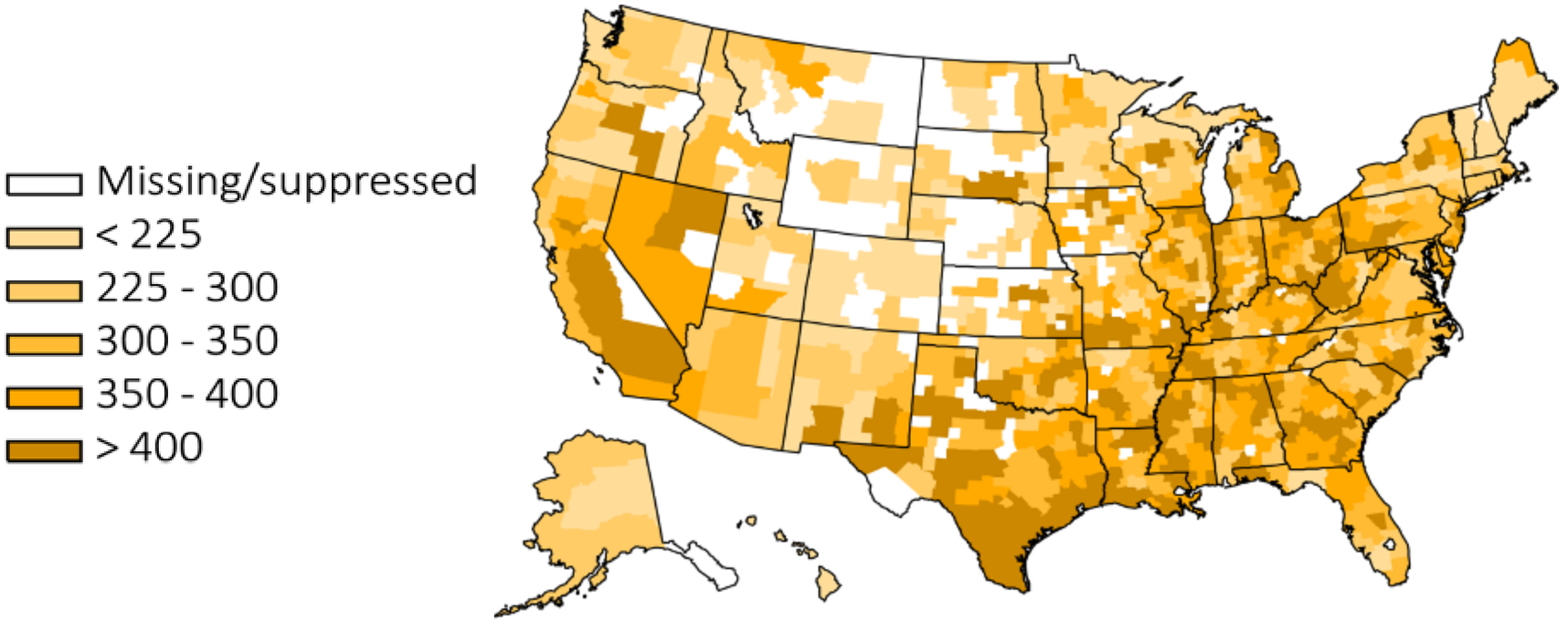
Conflicts of Interest

No conflicts of interest

Background

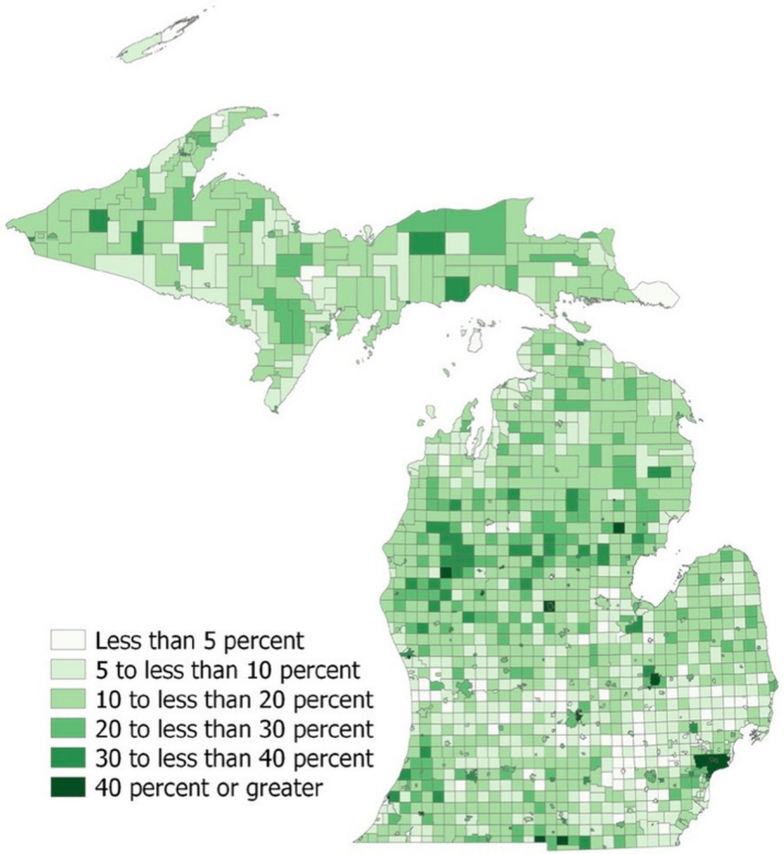
Incidence Rate (per million/year) for ESRD in the United States, 2011-2015



