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COMMENTARY

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# An age-friendly population health dashboard geolocating by clinical and social determinant needs

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## 1 | INTRODUCTION: MINDING THE GAP–4 M AND SOCIAL DETERMINANT COMMUNITY BASELINES

The call for age friendliness has been championed by numerous organizations. The World Health Organization, John A. Hartford Foundation, Institute for Healthcare Improvement (HI), American Hospital Association, and numerous others have envisioned age friendly cities, communities and health systems.[1–3] This call has resonated in a variety of interdisciplinary contexts including education,[4] nursing,[5] pharmacy,[6] audiology[7] and oncology.[8,9] Age-friendly health care has also spanned the continuum of care in ambulatory,[10] emergency department,[11] hospital,[12] "minute clinic",[13] and even rural settings.[14]

The success of the age friendly movement has led to an endeavor to create an age friendly ecosystem including age friendly public health systems with a focus on population health, and social determinants of health (SDH).[15,16] Age-friendly public health initiatives have ranged from homelessness and elder abuse,[17] poverty,[18] to teaching kitchens[19] and public transportation.[20,21,22] Despite these, knowledge regarding specifics of the "4 M's" ("mentation", "mobility", "medications", and "matters most") of Age-Friendly Health systems amongst clinicians has remained limited.[23]

One reason for this paradox may be lack of clinician awareness regarding baseline levels of "4 M" clinical quality care gaps in their community settings. In our own local community, around the Cleveland Clinic Health System (CCHS), while surveys of age friendliness have been performed in neighboring cities,[24] these have not been through the 4 M lens.

Technology may help to efficiently and accurately identify 4 M care gaps. However, age friendly technologies have hitherto been focused on patient portals,[25,26] mobility[27] or hospital based electronic medical records (EMR's) where adoption of structured 4 M frameworks has remained low.[28]

The Area Deprivation Index (ADI) ranks neighborhoods by socioeconomic disadvantage at state and national levels. It includes domains of income, education, employment and housing quality.[29] Correlations between ADI and function,[30] multi-morbidity[31–35] including COVID 19[36] as well as utilization[37,38] are well established. To our knowledge, only very novel 4 M based age friendly technology efforts have harnessed ADI to establish social determinant of health (SDH) needs, in addition to clinical, for community older adults.

In this commentary, we describe the development of an electronic population health dashboard that identifies baseline demographic and clinical 4 M characteristics for an older adult community in Ohio served by CCHS, and geo-locates patients to zip codes with the highest ADI.

## 2 | OUR RESPONSE: AN ELECTRONIC AGE FRIENDLY 4 M POPULATION HEALTH DASHBOARD ("AF4MD")

An electronic Age Friendly 4 M population health dashboard ("AF4MD") was designed as follows: The target population consisted of community dwelling older adults with primary residence in Ohio,

completion of an office or virtual visit between 2016 and 2021 at the CCHS and age range between 61 and 110. Patients were categorized by gender, race, age bands with 10 year ranges and using the 4 M framework.

The AF4MD was constructed via aggregation of demographic, geospatial, and clinical data sourced from the EPIC EMR (Figure 1). Connections were built between population health and proprietary risk management metrics using Teradata (relational database management system) and Tableau (visual analytic software). The 4 M categories were defined as follows; "Mentation" by ICD-10 codes F03.90 and F03.91 on EMR problem lists; "Mobility" by EMR documentation of either two or more falls or one or more fall with injury in the last 12 months, or patients utilizing ambulatory assistive devices; "Medication" defined as any patient with 10 or more currently active medications in the EMR; "Matters Most" as completion of an Advance Care Planning (ACP) discussion between 2019 and 2021 using Current Procedural Terminology (CPT) codes 1123F and 1124F and Healthcare Common Procedure Coding System (HCPCS) codes of 99,497 and 99,498.

Populations were mapped geographically by zip codes of primary residence including by highest ADI (highest average decile for the state) as a marker for elevated SDH needs. This enabled the creation of a geospatial heat map, identifying population densities within different zip codes (please see Figure 2).

Reported variables included demographics; by age band deciles, gender, race, residence in "highest ADI" and "non-highest ADI" zip codes and by "M" domain. All aforementioned variables were also reported for within "highest ADI" and "non-highest ADI" zip codes. All patient populations were de-identified and descriptive statistics from cross sectional analysis reported in aggregated form.

