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An Idealized Design for a Prevention-Oriented Primary Care Clinic

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1.0 Introduction

Innovative solution approaches to old and durable problems often arise from new combinations of proven elements integrated in completely new ways by innovative designers. The purpose of this article is to propose an idealized design of an innovative approach to healthcare for the healthy. This idealized design emphasizes maintaining wellness as opposed to dealing with illness. Once a person acquires a chronic illness such as diabetes or coronary artery disease, opportunities for timely preventive action diminish, and cost of managing un-wellness rise dramatically.

The idealized design assembles existing elements from diverse fields to propose an ideal design. This ideal can only be approximated -- how closely it can be approximated must be determined by pilot testing in practice. Much of the potential for this design rests on finding ways to deliver effective preventive care before healthy people become patients with chronic illness. The ideal design is for a wellness clinic supported by an integrated system of patient reported wellness using computer based methods for obtaining patient reported outcomes, analytics applied to longitudinal data on morbidity by demographic cohorts, population surveys to obtain ethical decision rules for allocating preventive care where the statistically estimated benefit will be maximized, and supporting , and operational support for managing patient flow and clinical resource utilization.

Preventative healthcare in the asymptomatic population poses behavioral challenges at personal and social levels. A thorough literature search found no significant published evidence that poor health habits can be changed sustainably. (Ambani, Dunlap and Ho, 2013). So the idealized clinic design seeks to build motivation by focusing behavior change effort on population members whose current demographic and personal characteristics empirically match those of a patient sub population which actually did develop chronic illness. Techniques for segmenting populations based on empirical historical and survey results are widely used in marketing for market segmentation. When a currently healthy person matches the characteristics of a group which is highly likely to develop a preventable condition in the future, then empirical forecasts of that person's future un-wellness would be used to help focus patient and clinical resources on interventions likely to change behavior in sub population members forecasted to benefit most from treatment or changing their health habits.

The idealized design provides a focal point for integrating many existing elements of service operations management, analytics and systems technology into a new and fundamentally leaner primary healthcare delivery system. This document outlines the main elements and interactions of this system concept.

2.0 Background (Abstracted from a literature research by Zainab Ambani, Patricia Dunlap and Suzanna Ho presented in Organizational Dynamics 634 - 2013.)

The Affordable Care Act provides coverage for health services useful in preventing illnesses. Covered services include screening and counseling for alcohol abuse, blood pressure, diet, obesity, tobacco use, and cholesterol A clinic which develops a lower cost bundle of healthcare services that improves and prolongs health in a well population of insured people will save insurers money, and enjoy a competitive advantage by becoming a preferred referral source for patients who eventually need secondary or tertiary care.

Chronic diseases drive approximately 75 percent of U. S. healthcare spending with care for those over 65 years of age driving nearly three times as much spending on healthcare than the average U. S. population member.

Chronic illnesses driving this high healthcare spending include heart conditions, trauma-related disorders, cancer, mental disorders, chronic obstructive pulmonary disease (COPD) including asthma, osteoarthritis, diabetes mellitus (DM), hypertension, back problems, and hyperlipidemia (AHRQ, 2010). The idealized clinic design would seek to make timely interventions primarily on those diseases for which lifestyle changes and preventive strategies exist. Ambani, et al. recommend six types of morbidity: heart disease, stroke, depression, chronic obstructive pulmonary disease (COPD)asthma, diabetes, and obesity, as an initial six conditions to prevent or postpone in the design of an ideal prevention-based clinic.

2.1 -- Heart disease and Stroke **--** The literature search found wide private and government programs to educate people on proven risk factors for developing heart disease and stroke (e.g., weight/body mass index (BMI), diet, exercise, blood pressure, alcohol consumption, smoking status, and cholesterol). They also found risk assessment questionnaires on the Internet which individuals may use without cost to convert blood pressure, weight, and cholesterol readings into disease risk scores which help educate people about their future health risks. The literature search also turned up evidence that while 70 percent of strokes and 80 percent of heart disease are preventable successful prevention must change behaviors.

2.2 -- Mental Illnesses and Depression –In 2010, $73 billion was spent on treating mental disorders. Each year, 18.8 million adults will suffer from a depressive illness. Depression has established correlations to other chronic diseases and is the most prevalent mental health illness amongst older adults. In 2009, $22.8 billion was spent on the treatment of depression and another $17 to $44 billion of cost was incurred for lost workdays. Depression is also the main cause of approximately 30,000 suicides annually.

