PHARMACEUTICAL CARE COORDINATION AND GENOMICS IN EMERGING MARKETS: A BUSINESS CASE FOR GHANA

Earl Ettienne, Howard University
Adaku Ofoegbu, Howard University
La'Marcus Wingate, Howard University
Georgia Dunston, Howard University
Jeronimo Augusto, Howard University

Abstract

In Ghana, the health care framework is comprised of traditional and Western modalities; patients often commingle these approaches. Some variability in treatment response of asthma may be attributed to concomitant use of traditional and Western medicine, with resultant unanticipated drug reactions. We aim to show that the use of genomics in patient care coordination will improve the concomitant use of Western and traditional medicine when treating asthma. Formal inclusion of the traditional medicine practitioner into the patient-centered medical home while employing the power of the electronic medical record and pharmacogenomic testing presents a unique business opportunity. This opportunity can be realized through the implementation of the IDEAL model, where proven methods are used to improve treatment outcomes, reduce adverse drug reactions, and aid in sustainable development.

THE NONCOMMUNICABLE DISEASE EPIDEMIC

Global markets are negatively impacted both socially and economically by the non-communicable disease (NCD) epidemic. NCDs, such as asthma, account for a massive socioeconomic burden around the world, particularly in low-income countries and among the poor in middle- and high-income countries. Furthermore, the World Health Organization (WHO) reports that 50% of all hospital admissions in Africa are due to adverse drug reactions (ADRs). Treating NCD patients in the latter stages of their health states tends to be more technology- and resource-intensive than utilizing preventative measures in the earlier phases of disease progression. In Ghana, government spending on health care accounts for 55.9% of all expenditures on health care and the amount funded by the government is increasing. This presents a significant opportunity for public-private partnerships where governments take the lead with the implementation of cutting-edge preventative technologies like those which utilize pharmacogenomic testing.

The WHO 2010 Global Status Report on NCDs estimates that more than 9 million deaths per annum in persons less than 60 years of age are caused by NCDs (WHO, 2011). NCDs also inflict a significant economic burden ranging from impoverishment of families to high health system costs and the weakening of country economies. The WHO Global Status Report on NCDs further espouses that poverty reduction efforts are being thwarted by the NCD epidemic as it utilizes funds that should be allocated to social and economic development. If lower-income countries are to grow and reverse the impact of the NCD epidemic, they must decrease the gap between the rich and poor and decrease the numbers of citizens who are disabled or diseased chronically.

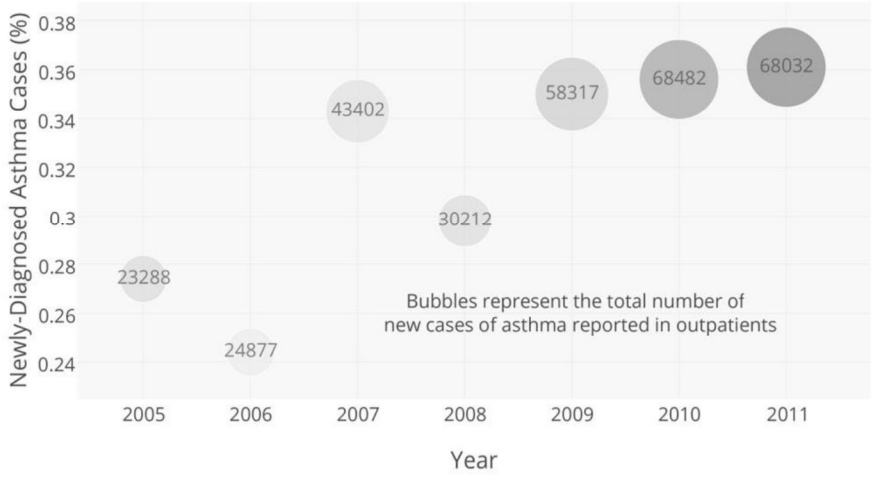
Therefore, a key strategic objective in the context of limited resources and the gaps in health systems is to improve access to cost-effective and sustainable health-care interventions that reduce the disease and socioeconomic burden of NCDs. Proactive interventions applied at the primary care level will have the greatest potential for reversing the progression of disease, preventing complications, and reducing hospitalizations, health-care costs and out-of-pocket expenditures.