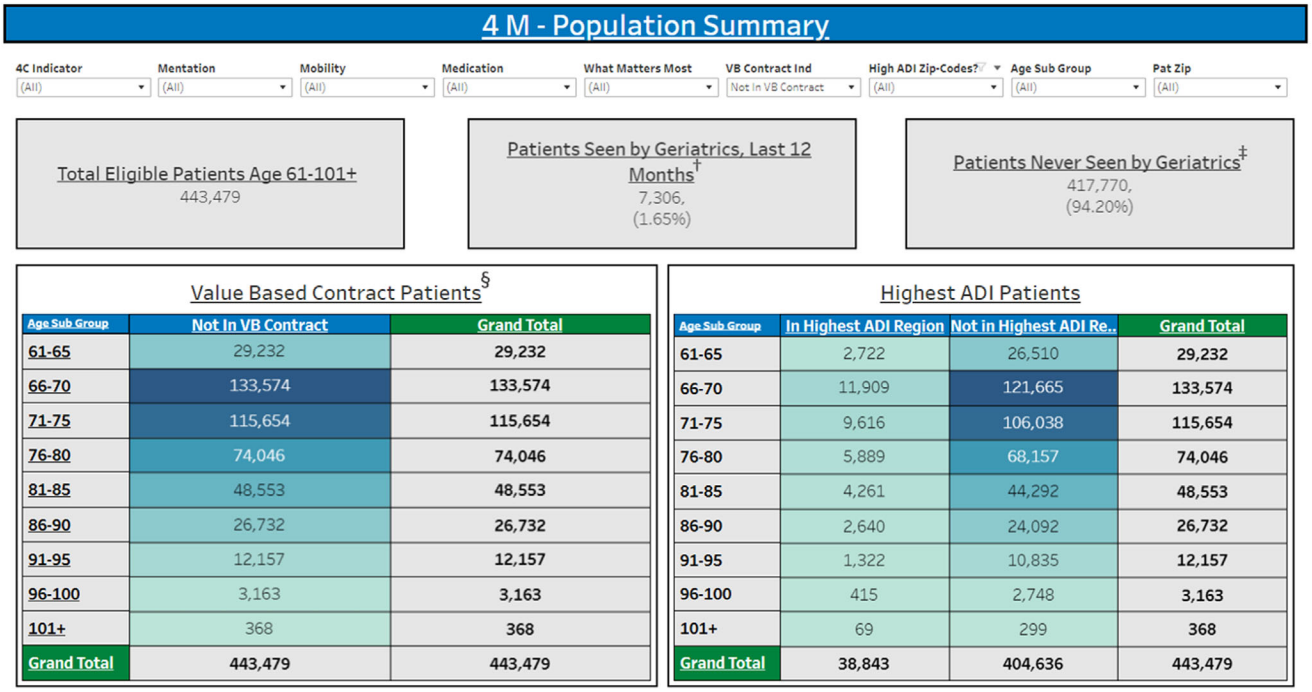
## 3 | AF4MD DEMOGRAPHIC, 4 M AND SDH HIGHLIGHTS

The AF4MD had a total of 438,146 patients meeting inclusion criteria with the following age band distribution: 161,481 patients (36.85%) ages 61 through 70: 186, 424 (42.54%) of ages 71 through 80; 74,590 (17.02%) of ages 81 through 90; 15,309 patients (3.49%) ages 91 through 100; 342 patients above age 100 (0.08%).

Gender distribution of overall dashboard population was 192,669 female (43.97%) and 245, 452 male (56.02%) and 35 other (0.01%). Race distribution was 36,271 White (83.82%), 43,931 African American (10.03%) (Who constitute 12.41% of the Ohio population), 4298 Asian (0.98%), 20,024 other (4.57%).

The target population satisfied conditions for single M domains as follows: 84,596 (19.31%) of patients only met conditions for Mobility; 52,094 (11.89%) only met conditions for Medication; 956 (0.22%) only met conditions for Mentation; 749 (0.17%) only met conditions for Matters Most (Figure 3 depicts the distribution of single "M" domain populations as well as selected combination M domains).