Depression is not only the most common mental disorder but it links to other chronic conditions and vice versa. While screening tools are available for detecting existing mental illness and depression, there are no tools currently able to predict mental illness or depression before it strikes. Early treatment for mental illnesses and depression is not yet well developed, so early detection as a basis for intervention produces little benefit, although potential exists for depression risk assessments for young members of the population.

3. COPD and Asthma – Ambani, Dunlap and Ho's literature search found no specific tools for assessing the risk of developing COPD. Assessment consists of patient history on tobacco smoking and other occupational or passive inhalation exposures as well as familial tendency for COPD. Although nearly 22 million American suffer with asthma, knowledge is currently insufficient to predict future COPD and asthma. Known risk factors include prenatal maternal smoking and antibiotic use, certain types of infant and childhood wheezing, reduced airway/lung function in infancy, childhood antibiotic use, elevated immunoglobulin E levels at birth, infant and childhood exposure to tobacco smoke, particular occupational exposures, and smoking tobacco/marijuana. Severity of known asthma triggers vary significantly so that assessment tools rely on patient reported conditions and tests of lung function – such as the Asthma Control Test (ACT) and the Asthma Control Questionnaire (ACQ).

In 2010, $49.9 billion was spent on managing COPD patients. Of that, over 55 percentof the cost results from complications such as emergency room visits and hospitalizations. COPD affects 13.1 million US adults, but another 24 million have evidence of impaired lung function. COPD is largely preventable, as smoking is the primary risk factor (causing approximately 85-90 percent of COPD deaths). Lag times between tobacco exposure and disease development mean that the prevalence of COPD is expected to continue rising. In 2007, $56 billion in total was spent treating asthma which affects 25.9 million Americans. In recent years, asthma accounted for more than an estimated 142 million lost work days and over 2 million emergency room visits.

4. Diabetes **--** Diabetes treatments cost Americans over $51 billion in 2010 and in the United States is the seventh leading cause of death as well as kidney failure, lower limb amputations, heart disease and stroke. There are 25.8 million Americans (8.3% of the US population) that have diabetes (NIH, 2010). The mortality rate among people with diabetes is double the rate among non-diabetic people within the same age group (NIH, 2010).The estimated number of Americans who are at risk for diabetes is 79 million. However, only 11% are aware they are at risk for developing DM (Reinberg, 2013).

Several screening methods for type 2 diabetes are available, such as oral glucose tolerance test (OGTT), hemoglobin A1c (HbA1C), fasting plasma glucose (FPG), family history of diabetes (FHD), and body mass index (BMI). Some of these tests are costly and time consuming. Researchers have found that the combination of HbA1c, FPG and BMI are effective screens for individuals at risk of future clinical diagnosis of type 2 diabetes. The Finnish Diabetes Risk Score (FINDRISC) is a well-established tool and recommended for evaluation of the risk of Type 2 diabetes, and the Canadian Task Force on Preventive Healthcare identified a screening model that predicts high risk of future Type 2 diabetes useful in clinical practice, though monitoring or management of other cardiovascular risk factors, such as dysglycemia, obesity, physical inactivity, tobacco use, hypertension, and dyslipidemia in individuals improves predictability of the likelihood of developing diabetes in the future.

5. Obesity – Data from the National Health and Nutrition Examination Survey found that between 2009 and 2010, over 78 million U.S. adults and about 12.5 million U.S. children and adolescents were obese (Ogden et al, 2012). Obesity can result in four common high-cost health problems: Type 2 diabetes, coronary heart disease, stroke, hypertension, and obesity-related cancers. Obesity-related healthcare costs approximately $117 billion annually. More than one quarter of U.S. healthcare costs are related to physical inactivity, overweight, and obesity. Therefore preventing obesity, prevents further adverse health consequences, and reduces the healthcare cost due to preventable health problems.

On its own obesity is a risk. It is also a major risk factor for such diseases as diabetes, heart disease, stroke, hypertension and cancer. Published forecast suggest that if trends in obesity rates continue, cases of type 2 diabetes, coronary heart disease and stroke could increase 10 fold between 2010 and 2020– and double again by 2030, adding over 6 million new cases of Type 2 diabetes, 5 million new cases of coronary heart disease and stroke, and over 400,000 new cases of cancer in the next two decades. However, if the average BMI is reduced by five percent, the number of cases would decrease dramatically and would save up to $81.7 billion (Healthy Americas, 2012). Rrisk factors for obesity include genetics, inactivity, unhealthy diet, family lifestyle, smoking, certain medications, socioeconomic status, and other medical problems. Published studies recommend using the body mass index (BMI) to screen overweight and obesity.

