Research Article ISSN: 2833-0382

International Journal of Family Medicine & Healthcare

Frontier-Breaking Primary Care: Community-Oriented Deep Medicine

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Received: 17 Dec 2023; **Accepted:** 23 Jan 2024; **Published:** 29 Jan 2024

Citation: Richard R. Love. Frontier-Breaking Primary Care: Community-Oriented Deep Medicine. Int J Family Med Healthcare. 2024; 3(1): 1-5.

ABSTRACT

45 years following the declaration of Alma-Ata that health care is a human right, delivering population-accessible, meaningfully high-quality primary health and health-creating care has occurred but rarely across the globe. The major issues central to impactful primary care systems for communities are known: creation of value-oriented networks of community health workers, virtual care providers, and ambulatory care specialists whose activities are integrated by wireless broadband technology and customized electronic medical record systems.

Within such optimal systems there are now four critical perspectives that must be addressed. First is the emerging paradigm for health that inflammation is a common biological pathway for multiple and interacting health conditions. This insight demands increased focus-deep medicine- on the identification of patient-specific causes and stressors producing low-level chronic inflammation. Second, is the need to more rigorously follow evidence-based medical data considering all critical metrics: efficacy, safety, efficiency, patient-centeredness, timeliness, and equity. Third, health systems must become more focused as learning centers. Finally, we must thoughtfully recognize and embrace the artificial intelligence revolution, and boldly define care implementation solutions for our commonest medical problems. Together with population-targeting systems, attention to these four subjects can lead to practicing more impactful medicine for communities.

Keywords

Community-oriented care, Deep medicine, inflammation, quality of care metrics, learning centers, artificial intelligence.

"What we have before us are some breath-taking opportunities, disguised as insoluble problems." [1]

45 years following the declaration of Alma-Ata that health care is a human right, delivering population-accessible, meaningfully high-quality primary health and health-creating care has occurred but rarely across the globe [2,3]. The COVID pandemic has magnified shortcomings in public health and suggested greater attention to the interaction of public health and clinical practice [4]. Five years ago, the World Health Organization, and now more recently the World Bank have highlighted this history in calling for more action in addressing non-communicable diseases and primary care globally [5,6]. A consensus report from the National Academy of Medicine in the United States has summarized the weakened circumstances of primary care and documented the breadth of changes needed [7]. We have proposed a model of community-oriented primary care grounded in the extensive data this recent literature has emphasized: creation of value-oriented networks of community health workers, virtual care providers, and ambulatory care specialists whose activities are integrated by wireless broadband technology and customized electronic medical record systems [8]. Beyond and behind these organizational issues however, there are some major emerging perspectives or themes, which deserve the attention offered in this communication. These perspectives are not ivory-tower developed, or policy-conceived but rather grass-roots front-line primary care in their relevance to meeting health system shake-up demands. With these perspectives, I offer several practical ideas and tools.

Emerging Critical Big Picture Perspectives Bearing on Frontier-Breaking Primary Care