Ghana Statistics

According to the WHO, the population of Ghana reached over 25 million people in 2012, up from almost 20 million in 2002 (WHO, Ghana Statistics Summary, 2014). The median age of the population was 20.45 years and the percentage of the population living in urban areas was 53% (WHO, Ghana Statistics Summary, 2014).The gross national income per capita for Ghana in 2012 was $1910, and the total expenditure on health per capita and total expenditure on health as a percentage of gross domestic product (GDP) were $106 and 5.2%, respectively (WHO, Ghana Statistics Summary, 2014).

Currently, there is insufficient data on the national burden of asthma in Ghana; the WHO estimates an asthma incidence rate of 1.5 per 1000 population per year (A. S. AMOAH, 2012). Figure 1 shows the number of asthma cases reported to the outpatient departments affiliated with the Ghana Health Service. According to the 2011 Ghana Health Service Annual Report, when compared to total newly-reported disease in Ghana, the newly reported cases of asthma increased from approximately 0.28% in 2005 to nearly 0.38% in 2011. Further research must be performed to definitively represent the incidence and prevalence of asthma in Ghana.

FIGURE 1
Number and Proportion of New Asthma Cases Reported to Outpatient Departments of the Ghana Health Service



HEALTHCARE IN GHANA

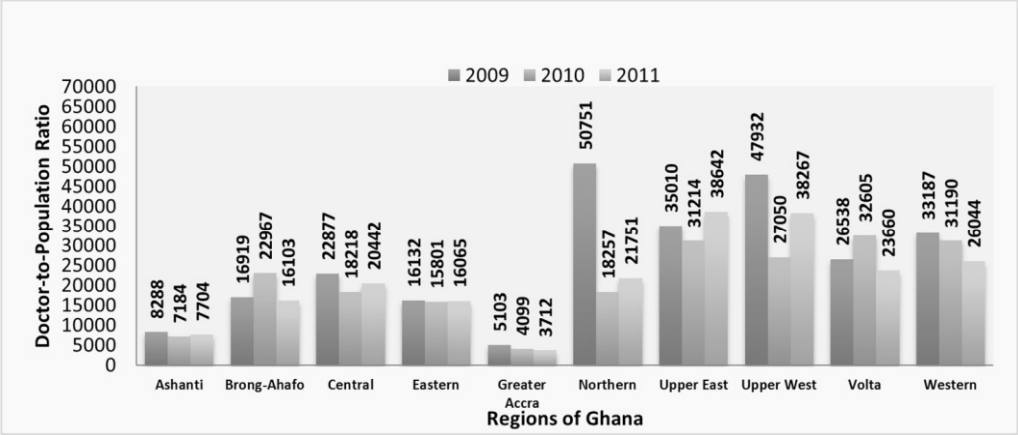
According to the WHO, missionaries introduced Western medicine to Ghana during the colonial period, and after Ghana gained its independence in 1957, the government promoted Western medicine as Ghana's official medical system (WHO, 2014). Presently, the health care framework of Ghana is comprised of both Western and traditional medicine modalities. Research demonstrated that patients opt to utilize the former, the latter, or a combination of both in response to care and treatment needs. According to Tabi et al, factors affecting the choice of care and treatment modalities, included level of education, influences of family and friends, and spiritual or religious beliefs (Tabi, 2006).

Western Medicine

According to the Ghana Health Service Annual Report for 2011, the national doctor-to-population ratio for years 2009, 2010, and 2011 were 11,929, 10,243, and 10,034, respectively. Figure 2 shows the doctor-to-population ratios for the ten regions of Ghana.

Most regions have seen an improved distribution of doctors in the population over time. The Greater Accra and Ashanti regions have the highest doctor-to-population ratios, with 50% of these doctors concentrated in two teaching hospitals(GHS, 2011): the Komfo Anokye Teaching Hospital in the Ashanti region and the Korle Bu Teaching Hospital in the Greater Accra region.