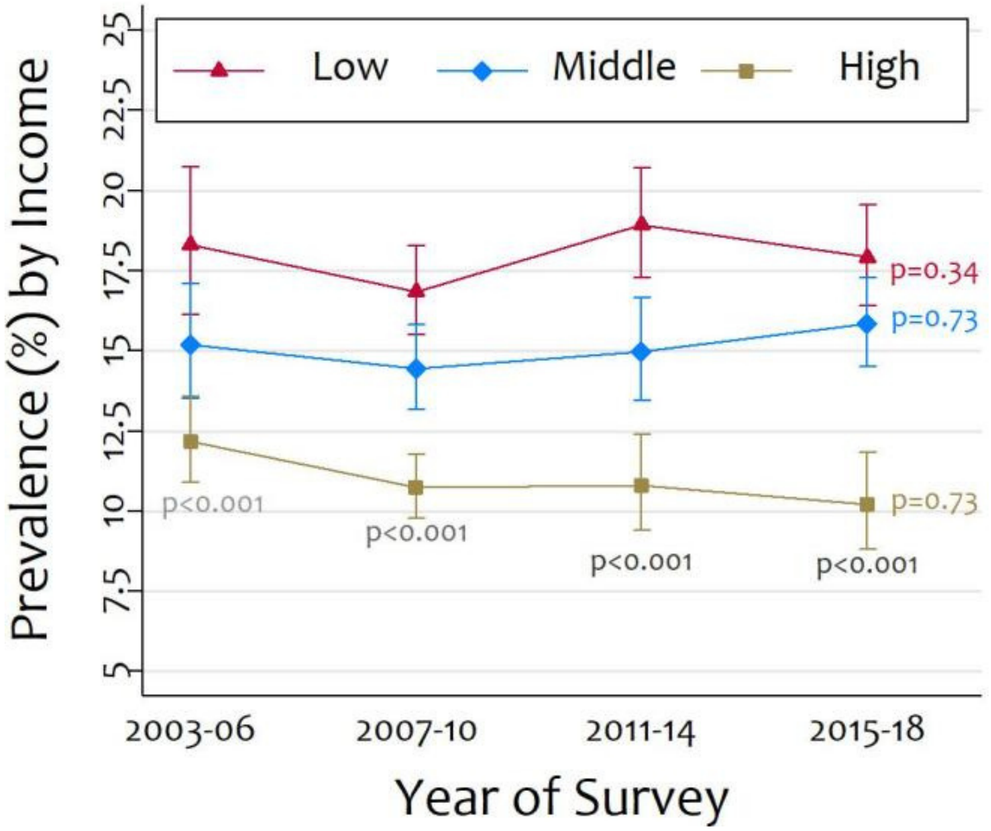
Source: United States Renal Data System. 2017 USRDS annual data report: Epidemiology of kidney disease in the United States. NIH. Bethesda, MD.