The Apple Store as an Ideal Clinic Format

A prevention oriented clinic may be thought of as a retail service operation. It has a staff offering a range of services which customers may need. Customers may arrive at random or by appointment expecting satisfaction of their wants and needs. An ideal clinic design should embody a concept of a patient's ideal way to obtain health services. It is beyond the scope of this article to engage actual healthcare customers in proposing their ideal health care experience. However, the retail service sector is very competitive and innovative. So the initial iteration of an ideal clinic design will be based on one of the most successful retail formats ever developed.

By customer satisfaction as well as operational and financial measures, Apple, Inc.'s retail stores are one of the most successful retailing and customer servicing formats in modern commerce. The stores provide layered service levels depending on customer needs and offer many services by appointment or on a walk-is basis. After careful study of the Apple Store system, the author chose it as an operational model on which to base an ideal clinic design.

Table 1 -- Apple Store Service Layers

High Level Description of Apple Store's Service System		
Level	**Apple Store**	**Purpose or Function**
1	Greeter and Triage (At store entrance)	Greet each visitor, listen to his or her need, and use a hand-held device to locate an available expert on that issue, summon that expert to the front of the store, introduce and hand the visitor off to the expert.
2	The Red Zone (Immediately behind triage)	The area immediately behind the greeter/triage is a set of tables on which all Apple products are displayed for hands-on demonstrations and customer experimentation. Apple employees rotated into the red zone work as sales staff while assigned there. The Red Zone tends to be busy and noisy.
3	Project Tables One or two rows of conference tables that parallel aisles leading deeper into the store	A set of tables that seat six comfortably, with a staff project consultant at each table. Any Apple computer owner may come in to any Apple store in the world, sit at an open seat at a project table and receive 10 to fifteen minutes of one-on-one consultation by the project consultant, who goes from person to person around the table in sequence. The convention is that while the consultant is helping person N, all other customers at the table do not interrupt, but wait for their next turn. Project tables are also used for short courses that are booked in advance by web interface.
4	One-on-One Tables Located behind the Project Tables deeper in the interior of the store.	One-on-one sessions are by appointment only, and consist of one or two hour face-to-face meetings with the customer's choice of an Apple expert who provides in depth coaching and teaching on the customer's issue or how-to question. Customers book each one-on-one session with an expert of the customer's choosing, from an on-line catalog that lists names of all experts by specialty and time slots available.
5	The Genius Bar Along the back wall of the store facing front.	The Genius Bar is literally a counter parallel to the back wall of the store with a line of bar stools on which customer may sit. Individual "geniuses" (highly trained technical experts) sit behind the bar facing each customer. They render hands-on technical support for the range of Apple products sold in the store and are equipped to make repairs if necessary. Customers must make an appointment on-line for genius bar service.

Table 2 -- Walk-In Medical Clinic Analogy

Illustrative Example Only High Level Idealization of Walk-In Clinical Service System		
Level	**Clinical Area**	**Purpose or Function**
1	Greeter and Triage (At clinic entrance)	Greet each visitor, listen to his or her need, and use a checklist on a hand-held device to confirm and direct to appointment. For walk-in visitors, a checklist considering urgency and complexity is used to locate and route the visitor to an available therapist, nurse, clinician or physician relevant to the patient's issue. The triage would also direct scheduled patients to the clinician or expert (or summon the expert to the front of clinic) and introduce patient and clinician.
2	The Red Zone (Immediately behind triage)	The intake area immediately behind the greeter/triage could include a pharmacy as well as privacy intake cubicles in which nurse practitioners, physician's assistants or therapists make primary contact with walk-in patients, help them answer fact finding questions using on-line versions of John Ware's PROMIS software for SF-36, or interact with specialized diagnostic surveys or other tools chosen by the primary care clinician. Based on the clinician's reading of the results of the fact find, the patient may be handed off to an available specialized resource person (nurse practitioner, specialized therapist, or if warranted a physician) or have an appointment made for a future visit.
3	Treatment and Procedure Area -- Clusters of consulting and therapeutic rooms and supporting infrastructure behind the red zone	The area behind the intake cubicles contains private spaces for physical therapists, nutritionists, social workers, psychologists, and other specialists based on population health maintenance needs. These resources provide service on-demand or by-appointment. Appointments may either be system generated and patient confirmed, or requested by patients via an on-line or voice mail. Walk-ins for on-demand service are a lower priority than ACO patient members who have made appointments or who have accepted appointments issued for preventive care
4	One-on-One Consulting Area Located behind the treatment and Procedure Area deeper in the interior of the clinic close to the physician consulting area.	This space immediately in front of the physician's offices accommodates one-on-one appointments with individual clinic specialists either for routine preventive examinations or to follow up on signals from the PROMIS patient monitoring system that signal out-of-tolerance SF-36 scores when detected. Each session would entail a face-to-face meeting with either the patient's preferred specialist for appointments, or the next specialist available for walk in consultations. An on-line resource would provide a personalized catalog listing names and treatment styles of all experts by specialty and would display appointment times available for booking.