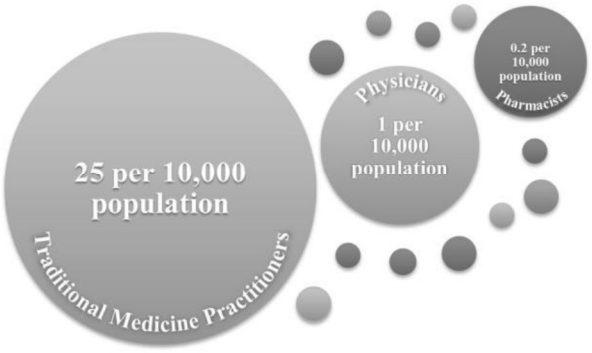
FIGURE 2
Doctor-to-Population Ratios for the Ten Regions of Ghana



Traditional Medicine

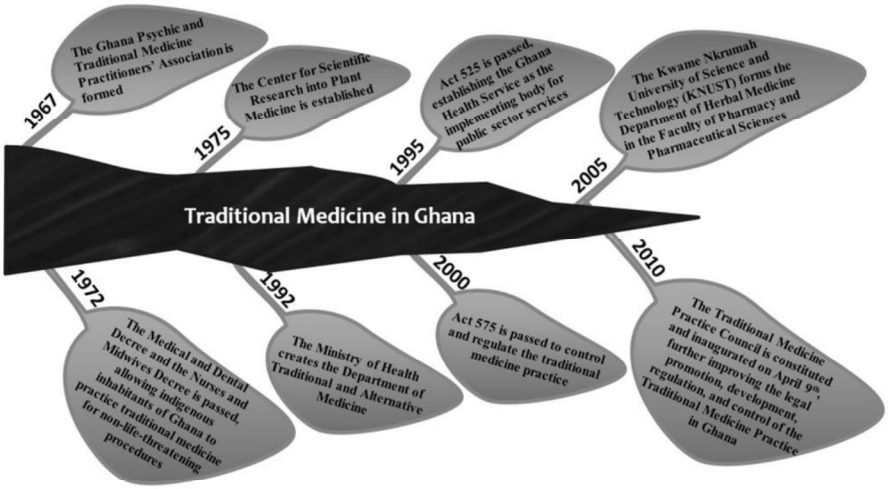
According to the WHO, traditional medicine can be defined as "the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, used in the maintenance of health and in the prevention, diagnosis, improvement or treatment of physical and mental illness." Approximately 70% of health care in Ghana is provided by traditional medicine practitioners, with a ratio of one traditional medicine practitioner for every 400 inhabitants. (Amoah, 2014). Figure 3 features a comparison of the ratios of traditional medicine practitioners, physicians, and pharmacists per 10,000 population. Traditional medicine practitioners outnumber both physicians and pharmacists and play an important role in health care provision due to their wider distribution in the population.

FIGURE 3
Comparison of Ratios of Health Care Practitioners per 10,000 Population



Traditional medicine is an essential part of Ghanaian culture and incorporates elements of herbal medicine, folk knowledge, spiritual therapies, traditions and values, and health behavioral rules and patterns (Tabi, 2006). Ghana has taken several steps to formally incorporate traditional medicine into the health care delivery system, from the formation of regulatory bodies and the enactment of legislation by the federal government to the development of a Bachelor's of Science in Herbal Medicine.

FIGURE 4
Timeline of Selected Milestones in the Formalization of Traditional Medicine in Ghana



With the commingling of traditional and Western medicines, there lies a risk of harmful interactions with prescribed products, potentially leading to adverse events and therapeutic failure. Due to the substantive role that traditional medicine plays in Ghanaian health care, caution must be exercised to circumvent this risk without excluding traditional medicine from the equation. A unique approach to this problem would be to formally incorporate traditional medicine practitioners into the patient-centered medical home, determine the properties of the active ingredients of compounds used in traditional medicine, and utilize the electronic medical record (EMR) to bridge the health care team and incorporate traditional medicine into the clinical decision-making process.