Background

Percentage of Population Living in Poverty by City/Township



Age-adjusted Prevalence and of Chronic Kidney Disease by Family Income-to-Poverty Ratio



Source: Kibria GMA, Crispen R. Prevalence and trends of chronic kidney disease and its risk factors among US adults: An analysis of NHANES 2003-18. Prev Med Rep. 2020 Sep 1;20:101193. doi: 10.1016/j.pmedr.2020.101193. PMID: 33101883; PMCID: PMC7578737.
U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates.

Background

- Leveraging existing EHR data by developing computable CKD phenotypes may be a novel way to characterize and begin to address rural CKD disparities
- Conducted a proof of concept study by developing a CKD phenotype and implementing it in a rural health system to characterize CKD burdens

Prognosis of CKD by GFR and albuminuria categories: KDIGO 2012

GFR categories (ml/min per 1.73 m^2) Description and range				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
	G1	Normal or high	⩾90			
	G2	Mildly decreased	60–89			
	G3a	Mildly to moderately decreased	45–59			
	G3b	Moderately to severely decreased	30–44			
	G4	Severely decreased	15–29			
	G5	Kidney failure	<15			

Green: low risk (if no other markers of kidney disease, no CKD); yellow: moderately increased risk; orange: high risk; red, very high risk.

Source: Levin A, Stevens PE. Summary of KDIGO 2012 CKD Guideline: behind the scenes, need for guidance, and a framework for moving forward. Kidney Int. 2014 Jan;85(1):49-61. doi: 10.1038/ki.2013.444. Epub 2013 Nov 27. PMID: 24284513.

Methods

Study Design and Population:

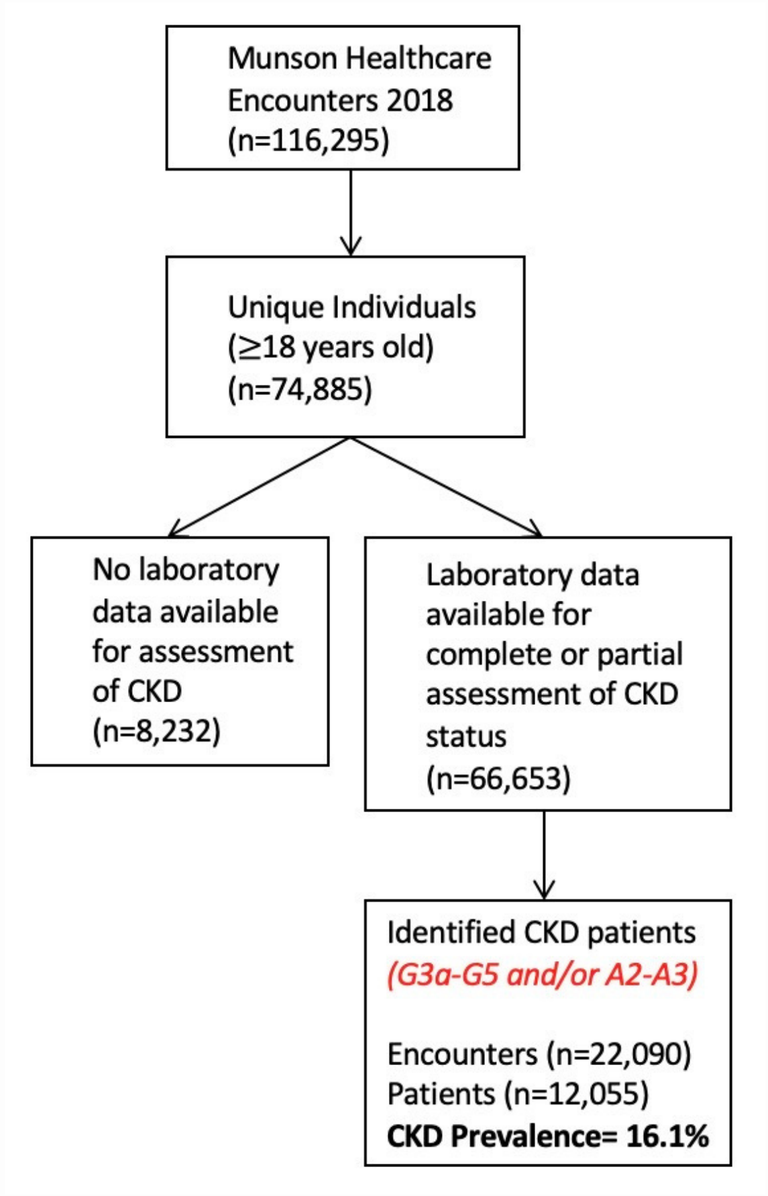
Retrospective analysis of EHR data at Munson Health System, a rural community health system in Northern Michigan, comprising a network of primary care and specialty clinics and acute care hospitals