Illustrative Example CONTINUED
High Level Idealization of Walk-In Clinical Service System

Level	Clinical Area	Purpose or Function
5	The Medical Area --Private offices and consulting rooms along the back wall of the facility organized to minimize intra-clinic travel.	The Medical Area is the deepest level of the service system and has the highest proportion of patient visits by appointment. Patients would select physicians based on the doctors' personal statements of professional interest in primary and preventive health care with emphasis on patient preferences and desire for preventive strategies. Feedback from patients on quality of experience could also be displayed for each provider.

Clinical Mission, Design Requirements and Competitive Scenario

The mission of the clinic is to provide as complete and effective state of the art primary and preventive care delivery as is economically and technically feasible. This mission includes serving as many patients without regard to income or education as early in their lives as possible in order to help them maintain their good health through prevention. This objective also includes unifying support and clinical employees into an agile and high performing team or set of agile sub-teams that work cooperatively to deliver fast, high quality preventive and primary care services. The clinic's mission includes allocating a significant portion of staff time to maintain learning and professional skill development of the clinic's staff members.

Clinic staff members need to be selected for their personal motivation to constantly update and upgrade their health care skills. Staff would also be selected based on their potential for professional development and desire to work on a team that continuously finds innovative ways to deliver better and more economical care to a growing population served. The need for continuous innovation, team work and skill development, implies that staff selection must use character-trait based selection methods, as personality and character traits of high performing team members become apparent and can be studied and translated into new staff screening and selection tools.

The clinic should become a preferred employer for all skills it needs in routine operation. The objective is to have a surplus of people willing to work in the clinic because of their personal intrinsic satisfaction derived from working there. The clinic will not necessarily be a high paying employer, because high pay is a poor substitute for a workplace in which people derive great satisfaction from doing their job well and being recognize and thanked for doing so. Clinical management must obtain ongoing feedback from the care provider teams and systematically use the feedback to innovate improvements in quality of the work environment, while simultaneously removing de-motivators and reducing unsatisfying aspects of work in the clinic.

The clinic's management must place particular emphasis on developing new and effective approaches to encouraging the served population to modify behaviors that drive up healthcare costs. For population members to modify their behaviors they will need to find that the easiest and most satisfying choices available to them favor healthier and prevention-oriented behaviors over un-healthy behaviors. It is important that all behavioral nudges used preserve population member individual freedom of choice. However those choices that are behaviorally easiest and most convenient should be designed to favor doing the right thing to prevent illness. Development of new and better methods for stimulating and reinforcing preventive behaviors will be critical to generating lower cost health maintenance, within this concept and for the nation as a whole.

As a low cost, high quality provider, the clinic will be strategically able (as lean producers have shown in other industries) to expand at will by recycling lower cost into lower than market rates that attract preferred population members from high cost, poor quality providers. The clinic's operation and payment plans would be designed to select in favor of patients whose behavioral tendencies predispose them to favor early prevention of ill health rather than reacting with costly interventions after long avoidance of preventive behaviors. Lower costs can also fund nudges that help maximize the likelihood that served population members make ongoing healthy choices that matter and keep long run clinic costs down.

Patient self-selection might be achieved by designing "nudges." Example nudges might include first choice in honoring doctor preferences, more convenient appointment times, lower co-pays for preventive visits, higher co-pays for preventable emergencies services, deductibles or premiums that encourage prevention and discourage lack of prevention, or discounts for behaving in healthy ways or that encourage those who avoid prevention and engage in risky behaviors to reconsider and modify their behaviors going forward.