The impact of the low percentages of Mentation and Matters Most on combination M descriptions was significant. As shown in Figure 3, an example is the Medication and Mobility combination of




Value Based Contract Patients§

| Age Sub Group | Not In VB Contract | Grand Total |
|---|---|---|
| 61-65 | 29,232 | 29,232 |
| 66-70 | 133,574 | 133,574 |
| 71-75 | 115,654 | 115,654 |
| 76-80 | 74,046 | 74,046 |
| 81-85 | 48,553 | 48,553 |
| 86-90 | 26,732 | 26,732 |
| 91-95 | 12,157 | 12,157 |
| 96-100 | 3,163 | 3,163 |
| 101+ | 368 | 368 |
| Grand Total | 443,479 | 443,479 |

Highest ADI Patients

| Age Sub Group | In Highest ADI Region | Not in Highest ADI Re.. | Grand Total |
|---|---|---|---|
| 61-65 | 2,722 | 26,510 | 29,232 |
| 66-70 | 11,909 | 121,665 | 133,574 |
| 71-75 | 9,616 | 106,038 | 115,654 |
| 76-80 | 5,889 | 68,157 | 74,046 |
| 81-85 | 4,261 | 44,292 | 48,553 |
| 86-90 | 2,640 | 24,092 | 26,732 |
| 91-95 | 1,322 | 10,835 | 12,157 |
| 96-100 | 415 | 2,748 | 3,163 |
| 101+ | 69 | 299 | 368 |
| Grand Total | 38,843 | 404,636 | 443,479 |

**FIGURE 1** Age friendly 4 M population health dashboard (AF4MD) screenshot. † Denotes patients seen by Geriatric within the most recent 12 month period. ‡ Denotes patients never seen by Geriatrics. § Operational indicator to flag aggregate patient participation in a value-based contracts - Set to omit identification of value-based contract participation in order to satisfy operational privacy and inclusion of dashboard figure [Color figure can be viewed at wileyonlinelibrary.com]