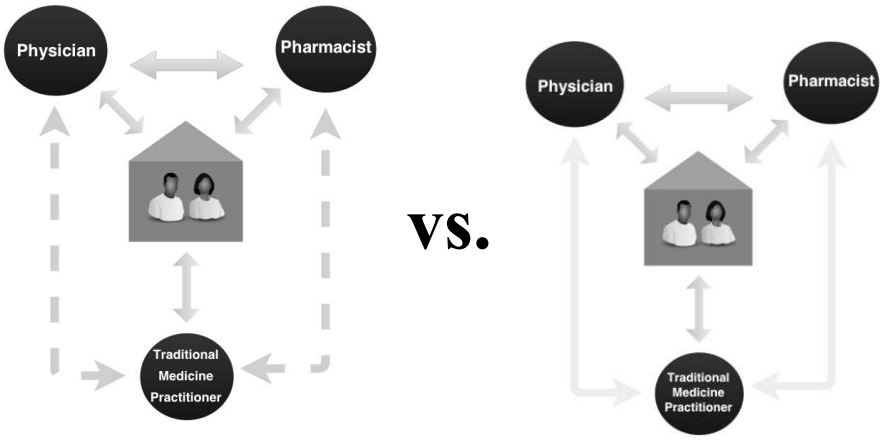
Continuity Of Patient Care

The patient-centered medical home is a primary care construct where members of a multidisciplinary health care team work collaboratively to provide optimal patient care. This health care model relies heavily on communication between members of the health care team, as the specialties lend a unique perspective and provides balance and

reinforcement in the clinical decision-making process. Figure 5 shows a comparison between a discontinuous and continuous patient-centered medical home. With Western medicine and traditional medicine on different sides of the aisle, the patient becomes the common link. However, without fully incorporating the traditional medicine practitioner into the patient-centered medical home, patient care is unequivocally discontinuous and the risk of treatment discordance increases.

Treatment discordance manifests in various forms. The simultaneous prescribing of medications by Western and traditional medical practitioners can produce antagonistic or synergistic pharmacodynamic effects. In addition, the prescribing of a medication by one health care modality that induces or inhibits the activity of the enzymes needed to metabolize the medication from the other can also create discordance. Traditional medicine is an indispensable component of the Ghanaian health care system, and its inclusion in the medical home allows for truly continuous care. Coupled with genomic medicine and the advent of the EMR, improved clinical decision support and added efficiency in the patient-centered medical home is possible.

FIGURE 5
Comparison of a Discontinuous (Left) Versus a Continuous (Right) Patient-Centered Medical Home



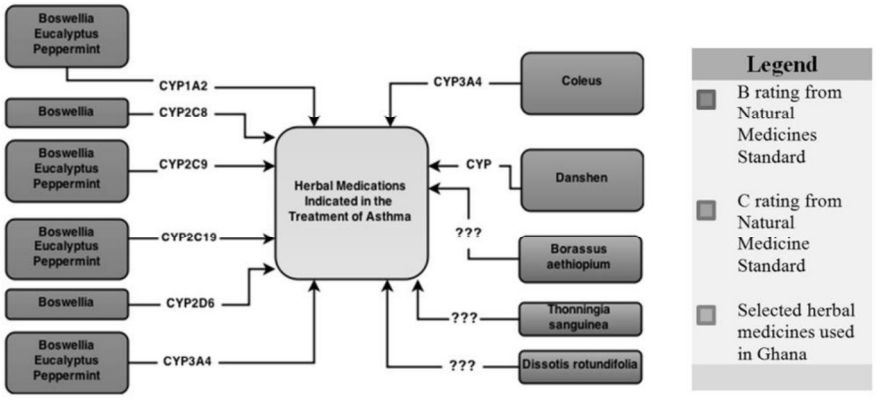
PHARMACOGENOMICS AND NUTRIGENOMICS

Pharmacogenomics is the study of how genetics affect drug response in a patient. It combines pharmacology (the science of drugs) and genetics (the study of genes and genetic functions) in order to individualize a patient's medication therapy (NLM, 2015). Nutritional genomics, or nutrigenomics, is the study of how foods affect our genes and how individual

genetic differences can affect the way we respond to nutrients (and other naturally occurring compounds) found in food.