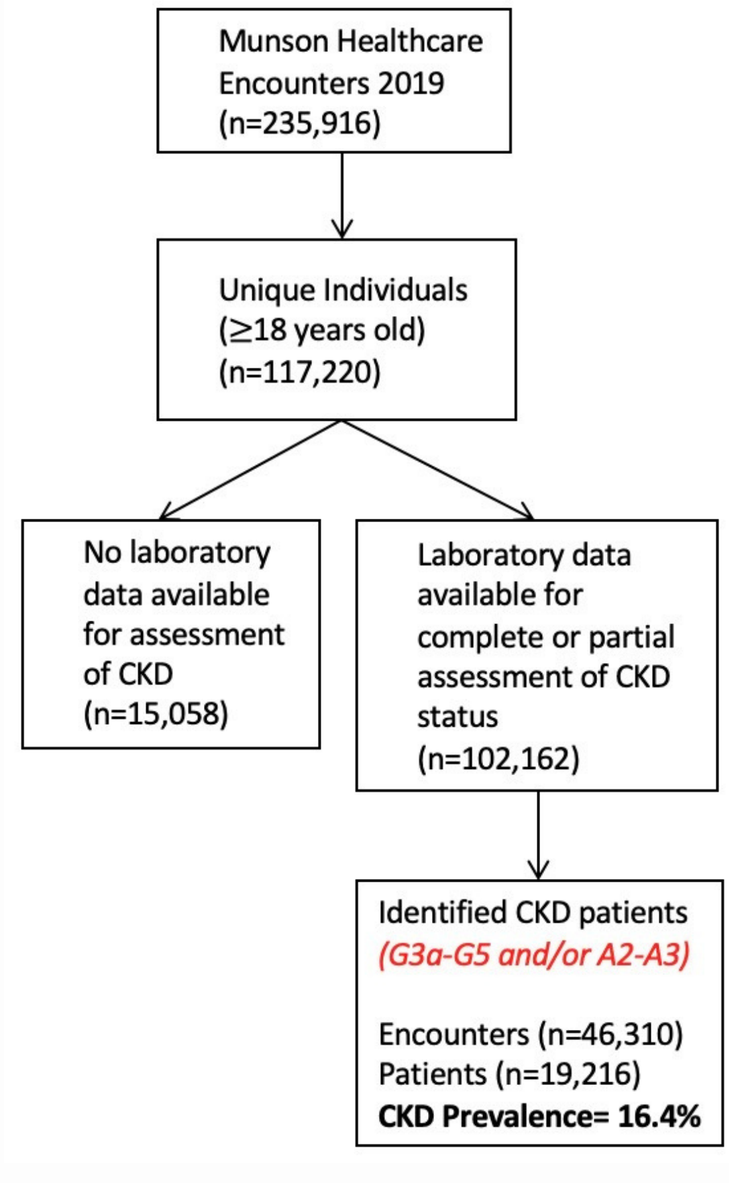
Step 1- Define patient population
All patients having at least one laboratory encounter between Jan 1st, 2018 and Dec 31st, 2020