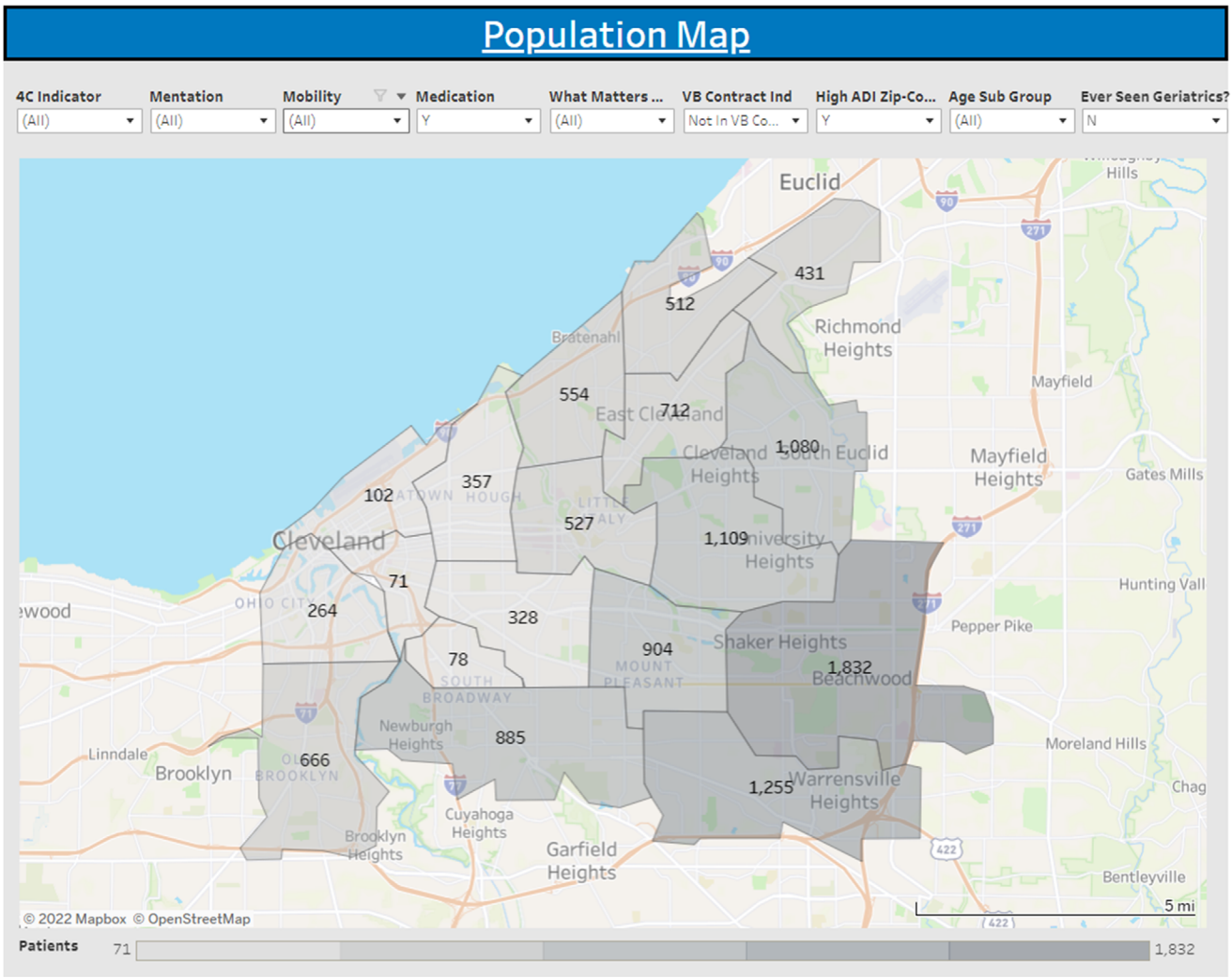



**FIGURE 2** Age friendly 4 M population health dashboard (AF4MD) geospatial heat map of older patients living in highest area deprivation index (ADI) zip codes (shaded) with medication flag (Ten or greater medications) and never seen by Geriatrics filters [Color figure can be viewed at wileyonlinelibrary.com]

14.07% which decreased to 0.33% when Mentation alone was added and 0.29% when Matters Most alone was added. Similar impact of Mentation and Matters Most domains was seen for all 12 permutations of the Age Friendly 4 Ms.

An overall 131 (0.03%) of patients met conditions for all 4 M's and 232,025 (52.96%) of patients met conditions for none of the 4 M categories.

By geospatial location, 38,520 patients (8.79%) were residents of highest ADI zip codes and 399,626 patients (91.21%) were residents of non-highest ADI zip codes.

Of the total A4MD population, 94% had never seen the Geriatrics team.

Table 1 shows the percentage distribution of patients residing in highest ADI and non-highest ADI sub-populations by "M" domains, gender and race (as opposed to for the total dashboard population).

Race distribution of the highest ADI and non-highest ADI sub populations was as follows: 20, 843 (54.11%) of highest ADI and 23,373 (5.85%) of non-highest ADI were African American; 15,564 (40.4%) of highest ADI and 354,020 (88.59%) of non-highest ADI were White. Asian, Hispanic and "Other" populations were similar between highest ADI and non-highest ADI zip codes.

It is not possible with our electronic dashboard to establish any association. However, this observation of co-occurrence of highest ADI zip codes with a greater African American population should inform health care policy and population health research. Similar trends linking ADI with African American race and even COVID 19 outcomes have been observed.[39]

To our knowledge this is the first use of technology to identify baseline characteristics for community dwelling older adults based on a combination of "4 M", demographic and SDH variables via an electronic dashboard. To date, use of technology for age friendly initiatives has spanned EMR based 4 M documentation in the hospital and long-term care settings,[28] clinician to clinician videoconferencing around Mentation in the long term care setting in ECHO-Age[40,41] and patient portal technologies.[25,26] Therefore it is not possible to compare our AF4MD with other studies.