The clinic should be designed to maximize each participating physician's satisfaction with his or her work, so that the physicians are relieved of administrative burdens that reduce capacity for service delivery or professional development. The clinic design and operation must also account for the full range of educations and incomes in its natural service area – from least and lowest to best and highest. So, equity and economic issues must be considered. This can partly be handled by the choice of location so that the clinic serves a roughly homogeneous socio-economic population group. Ethical choices will need to be clarified and handled in an ethical and diligent manner.

If the idealized clinic can indeed become the lowest cost, highest quality source of primary care for a significant share of the whole population in a large area, it can alter the competitive dynamics in its service area. Lowest-cost/highest-quality status will effectively let a chain of such clinics control the flow of referrals to secondary specialists or tertiary care facilities such as hospitals and walk in surgeries. Control over the stream of referrals will become a central issue in healthcare competition. Attracting referrals should lead secondary and tertiary providers to exert strenuous efforts to become "suppliers of choice" to the idealized clinics, once a chain of these idealized clinics serves a significant fraction of the population in a market area. The idealized clinic will also become a central repository for all data on costs and outcomes for its served individuals based on its referrals to specialists or hospitalizations.

The Clinic should also closely coordinate with school and educational institutions in the area as a means of increasing the younger generation's awareness of the need to care for themselves through proper hygiene, nutrition, exercise and life-style choices.

Environmental Considerations and Risk Factors

- Healthcare delivery and human biology differ fundamentally from computing and networking hardware and software. An Apple Store uses, sells and services electronic and symbolic manipulation technology designed by humans. With sufficient engineering effort this technology is completely understood -- all failure modes can be diagnosed and corrected. Patients with symptoms or with patterns of biometric parameters correlated with future illness however, may be viewed as complex biological systems. Human biological processes and systems are very far from completely understood. Healthcare professionals must fill gaps in knowledge needed to diagnose and treat patients by using empiric work processes that bridge knowledge gaps with tacit knowledge gained from experience. By definition tacit knowledge must be learned by doing with continuous, constructive and operationally helpful feedback from the work to the learner, followed by reflection on practice and outcomes. This form of learning is most highly developed in lean processes, and must yet be developed for the clinic to deliver much higher levels of quality and much lower expenditure of effort achieved by reduction of non-value added activity. This is, in fact a central challenge and risk factor for the development of the idealized clinic.

- Healthcare is a socially, economically and politically complex and chaotic area of society at present. The fee for service payment model discourages investments of human and financial capital in prevention; while procedure-oriented specialties attract massive human and financial capital investments because of high returns and profitability.
- Many vested interests in the current healthcare system can be expected to resist or oppose changes that threaten their business models. So, malpractice and tort lawyers, health insurers, large hospitals and perhaps individual or group practices who feel challenged by competition from a new type of clinic may actively oppose development of such clinics.
- Healthcare organizations are risk averse institutions. However, public domain performance data is expanding the visibility of many clinical and service areas for providers. The availability of such data and the public's appetite for efficient, useful and valuable healthcare will drive customer switching behavior in a search for better service and healthcare choices.
- The post-war baby boom is entering old age, a period of high healthcare costs. This will reduce the leverage of any long-term prevention strategy for the over sixty fraction of the served population. People in their sixties, seventies and eighties have already lived a life which now influences the amounts and types of care they need. An aged served population is likely to exert a drag on the effectiveness of a prevention strategy. Unfortunately, most individuals reportedly incur the majority of their healthcare expenses in their last few months of life.
- Provisions of the Medicare Shared Saving Program within the Affordable Healthcare Care Act could, if allowed to stand, alter economic incentives in favor of prevention-oriented healthcare providers even if the population is heavily geriatric. Shared savings may be sufficient to fund rapid expansion of a prevention oriented model that is clinically effective, not just for older population members, but also for those where staying healthy offers real long term benefits.
- The characteristics of a high quality and effective primary care physician are still uncertain and would have to evolve from experience with the new type of clinic. While PCPs have been a feature of many health maintenance plans, a good internist may or may not be a good PCP because experience is far more important than just passing a licensing examination in internal medicine.
- The core medical and support staff will be organized into one or more cross-functional teams responsible for translating feedback on their clinical outcomes and customer experience into better methods, processes, scheduling and treatment methods. They will require training in inquiry and process improvement methods, as well as support from skilled team facilitators to develop and implement corrective and preventive measures and improve their care delivery processes. An escalation process for broader or difficult issues will be needed to ensure that major issues affecting the whole clinic receive proper attention and resources.