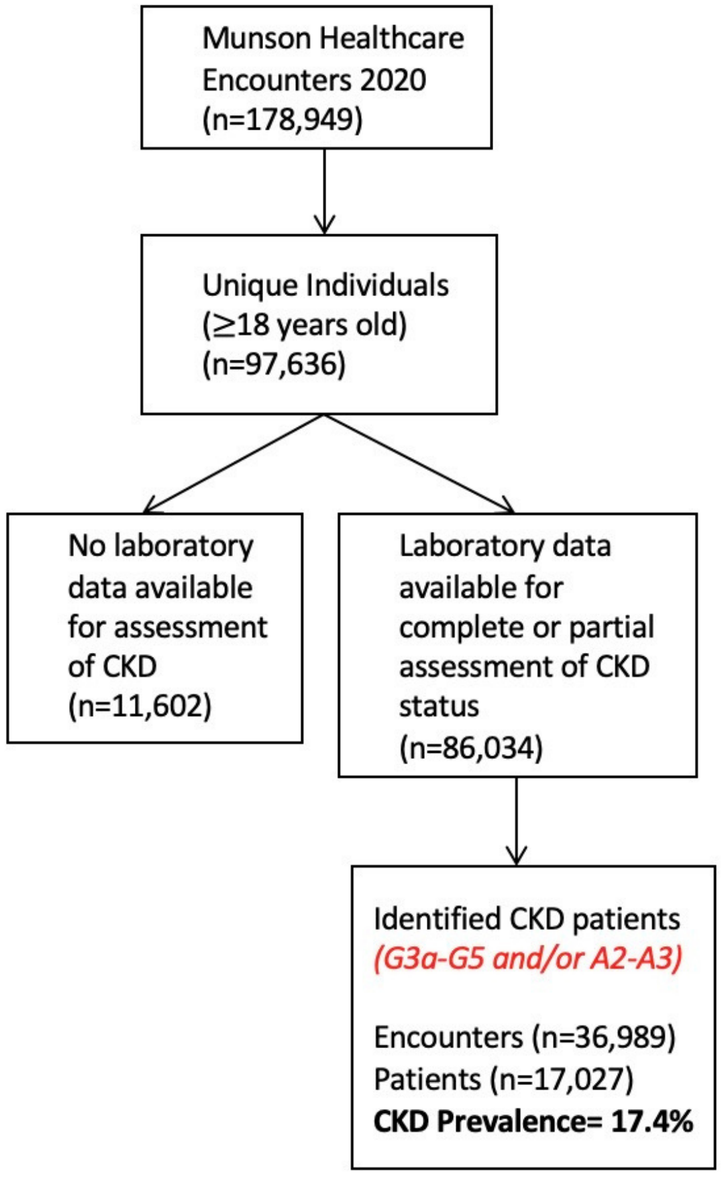
Step 2 – Identify clinical variables
Age, Sex, Race, Zip Code
Serum Creatinine
Urine albumin-to-creatinine ratio
Urine protein-to-creatinine ratio

Step 3- Apply phenotype definitions
Applied a distinct CKD computable phenotype definition based on KDOQI guidelines.

Results


Munson Healthcare Encounters 2018 (n=116,295)
Unique Individuals (≥18 years old) (n=74,885)
No laboratory data available for assessment of CKD (n=8,232)
Laboratory data available for complete or partial assessment of CKD status (n=66,653)
Identified CKD patients (G3a-G5 and/or A2-A3)
Encounters (n=22,090)
Patients (n=12,055)
CKD Prevalence= 16.1%


Munson Healthcare Encounters 2019 (n=235,916)
Unique Individuals (≥18 years old) (n=117,220)
No laboratory data available for assessment of CKD (n=15,058)
Laboratory data available for complete or partial assessment of CKD status (n=102,162)
Identified CKD patients (G3a-G5 and/or A2-A3)
Encounters (n=46,310)
Patients (n=19,216)
CKD Prevalence= 16.4%


Munson Healthcare Encounters 2020 (n=178,949)
Unique Individuals (≥18 years old) (n=97,636)
No laboratory data available for assessment of CKD (n=11,602)
Laboratory data available for complete or partial assessment of CKD status (n=86,034)
Identified CKD patients (G3a-G5 and/or A2-A3)
Encounters (n=36,989)
Patients (n=17,027)
CKD Prevalence= 17.4%