On a commercial level, attention has been directed towards the effect of pharmacogenomics on prescription medications. The incorporation of nutrigenomics would further enhance clinical decision support because the active ingredients found in foods and herbal medicines utilize the same metabolic pathways as prescription medications. Therefore, food-drug and herb-drug interactions are as salient as drug-drug interactions. Figure 6 below includes selected herbal medications used to treat asthma. The herbs Boswellia, Eucalyptus, and Peppermint received a rating of "B" from the Natural Medicines Comprehensive Database, indicating positive evidence for their use in asthma treatment. These herbs are collectively metabolized by six cytochrome P450 metabolic enzymes: CYP1A2, CYP2C8, CYP2C9, CYP2C19, CYP2D6, and CYP3A4. The herbs Coleus and Danshen received a rating of "C" from the Natural Medicines Comprehensive Database, indicating unclear or conflicting scientific evidence for their use in treating asthma. According to Darko, the root of Borassus aethiopium and the leafy stems of Dissot is rotundifolia are indicated in the treatment of asthma (Darko, 2009). Additionally, Gyamfi and Aniya noted that Thonningia sanguinea, an herb in Ghana used for the treatment of bronchial asthma, contains the active constituent Thonningianin A, an antioxidant with in vitro activity against CYP3A1 in rat liver microsomes and in vivo activity against CYP1A2. However, definitive evidence of the metabolic pathways of these herbs needs to be clarified before incorporation into a nutrigenomic/pharmacogenomic panel.

FIGURE 6
Selected Herbal Medications Used in the Treatment of Asthma



A NOVEL APPROACH

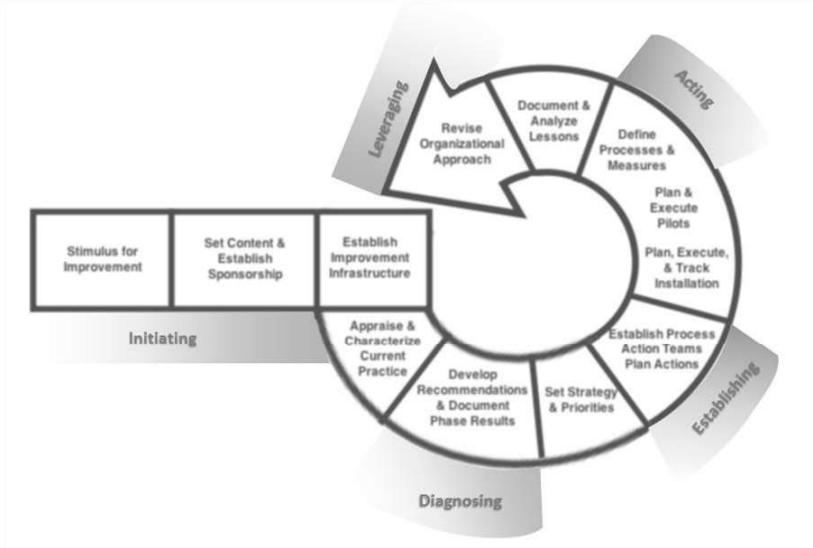
We propose that Ghana establish public-private partnerships at institutions like the Korle Bu Teaching Hospital (KBTH). Using the patient-centered medical home concept, practitioners like the pharmacist, physician, and traditional medicine practitioners could secure a buccal swab from currently-diagnosed asthma patients and use the genetic information collected to create a nutrigenomic/pharmacogenomics profile. This profile determines gene-drug interactions and whether treatment modification is necessary.

This report will be incorporated into the EMR for each patient and made accessible to any practitioner with prescribing, clinical, or dispensing responsibility via a secure portal. While computer technology may not be pervasive in the health care delivery system, this presents a unique opportunity for government to facilitate enhanced health care coordination by initiating a capacity-building program aimed at ensuring that all health care practitioners have access to EMR software and computer technology.

Implementation

Implementing our solution would take proven methods combined with situational creativity. An example of such a proven method is the IDEAL (Initiating, Diagnosing, Establishing, Acting, Leveraging) method. The US Department of Defense in conjunction with Carnegie Mellon University designed the IDEAL model represented in Figure 7 during a large scale computer system integration. This model affords the perfect approach when implementing a patient-centered medical home with genomic testing at the core.

FIGURE 7
Illustration of the Ideal Model



The Initiating Phase allows the establishment of roles and responsibilities for the medical home, inclusion of the genomic profile into the medical record and the allocation of resources. In this phase, a medical home Genomic Inclusion Plan (GIP) is created to guide the organization through the completion of the Initiating, Diagnosing and Establishing Phases. Approval for the GIP initiative is obtained along with an assessment and commitment of future resources for the project coupled with general goals. The GIP is designed based on the business needs of the organization and will be refined and made specific during the Establishing Phase of the model.