Idealized Design

Idealized Design is a group process to design an ideal system and its closest feasible approximation. Idealized Design involves all stakeholders confronted with a messy current situation in designing their ideal present system (what they would wish for, if all their wishes came true today.) The logic of idealized design is that solving all problems in a current organizational system, does not yield a better system; but only the current system without its current problems. Instead, significantly better results can be achieved by approximating an ideal system design as closely as possible to produce a significantly better system.

An idealized design is not pie in the sky. All elements used in the idealized design of a system meet three conditions: (1) they must be technically feasible and not require research or development, (2) they must be sustainable if used, and (3) they must be agile enough to adapt as requirements change. The ideal system is that design which could and should be built if we are not limited by constraints imposed by the current system. Given the design of an ideal system, the greatest possible improvement in outcomes for given means and resources results from replacing the current problematic situation with the closest possible approximation to the idealized design.

People may have ideas about what their ideal system might be in some distant future. However, most have difficulty stating what their ideal would be right now. This description relies on methods, systems and approaches which are all operationally feasible now, and which could be adapted into a first approximation to the Idealized clinic design. In particular the technologies and methods called for in this idealized design include:

- Ethical surveys of care populations which quantify attitudes about fairness of decisions about who will be served and who must wait for clinical resources. These surveys are used in organ transplant decisions and methodologies exist to ascertain the different principles of fairness that stakeholders use to decide about choices between patients with different urgency, relative clinical status and likely change in quality of health or life with or without treatment.
- John Ware's lifetime of research, which has resulted in several thousand validation studies, along with the NIH's support of PROMIS (Patient Reported Outcome Measurement Information System), provides a proven public domain computer adaptive testing (CAT) technology for patients to translate non-technical questions about quality of life into information displayed on validated scales useful in spotting diagnostically significant change.
- Checklist and templates are now becoming common place as aids to human judgments in place of unaided reliance on experience and intuition. Research by Nobel Laureate Daniel Kahneman and many others show that such templates consistently produce superior decisions and assessments in complex or confusing decision settings. For example replacing obstetric observations and intuition with the Apgar Index (a simple five scale checklist) is estimated to have saved the lives of thousands of new born infants annually compared with previous expert intuition.
- The pooling of expert knowledge necessary to create and validate diagnostic checklists and templates is a team activity. Such team approaches to developing job aids are used in almost all other fault-intolerant operations of our economy. Their advantage is that when deployed and followed, checklists prevent error, ensure good and reliable outcomes and constitute a strong defense against liability lawsuits. They also make continuous refinement and improvement easier to document and deploy to practitioners.

- Information analytics technology for assessing and evaluating patterns in massive data bases, for organizing and classifying individuals into groups or segments base on behavioral or other similarities, are already used by such firms as Amazon, Google and others to monitor behaviors and to make suggestions for optimal messages to be sent to cohorts of individuals based on their likely response to the message.
- The U. S. Department of Veterans Affairs is seeking qualified researchers to conduct healthcare studies on longitudinal data sets maintained by MAVERIC, Massachusetts Veterans Epidemiology Research & Information Center. These data sets may be suitable for researching the usefulness of cohort analysis for forecasting primary care workloads by diagnosis and future time periods.
- Rating and ranking software systems are available for mass producing thousands or millions of small resource allocation decision in such areas as credit applications, loans, tax audits and the like. Some of these models and methods will be adapted for use as triage checklists that consider both member need as well as resource availability. Triage decisions maximize throughput by separating a stream of demand into multiple work flows that route those who need a bottlenecked resource to it directly, and those who do not need that resource away from it. The result is better resource utilization and less congestion and waiting in the service system.
- Demand and Workload Forecasting enables planning for peaks and valleys in demand for service. Advance planning maximizes the value each resource for a given flow of demand, so that the system delivers maximum possible value. Probability models such as the classic ‘newsboy algorithm” can be used to set staffing levels that reflect the relative odds and costs of over- or under-staffing by day of week. Also the availability of such models as Guarisco and Samuelson’s qTrack show how operations management and operations research models can be used to identify and eliminate bottlenecks causing delays in serving patients by reducing over-utilization of constrained resources such as care providers.
- RFID systems for tracking the location of all care providers and visitors to a clinic will generate data to drive analytical and simulation studies of patient and work flows. While in the clinic, each person wears an RFID bracelet that identifies its wearer to sensors. Each second the sensors record the location of every bracelet in the building with high accuracy. This system yields accurate data on time spent with each care provider, waiting times, and so on. Data analyses can identify bottlenecks, high and low urgency and complexity patient flows, and evaluate impacts of different triage and resource management strategies on throughput, patient cycle times and resource utilization.
- RFID studies should also permit identification of tasks now performed by physicians that can be offloaded just in time to physician extenders earning one fourth of a physician’s salary. The expanded use of physician extenders potentially can expand the capacity of the clinic far beyond what is possible in conventional physician office visits.
- Resource allocation models to optimize the use of resources in a situation in which demand for resources far exceed the resources available are used in many areas of the economy and powerful software systems are available to do the necessary calculations.
- Full service customer service systems often combine third party offerings with their own services. For example, a large wall display in an Apple Store displays for sale many types of ancillary and accessory products produced by Apple supplier partners. Therapeutic services such as nutrition counseling, physical rehabilitation, health and fitness devices and services could be provided in-house by third party partners operating as tenants within the clinic and as parts of its prevention-based system.
- Finally, lean process methods will be used to ensure that total cycle time for a customer’s clinical visit is less than two times the total time spent adding value during the visit. This conceptual design seeks a