Health Care Seeking Population Trends

2018	2019	2020
CKD Prevalence-16.1% (95% CI: 15.8%-16.4%) Mean Age- 73.5 ± 12.3 Female- 55.4%	**CKD Prevalence-16.4%** (95% CI: 16.2%-16.6%) Mean age- 73.5 ± 12.0 Female- 53.4%	**CKD Prevalence-17.4%** (95% CI: 17.2%-17.6%) Mean age- 73.5 ± 12.0 Female-53.5%

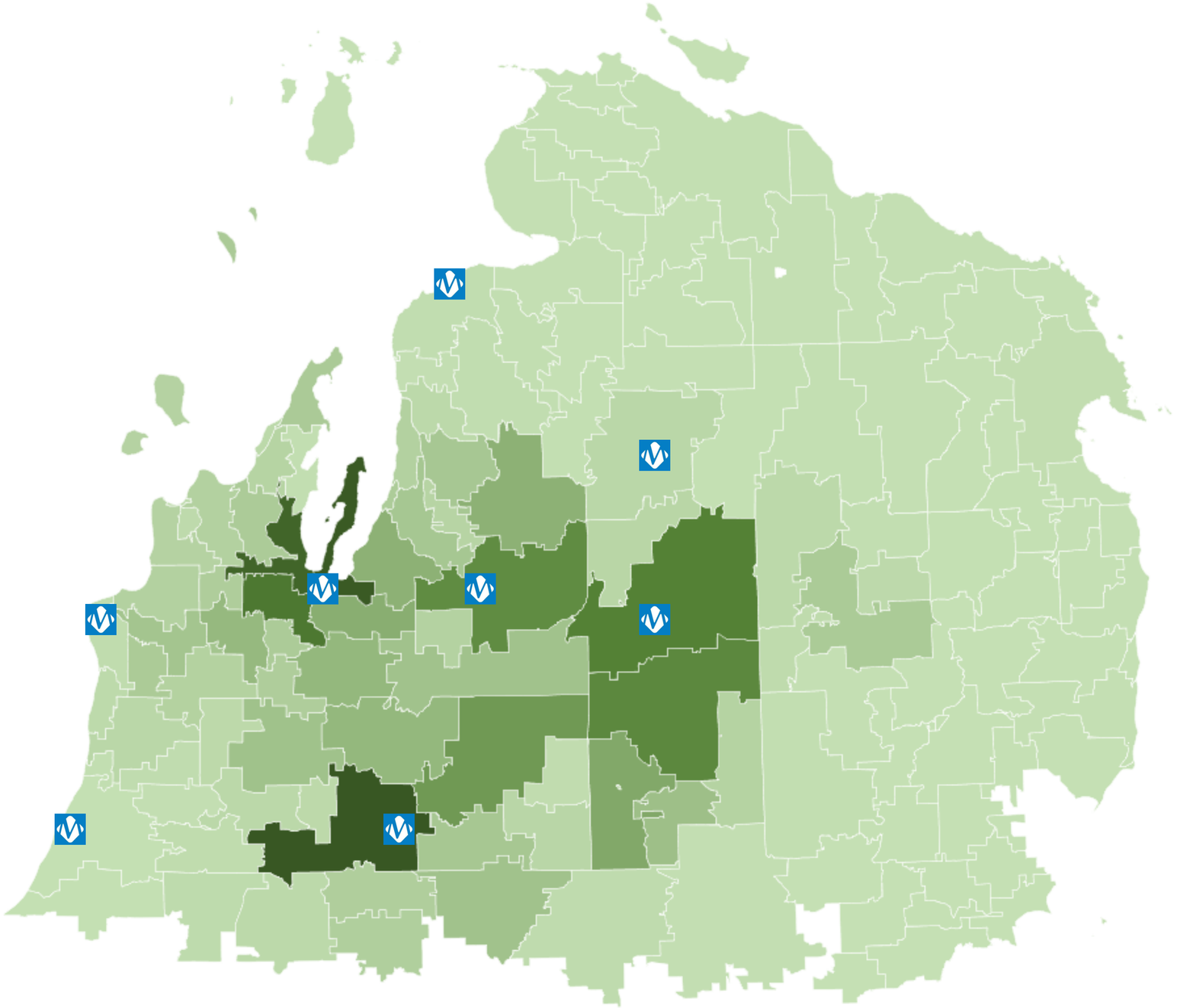
2020 Staging Glomerular Filtration Rate

Stage	Category	GFR range (ml/min per 1.73 m2)	Number of Encounters	Percentage of Encounters (%)
G1	Normal or high	>90	62471	35.0
G2	Mildly decreased	60-89	64840	36.2
G3a	Mildly to moderately decreased	45-59	18248	10.2
G3b	Moderately to severely decreased	30-44	9521	5.3
G4	Severely decreased	15-29	4012	2.2
G5	Kidney failure	<15	2767	1.5
GFR Not listed	-	-	17090	9.6

2020 Staging Proteinuria

Stage	A1	A2	A3	Albuminuria/ Proteinuria Not Listed
Category	Normal to midly increased	Moderately increased	Severely increased	-
Albuminuria range (mg/g)	<30	30-300	>300	-
Proteinuria range (mg/g)	<150	150-500	>500	-
Number of Encounters	10723	4221	2046	161959
Percentage of Encounters (%)	6.0	2.4	1.1	90.5

Identified CKD Cases in Northern Michigan, by ZIP Code

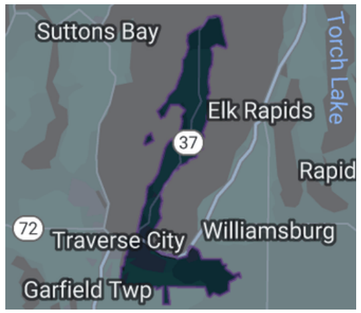


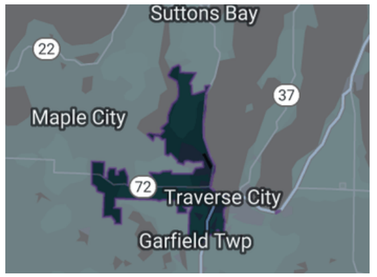
Prevalence

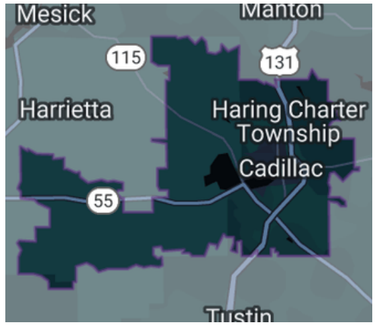
Munson Affiliated Hospital Facility

Discussion

- Leveraged EHR and phenotypic CKD definitions to identify large rural CKD burden
- Largest number of cases identified in Traverse City and Cadillac area
  - Proximity to hospital appearing to be a key factor
- Data are limited based on Munson Healthcare facility data
  - EHR should support exchange of CKD-related information across health care settings







Discussion

- In 2020, 11.9% of patients did not have appropriate laboratory data to identify CKD risk
- Only 18.9% of individual patients identified with CKD risk by GFR staging alone had a corresponding documented albuminuria
  - Inadequate screening
  - Lacking appropriate data to accurately assess overall CKD risk
  - Obstacles to implement goal directed therapy
- Proper surveillance is warranted to identify patients at risk for CKD

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Discussion

- Use of EHR and phenotypic definitions of CKD proved successful for characterizing CKD burden in part of rural Northern Michigan
  - Vital for detect high risk populations
  - Crucial for rural areas with pre-existing health disparities and barriers
- Consider integration of phenotypic definitions into EHR
  - Surveillance or registry program
  - Engage patient with goal directed therapies
  - Proactive recognition and intervention
  - Improve public health and health care planning

Conclusion

- Further studies needed to characterize geographic disparities
- Consider including data across multiple hospital systems to better understand population statistics of Northern Michigan
- Identify patient risk factors, resource utilization, previous interventions, socioeconomic status, and possible environmental exposures
- Consider implementation of phenotypic CKD definitions into EHR to more readily identified high risk patients