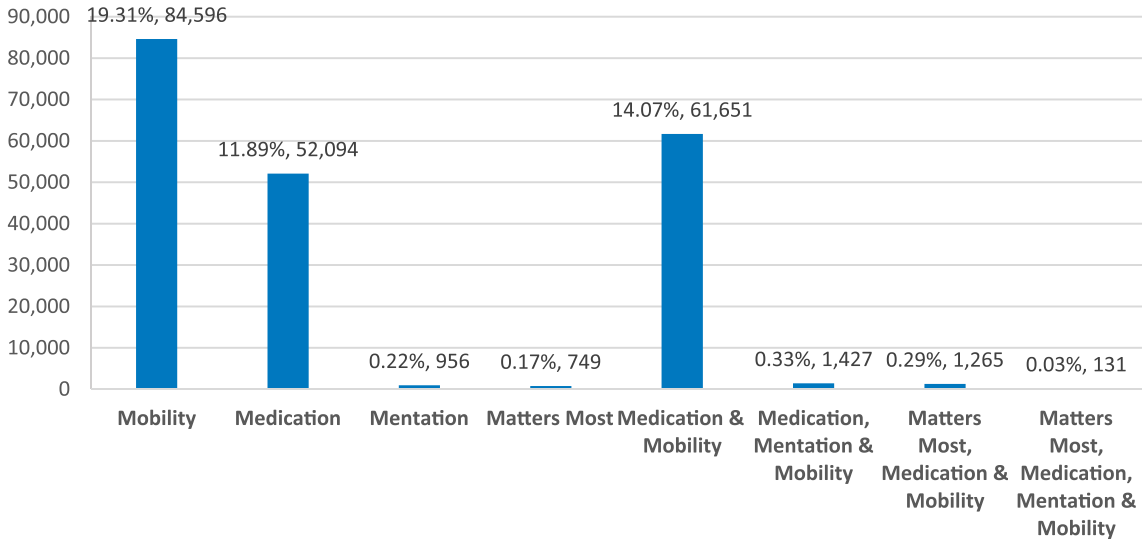



**FIGURE 3** Age friendly population health dashboard (AF4MD) population by 4 M domain documentation in EMR [Color figure can be viewed at wileyonlinelibrary.com]

**TABLE 1** Highest area deprivation index (ADI) and non-highest ADI zip code age friendly 4 M population health dashboard sub populations by 4 M domains and demographics[a]

| Demographics | Highest ADI zip codes | Non-highest ADI zip codes |
|---|---|---|
| Matters most only | 100, (0.26%) | 649, (0.16%) |
| Medication only | 5611, (14.57%) | 46,483, (11.63%) |
| Mentation only | 213, (0.55%) | 1292, (0.32%) |
| Mobility only | 7332, (19.03%) | 77,264, (19.33%) |
| All 4 M domains | 28, (0.07%) | 103, (0.03%) |
| Female | 22,996, (59.7%) | 222,456, (55.67%) |
| Male | 15,523, (40.3%) | 177,146, (44.33%) |
| Other | 1, (0.00%) | 24, (0.01%) |
| Caucasian | 15,564, (40.4%) | 354,020, (88.59%) |
| African American | 20,843, (54.11%) | 23,373, (5.85%) |
| Asian | 413, (1.07%) | 3898, (0.98%) |
| Hispanic | 1, (0.00%) | 5, (0.00%) |
| Other | 1700, (4.41%) | 18,335, (4.59%) |
| Total | 38,520, (100%) | 399,626, (100%) |

[a]Percentages here represent percentages of the total highest ADI and non-highest ADI sub-populations respectively.

There is however a compelling contrast between the "4 M" baselines characteristics by individual "M" domains generated for AF4MD compared to both Ohio and national metrics illustrating actionable 4 M clinical gaps. As regards Mentation, 11.2% of Ohio residents above age 65 were reported in 2019 as having cognitive decline[42] compared with the AF4MD 0.22%. This importantly underscores that AF4MD dementia identification rates are significantly lower than the state averages despite the prevalent challenges of poor dementia identification and documentation being common to both populations. This difference will be the impetus for active patient outreach to connect AF4MD patients to Cleveland Clinic Geriatrics for closing the Mentation (and other 4 M) clinical identification gaps.

Per the Center for Disease Control (CDC), 36 million older adults had a fall in 2018 resulting in injury in 8 million cases. The prevalence of annual falls for Ohio is 25.7% with a national fall average of 28%.[43] This is in alignment with our dashboard Mobility M of 19.31%.

Polypharmacy in the elderly has been extensively described as being related to falls and increased hospital utilization.[44,45] There is significant heterogeneity in the literature re: polypharmacy's definition ranging from a count of two to eleven medications with one systematic review describing 46.4% of included studies using a definition of five or more medications.[44] Our dashboard used a definition of 10 or more medications to identify those older patients at highest risk of "hyper-polypharmacy" (> 10 medications) which is significantly increasing over time.[46,47] The heterogeneity of polypharmacy definitions also leads to significant variability in the literature for estimated polypharmacy prevalence rates. It is challenging therefore to compare the 11.89% of AF4MD patients meeting our definition of polypharmacy with other studies. Patient outreach to evaluate how much of this polypharmacy is inappropriate per the Beers criteria[48] and warrants "deprescribing" efforts will be important. To our knowledge, there are no polypharmacy prevalence statistics for the state of Ohio. The AF4MD may help address this research gap.