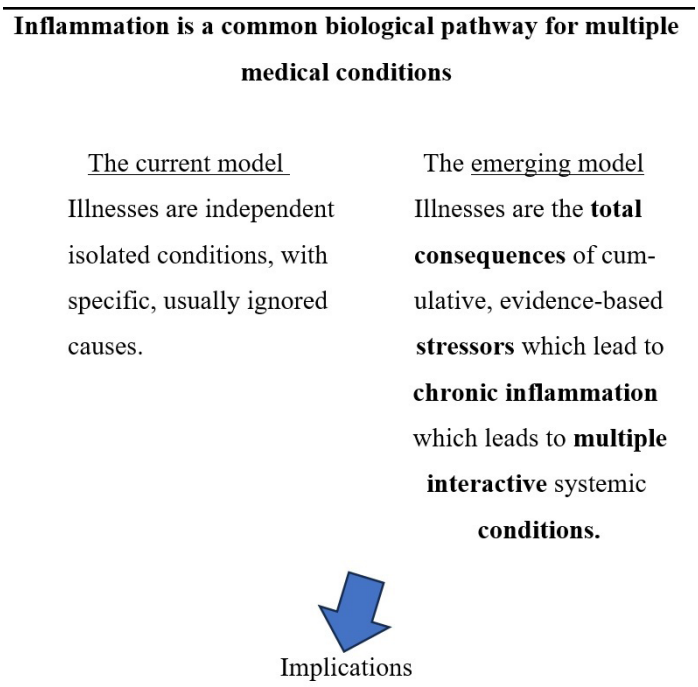
The Iceberg Challenge: Health Redefined

For more than a quarter century, Michael Marmot and Nigel Crisp have been advocating a more expansive view of measures to improve health, beyond biological factors, emphasizing ecological and social determinants [9-14]. In general, only recently have some systems begun changing, mostly however in response to pressures to reduce costs [15]. During this same period, increasing biological evidence has been accumulating supporting a major role for inflammation as a common biological pathway for multiple interacting chronic conditions (Figure 1) [16-18]. While this evidence grounds the ecological determinants more firmly in biology, it also broadens further the need to address causative factors—stressors-- contributing to worsening health by developing what Topol and others have called deep medicine [17,19]. Topol considers deep medicine to have three components: #1. Deep phenotyping, meaning the breadth of data which define an individual's health status; these are life-long detailed biological and ecological factors. #2. Deep learning, meaning synthesis and comprehensive analyses of all phenotypic data, in light of up-to-date scientific evidence. And #3. Deep empathy and connection, meaning having the rich relationships to get #1, and apply meaningfully #2 (19, pp. 16-17) [20,21].

These concepts lead to what I call the clinical deep medicine iceberg challenge: Medical issues-diagnoses and biological metrics-- are both more definable and less numerous than ecological issues critical to health. Consider some common biological stresses faced by the majority of inhabitants of low- and middle-income countries (Table 1). Certain items listed in this table bear specific comments. In a large, controlled study I conducted with colleagues in Nepal, 17% of women with blood test confirmed COVID reported being unrecovered 6 months later [22]. What was particularly remarkable was that one-third of these unrecovered women did not have any of the three most common symptoms associated with this status--fatigue, pain, and shortness of breath—which suggests that other chronic conditions were activated in these women and responsible for their perception that they were unrecovered. Such an observation is consistent with the emerging low-level chronic inflammation model.

That food scarcity or famine in parents, which according to the United Nations affected 29% of global citizens in 2021, might cause epigenetic changes leading to chronic inflammation in offspring is suggested by the Dutch famine study [22,23]. As summarized by Ravella, there are increasing reports of neurological changes associated with frequent social media activity, likely mediated by chronic inflammation [18]. Finally, globally poor oral health of teeth and gums affects almost half the world's population and is little considered as a contributor to systemic conditions [24]. This chronic inflammation model clearly demands consideration and investigation of the breadth of chronic stressors in the management of all non-communicable diseases. The emerging potential of artificial intelligence tools to be considered below will be important in meeting this challenge.

Figure 1: A new paradigm for health.



A new approach, deep medicine, which emphasizes attention to causes and stressors, is needed to create greater health in populations.

Table 1: Common individual acquired chronic biological stresses.

• Over consumption of animal protein and fat, sugar, salt, and ultra-processed foods* with additives and emulsifiers [20]
• Non-recovery from COVID-19 infection at 6 months (patient assessment) [21]
• Food scarcity currently or in the past [22]
• In women, eclampsia
• Major trauma or surgery
• Over-participation in social media [18]
• Teeth with holes or black spots (cavities) or red and bleeding gums [24]

* Industrially formulated foods of high caloric content containing 5 or more ingredients extracted from whole foods or synthesized, often high in starch, sugar, saturated fats, salt, additives, and emulsifiers. Examples include sodas and candies.