Two key components should be established, a management steering group (MSG) and an electronic medical record/software engineering process group (EMR/SEPG). Also during the Initiating Phase, plans are made for communicating the start of the GIP initiative pilot, and it is suggested that organizational assessments be performed to determine the readiness of the organization for a GIP initiative.

The Diagnosing Phase of the IDEAL model starts the organization on the path of continuous medical home process improvement. This phase lays the groundwork for the subsequent phases and initiates the GIP action plan in accordance with the organization's vision, strategic business plan, lessons learned from past improvement efforts, key business issues faced by the organization, and long-range goals. Appraisal activities are performed to establish a baseline of the organization's current state. The results and recommendations from appraisals and any other baselining activities should be reconciled with existing and/or planned improvement efforts for inclusion into the GIP action plan.

During the Establishing Phase, the organization finalizes the GIP as the primary goal. The GIP action plan draft will be completed in accordance with the organization's vision, strategic business plan, lessons learned from past implementation/improvement efforts, key business issues facing the organization and long-range goals.

During the Establishing Phase, measurable goals are developed from the general goals that were defined in the Initiating Phase; these measurable goals will be included in the final version of the GIP action plan. Metrics necessary to monitor progress are also defined, and resources are committed and training provided for the technical working groups (TWGs). The action plan developed will guide the GIP activity as it addresses the prioritized findings and recommendations from the Diagnosing Phase. Also during this phase, tactical action plan templates are created and made available for the TWGs to complete and follow.

In the Acting Phase of the IDEAL model, solutions to address the areas for improvement discovered during the Diagnosing Phase are created, piloted, and deployed throughout the organization. Plans will be developed to execute pilots to test and evaluate the new or improved processes. After successful piloting of the new processes and determining their

readiness for organization-wide adoption, deployment, and institutionalization, plans to accomplish the roll-out are then developed and executed.

The objective of the Leveraging Phase is to make the next pass through the IDEAL model more effective. By this time, solutions have been developed, lessons have been learned, and metrics on performance and goal achievement have been collected. These artifacts are added to the process database that will become a source of information for personnel involved in the next pass through the model. Using this collected information, an evaluation of the strategy, methods and infrastructure used in the GIP program can be performed. By doing this, corrections or adjustments to the strategy, methods, or infrastructure can be made prior to the start.

Some questions that should be asked include: Has the infrastructure performance been appropriate? Have the methods employed by the TWGs in their solution development activities been satisfactory? Have the GIP communications activities been sufficient? Does the sponsorship for GIP need to be reaffirmed? Does another baselining activity need to be performed? The reentry point into the IDEAL model for the next cycle is highly dependent on the answers to questions such as these.

CONCLUSION

The type of service proposed is currently non-existent from the private or public sector in the Accra region. This service approach could help ease the stress on government agencies that provide primary care services in Accra.

While our approach initially concentrates on the asthma patient, information gathered from this project could be extrapolated to any disease state.

The health care practitioners, which would include physicians, pharmacists, and traditional healers, should have four community driven objectives:

1. Assist asthma patients with improved disease management on an ambulatory basis to reduce the incidence of costly hospitalizations;
2. Streamline services and communications across the medical home by providing professionals such as doctors, traditional healers and pharmacists with improved clinical decision support;
3. Provide opportunities for the community to serve individuals and their families to maximize the effectiveness of traditional and Western approaches to care;
4. Save tax payer dollars from wasteful spending on duplicated health and medical services by providing comprehensive health care management.

The public/private partnerships will allow the effective use of integrating the genomic information into the medical record where it can be usable for all providers. One can

question whether we do have the business models that would support the appropriate investment in and use of genomic medicine via a medical home model. Ghana's current business model is evolving and is in great need of revision in the genomic age. However, Ghana is perfectly poised with the new appetite for the implementation of EMR to have the technology implemented. The government should implement substantive revisions in the approach to delivering care and take advantage of the direct economic value of a healthier population with coordinated care approaches.

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