Every patient should be asked "What Matters Most" to them. The "Matters most" dashboard percentage of 0.17% is significantly less than the ideal of "Matters most" conversations for every patient. It is also much lower than the reported ACP conversation and billing percentages in the literature varying from 13% to 74%.[49,50] Our low "Matters Most" results may be secondary to poor documentation, patient and clinician discomfort or lack of awareness regarding the value of ACP which itself has been questioned recently.[51,52]

## 4 | AF4MD LIMITATIONS

Limitations included 4 M definition heterogeneity in the literature as described. This calls for standardization of 4 M definitions across Age Friendly Health Systems. Our AF4MD was dependent upon the completeness and quality of EMR 4 M documentation. Specifically, Mentation and Matters Most evidenced very low documentation. The Mobility definition does not account for specific number of falls per year nor mobility promoting interventions (A4MD was designed to capture community baselines not interventions). The Medications "M" did not allow confirmation that EMR medication lists were necessarily all being actively filled. Matters most definition included ACP billing which has been found to be low nationally, with only 15% of 53,926 practices being found to be billing for ACP.[53] Our dashboard design was cross sectional, so establishing causation was precluded. Only older residents of Ohio were included, thereby limiting the generalizability to other geographical settings.

## 5 | FUTURE DIRECTIONS/IMPLICATIONS

Access is a top priority for CCHS leadership with a "Patients First" creed. The Cleveland Clinic Community Care (4C) Institute in which our Center for Geriatric Medicine is based, is exclusively focused on population health and the "Quintuple Aim".[54] This commitment to access can be seen in the creation of multiple patient family advisory councils proposing themes of access, team based care and patient centric communication.[55] The thematic response has been multi-dimensional: Public health focused shared medical appointment programs for underserved communities[56]; telemedicine programs promoting mental health[57]; linkage of thousands to supplies and community resources during the pandemic and federally qualified health center partnerships[58]; building brand new grocery stores in "food deserts"; internet connectivity in impoverished local neighborhoods. All testament to the continued CCHS focus on access for our most underserved communities.

The CCHS Age Friendly 4 M Population Health Electronic Dashboard (AF4MD) has both strategic and quality improvement implications for the future. Our health system has had the vision to support the creation of this AF4MD so that the 4 M clinical and social determinant gaps identified can be the first step towards geospatial targeted outreach to those in most need. This outreach in turn will connect vulnerable older populations living in zip codes with greatest 4 M and SDH needs to our Cleveland Clinic Successful Aging platform. This program provides access to both "4 M" clinical care delivered by Geriatrics in combination with SDH services offered by community allies.

As an example, females aged greater than 85 had the highest number of Alzheimer's disease related deaths in Ohio, and increased cognitive impairment was seen in lower income households.[42] Currently, females constitute 43.97% of the AF4MD population and 8.79% of the total population were residents of the highest ADI zip codes. This should inform the targeting of future active engagement efforts to hone in on those demographics most affected by dementia. This may additionally guide research on cognitive screening in primary care, addressing concerns by the US Preventive Services Task Force (USPSTF) for current lack of sufficient related evidence.[59] So while the dashboard cannot practically be an intervention in and of itself, it is designed as a springboard for action: Similarly for Geriatrics Falls Clinic referrals (for Mobility gaps); for Deprescribing efforts to counter polypharmacy; and ACP outreach (for the Matters Most "M").

Furthermore, A4MD presents a call to action and blueprint for increasingly reaching out to those patient demographics not currently as actively engaged with our health system that is, additional engagement with African American, Lesbian, Gay, Bisexual and Transgender (LGBQT); female and oldest old (above age 80 and 90) populations. The AF4MD could also optimize 4 M community baseline awareness for clinicians as well as catalyze integration of 4 M screening at the point of care. Incidentally, the Mobility and Medication "M"s, the M domains most identified by our dashboard with percentages respectively equaling and surpassing national prevalence statistics, are also the M domains that have existent screening processes currently imbedded into clinical practice across CCHS. Emulating this for Mentation and Matters Most will be key.

The dashboard also highlights the immense role that Geriatricians could potentially play in addressing current 4 M clinical and SDH care gaps. Of the total 438,146 AF4MD population, 94% had never seen the Geriatrics team. This can be done via direct clinical care as well as in an advisory capacity to diffuse 4 M principles across CCHS, as inspired by the call to define the true mainstream identity of Geriatrics.[60]

At the national level, the AF4MD can be adopted by other health systems as a "live" data warehouse which redefines geriatrics quality metrics in the 4 M framework. It can also establish a 4 M paradigm for population health research promoting inclusivity of "4 M care gap" older populations who have historically been excluded from research trials and hence been unable to inform age friendly clinical guidelines. Moreover, the AF4MD can longitudinally track progress of Age Friendly initiatives both locally and nationally.

The clinical practice, educational, research and policy implications of the AF4MD are manifold. We hope that the AF4MD will guide the futuristic operationalization of Age Friendly Health system strategies, employing an aggregated data analytics approach towards optimizing health care delivery via geolocation.

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