customer cycle time efficiency of fifty percent or better. By comparison, I estimate that once a customer passes the triage in an Apple Store, cycle time efficiency in in the range of 60 to 80 percent. That is most of the time a customer spends in an Apple Store adds value as the customer defines it.

A Prevention-Based Demand and Clinical Resource Management System for the Idealized Clinic

This section outlines a conceptual design for a health records and resource management information system. The concepts are intuitively or logically necessary but have not been discussed with knowledgeable healthcare professionals. The purpose of describing the concepts in this document is to facilitate such discussions as a basis for improving the conceptual design and for selecting promising information and management technologies for implementing them.

The main resource to be managed by this system is time with healthcare professionals qualified to deliver primary, preventive and non-acute patient care to a served population that lives within fifteen or twenty minutes' drive to the clinic. This resource is scarce and must be allocated in an ethical, clinically effective and economically rational manner to maximize benefits to society as a whole. The main method of resource allocation is deciding who obtains which services from the clinic either by appointment, or by walking in spontaneously. These resource allocations must be ethically made in a non-discriminatory manner, with maximum patient and provider free choice.

To make this discussion concrete, the clinic will be imagined to be approximately the size of a supermarket. It would have a parking lot sized to handle peak patient visits on a rapid turnaround schedule in parallel with the Apple Store model. The workload, similar to the Apple Store, will have a scheduled base load component by appointment, and a walk-in variable component. The exact mix of scheduled versus walk-in care would depend on the mix and capacity of resources, the preferences of care providers, the size and needs of the served community and other factors that may be identified through pilot programs and market tests.

The following descriptions of elements in the Demand and Clinical Resource Management System correlate with the schematic flowchart in Figure 1. For clarity the term, "member of the population" refers to the set of people who rely on the clinic for routine health screening and primary and preventive care. The term, "patient" identifies a member of the population who is symptomatic or is actively being cared for in the idealized clinic in some modality.