#2. Attention to values: Medicine as science

Globally, business models have evolved to dominate the majority of health care. Commercialized operations models with associated vested interests and professionalized mindsets are increasingly compromising the practice of medicine as science in the service of man. Focusing specifically on the quality of care necessary to provide meaningful impact on health outcomes, the avowed emphasis is on efficacy of tests and treatments (and not much on service) generally however, to the exclusion of other important metrics (Table 2) [25]. To highlight, one example: With colleagues in Bangladesh, we have used breast ultrasound in evaluation of women presenting with breast problems [26]. As has been found

in a meta-analysis of this technology in similar countries, in evaluating over 25,000 patients we have found this approach to be very effective in breast cancer detection, and have found no added benefit from mammography, which in the meta-analysis was determined to be similar in efficacy [27]. What is important is that on all the other metrics of high quality listed in table 2, breast ultrasonography is better than mammography, particularly in younger women [25,27]. Recently in seeking to expand our clinical service activities we have encountered significant resistance to plans to have ultrasound as our primary diagnostic tool for breast problems, resistance that is clearly not grounded in medical science, but rather from individuals and groups with vested interests.

The quality issues with tests extend, of course, beyond questions of their choice—one test versus another—to details of their conduct and application. As examples, measurements of blood pressure are rarely done as recommended, the use of the Hemoglobin A1c test in monitoring patients with diabetes is significantly low, and repeated spirometry in patients with asthma to assess complete response to treatment is little practiced [28] (Table 3).

We need to be more attentive to meeting quality standards not only because this is good medical scientific practice which can give better outcomes, but because not following these values is leading to loss of patient trust.

Table 2: Characteristics of evidence-based medical tests, medical services, and treatments whose use produces high-quality medical practice (From 25):

Effective Care makes a significant positive impact on people's health and well-being.
Safe Care has no serious unwanted effects, and few limited bothersome effects.
Efficient Care maximizes value for the financial, time, discomfort, and other costs.
Patient-centered Care accommodates patients' unique needs and preferences and provides information and support for patients to make informed choices.
Timely Care is provided promptly when needed with minimal waiting time.
Equitable Care is provided to all individuals regardless of their socio-economic status and ethnicity.

Table 3: Examples of efficacy metrics for common non-communicable medical conditions.

• Hypertension: Blood pressure less than 130/85 by repeated blood pressure measurements, focusing on the proper (always at least two determinations) determination of this assessment [28].
• Diabetes: Hemoglobin A1c < 7% by repeated assessments.
• Asthma: Usual forced expiratory air volume in 1 second of 75% or more of total lung capacity by repeated assessments with spirometry.

Learning health systems

Both for health care workers and for target populations, health begins at home [12,13]. Economists have repeatedly made clear that learning increases economic productivity and increases health. Surely then, learning should be a central part of health system activities. Conceptually, our care-giving facilities need to evolve to become health communications centers and to practice communications technology medicine. We need to create more rigorous, flexible, and robust series of on-site health facility, and critically, home-learning activities: brief written and illustrated articles, posters, mini-videos, and in facilities, educational mini-stations. We need to promote, reinforce, and provide practical and feasible health-supporting and health-creating actions and behaviors. As examples: as noted in table 3 regarding blood pressure assessment, we need first to get measurement procedures right, especially with multiple measurements, and then get the messages right and repeat them [28]. Adherence to medication for hypertension or breast cancer declines rapidly with time; much greater attention to the details of patient and community education about these treatments is warranted and should begin with what is taught in health care facilities [29,30]. The subjects for opportunistic health education in clinics and offices are numerous and self-evident (Table 4). In line with the emerging causation and stressor model for health discussed above, as an example, much greater attention to such issues for patients with asthma is appropriate, with addition of culturally and circumstance-customized pictures (Table 5).

Table 4: Health facility educational poster title examples.

• Health starts at home
• Characteristics of high-quality medical care
• Asthma at home
• Diabetes at home
• Diabetes: special care issues
• Reversible eye changes with diabetes
• Exercise for everyone
• Hypertension: important things to know
• Hypertension at home
• Reversible eye changes with hypertension
• Good foods to eat
• Foods to avoid
• Keeping your teeth and gums healthy
• Keeping heathy with immunizations

Table 5: Asthma at home education poster.

* Cleaner air cooking stove
* No tobacco smoking indoors
* Reduce commonest allergen trigger exposure
* Use a well-fitting mask with smoke or when people around have respiratory infections.
* To use inhaler: Breathe out completely. Take a slow, deep breath while pressing the inhaler button to fill your lungs. After inhaling the medicine, hold your breath to let the medicine be absorbed.