References

1. United States Renal Data System. 2017 USRDS annual data report: Epidemiology of kidney disease in the United States. NIH. Bethesda, MD
2. Fink JC, Brown J, Hsu VD, Seliger SL, Walker L, Zhan M. CKD as an underrecognized threat to patient safety. American journal of kidney diseases : the official journal of the National Kidney Foundation. 2009;53(4):681-8.
3. Plantinga LC, Boulware LE, Coresh J, Stevens LA, Miller ER, 3rd, Saran R, et al. Patient awareness of chronic kidney disease: trends and predictors. Archives of internal medicine. 2008;168(20):2268-75.
4. Foote C, Clayton PA, Johnson DW, Jardine M, Snelling P, Cass A. Impact of estimated GFR reporting on late referral rates and practice patterns for end-stage kidney disease patients: a multilevel logistic regression analysis using the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA). American journal of kidney diseases : the official journal of the National Kidney Foundation. 2014;64(3):359-66.
5. Wang V, Hammill BG, Maciejewski ML, Hall RK, Scoyoc LV, Garg AX, et al. Impact of automated reporting of estimated glomerular filtration rate in the veterans health administration. Medical care. 2015;53(2):177-83.
6. Drawz PE, Archdeacon P, McDonald CJ, Powe NR, Smith KA, Norton J, et al. CKD as a Model for Improving Chronic Disease Care through Electronic Health Records. Clinical journal of the American Society of Nephrology : CJASN. 2015;10(8):1488-99.
7. Ma I, Guo M, Muruve D, Benediktsson H, Naugler C. Sociodemographic associations with abnormal estimated glomerular filtration rate (eGFR) in a large Canadian city: a cross-sectional observation study. BMC Nephrol. 2018 Aug 9;19(1):198. doi: 10.1186/s12882-018-0991-5. PMID: 30092764; PMCID: PMC6085713.
8. Inker LA, Eneanya ND, Coresh J, Tighiouart H, Wang D, Sang Y, Crews DC, Doria A, Estrella MM, Froissart M, Grams ME, Greene T, Grubb A, Gudnason V, Gutiérrez OM, Kalil R, Karger AB, Mauer M, Navis G, Nelson RG, Poggio ED, Rodby R, Rossing P, Rule AD, Selvin E, Seegmiller JC, Shlipak MG, Torres VE, Yang W, Ballew SH, Couture SJ, Powe NR, Levey AS; Chronic Kidney Disease Epidemiology Collaboration. New Creatinine- and Cystatin C-Based Equations to Estimate GFR without Race. N Engl J Med. 2021 Nov 4;385(19):1737-1749. doi: 10.1056/NEJMoa2102953. Epub 2021 Sep 23. PMID: 34554658; PMCID: PMC8822996.
9. Levin A, Stevens PE. Summary of KDIGO 2012 CKD Guideline: behind the scenes, need for guidance, and a framework for moving forward. Kidney Int. 2014 Jan;85(1):49-61. doi: 10.1038/ki.2013.444. Epub 2013 Nov 27. PMID: 24284513.
10. United States Census Bureau. B01001 SEX BY AGE, 2021 American Community Survey 5-Year Estimates. U.S. Census Bureau, American Community Survey Office. Web. 8 December 2022. http://www.census.gov/.
11. Nadkarni GN, Gottesman O, Linneman JG, Chase H, Berg RL, Farouk S, et al. Development and validation of an electronic phenotyping algorithm for chronic kidney disease. AMIA Annual Symposium proceedings AMIA Symposium. 2014;2014:907-16.
12. McLeroy K, et al. An ecologic perspective on health promotion programs. Health Education Quarterly 1988; 15:351-377.
13. Kibria GMA, Crispen R. Prevalence and trends of chronic kidney disease and its risk factors among US adults: An analysis of NHANES 2003-18. Prev Med Rep. 2020 Sep 1;20:101193. doi: 10.1016/j.pmedr.2020.101193. PMID: 33101883; PMCID: PMC7578737.
14. Long AS, Hanlon AL, Pellegrin KL. Socioeconomic variables explain rural disparities in US mortality rates: Implications for rural health research and policy. SSM Popul Health. 2018 Aug 31;6:72-74. doi: 10.1016/j.ssmph.2018.08.009. Erratum in: SSM Popul Health. 2020 Dec 10;12:100714. PMID: 30225336; PMCID: PMC6138992.
15. U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates.

Questions?