Developing and Embracing Artificial Intelligence Applications in Clinical Medical Practice Everywhere

Change and innovation are always hard to predict, but the indications are clear that artificial intelligence (AI) is a general purpose technology, and its development heralds a coming wave-a tsunami- a period of extremely high levels of innovation with staggering acceleration in human capacity. Suleyman describes AI as a transformative meta-technology [31]. By general purpose technologies, of which it is estimated there are perhaps 24 in human history, think the wheel, the printing press and books, the combustion engine, electricity, and the computer [32]. And then, for these consider their increasingly rapid huge proliferation and wide diffusion ripple effects. There are essentially two areas impacting medicine: synthetic biology-the ability to read, write, and edit the DNA life codes, with creation of new treatments and AI analytic capacities developing more efficient and accurate diagnoses and management [19,31,33]. Huge challenges are that first, the new treatment developments will likely be very costly and unavailable to most global citizens, and the AI applications in diagnosis and management are also likely to be costly and directed to clinical problems of patients with financial resources. We need to be bigger scanners of wide horizons and idea thieves, meaning we need to be thinking about and looking for new ideas using AI to address the most common problems in clinical medical practice at all levels, but particularly at the grass roots, primary care level [34]. We need greater imagination at scale [35]. Consider the breadth of AI tool-employing projects currently in process or appropriate to primary health care settings and common clinical problems globally [19,33] (Table 6). The highly prevalent non-communicable conditions contributing to these problems are hypertension, diabetes, asthma, and anemia—estimated to affect 1.25 billion, 422 million, 350 million, and 1.75 billion adults respectively.

Table 6: Artificial intelligence projects with potential impact in clinical primary care medicine.

- **Virtual medical assistant** to continually gather individual patient health information and survey the medical literature in a deep neural network to create virtual health guidance [19,33].
- Analyze **retinal fundoscopic images** in diabetic and hypertensive patients to create personalized reports and detect changes for which interventions are needed to prevent blindness.
- Characterize **individual responses to glucose and sodium** nutritional contents [18].
- Analyze **foot images in diabetics** to identify changes requiring interventions to prevent complications leading to amputations.
- Analyze **breathing sounds** heard through an acoustically augmented stethoscope to recognize specific lung conditions.
- Analyze prodromal symptoms in patients to **predict headache** development and interventions to prevent these.
- Analyze breadth of data in patients with **anemia** to design and implement targeted interventions.
- Analyze data in patients presenting with symptoms suggestive of **stroke** to allow rapid interventions to limit neurological damage.
- Create **personalized management programs** for patients with diabetes.
- Image analyses to recognize **common skin conditions** [36].

Conclusions

What John Gardner opined 60 years ago, is perhaps more true today: our opportunities to finally realize the human rights challenge of Alma-Ata are breath-taking [1,3]. It is surely time to move on to frontier-breaking community-oriented deep medicine from current widespread fast, shallow, and narrow business money-making only models, and walk the talk [6]. Realizing meaningful health care for populations as a human right is not about hospital care, advanced genetic testing and interventions, or major technologies in imaging or biologics. It's about marrying communications technology with the human right to health.

The systemic changes needed are clear [7]. How to be organized has been well-spelled out [6-8]. And now, as I have suggested here, the big picture issues we need to embrace are very evident: redefining health as a multi-source inflammory challenge, adhering more faithfully to our evidence-based medical practice values, promoting and developing our medical activities to include more comprehensive health education, and employing AI to better address common clinical problems.

How do we leap-frog and break these frontiers in our small individual local systems? We need excitement, imbuement with purpose, rewards, sense of ownership, and idea champions—Costa Rica's Quixotes [2,12,13]. The time is now to run to the revolutionary fire, get on the way, and walk the talk; it starts at the grassroots level [6].

Acknowledgements

I am grateful to Reza Salim, who has endlessly created a nourishing environment at Amader Gram in which to envision frontier-breaking approaches to health for the Bangladeshi population.

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