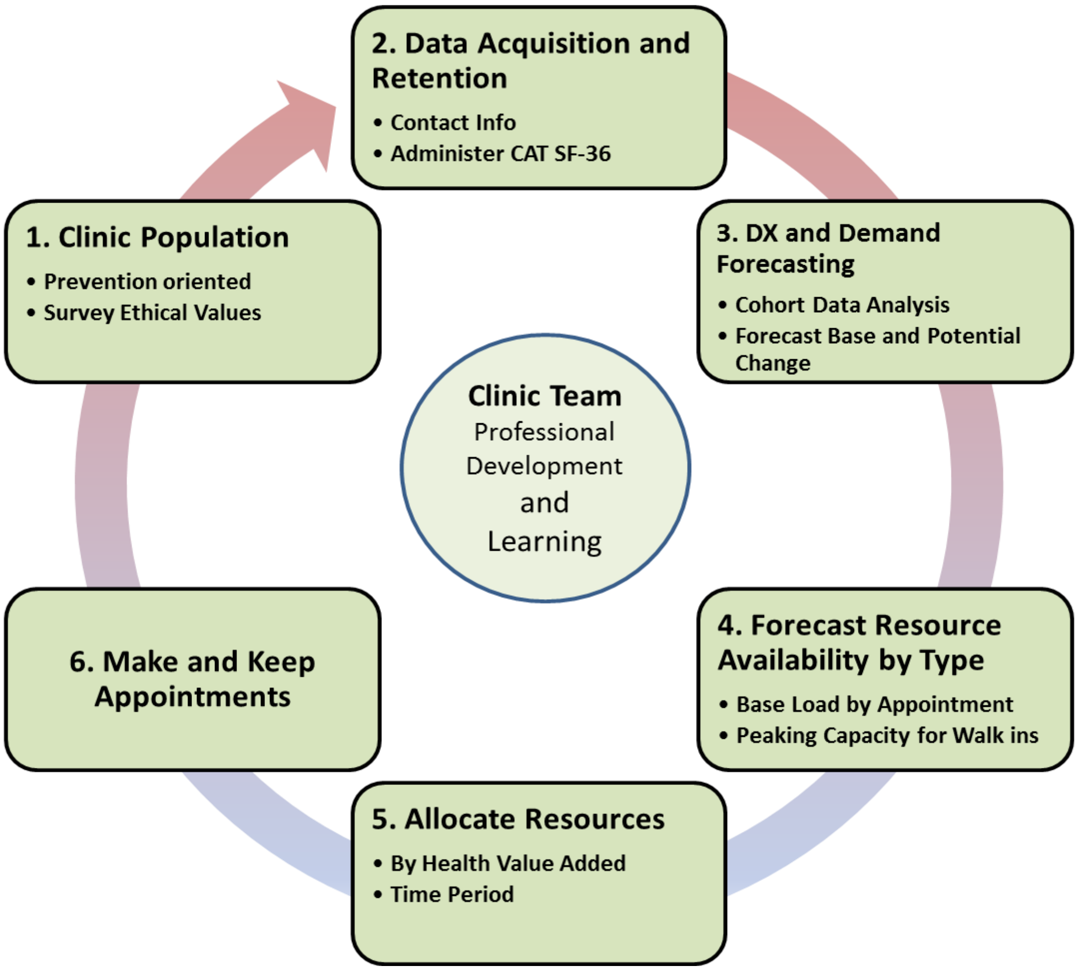

Figure 1 Clinical Resource and Management System

1. Clinical Population and its Ethical Values

1a-- Care Population -- The population served by the Idealized Clinic potentially includes all residents of the area served. This would include a pool with varying:

- Current health status -- well versus unwell at present.
- Health Related Quality of Life – general ability to function, well-being judged by positive feelings and self-evaluations, as well as self-reported evaluations or self-assessments of health impacts on participation in such activities as recreation, leisure, social and occupational.
- Ethnic/Racial background – judged by representation of all groups in service area
- Socio-Economic Status especially level of education and occupation
- Demographics such as age and location
- Family information

1b -- Ethics Survey – As with any scarce resource, situations will arise in which there are too few appointments with care providers to satisfy all demand in the served population. In this case, the decision of which of two individuals to serve must be recommended based on criteria for fair and equitable allocations of scarce healthcare resources. This module conducts calibration surveys of members in the served population. The questions posed in the surveys invite respondents to decide based on their expected health change, which of two patients should be allocated resources given that only one can be served. Statistical analysis of survey responses would produce decision criteria for fair and equitable allocations of scarce healthcare resources, as judged by the values of the served population derived from surveying them. This module would surveys members of the served population on a sampling basis to update ethical rules for allocating resources in the event that some population members can be served while others must wait.

2. Data Acquisition and Retention

2a -- Care Population Contact Information – A data base must be maintained containing names, mailing addresses and e-mail addresses of the patients in the population of the clinic.

2b-- Update Activity on Population Contact Information – A routine cycling through the data base of contact information on the population members is necessary to keep that information up-to-date and as accurate as feasible.

2c -- Computer Adaptive Testing – Periodically each member of the population is invited to complete a fifteen or twenty minute interactive SF-36 computer adaptive testing (CAT) questionnaire using PROMIS technology from NIH. The contact may be made by e-mail, postal mail, telephone call and reminder, voice activated response survey or other means as technology evolves and improves. The routine questionnaire for asymptomatic population members may be followed up by other, more specialized questionnaires needed to resolve uncertainties in the population member's health status.

Item response technology is capable of resolving some three dozen categories of diagnoses with better than 95 percent reliability according to Dr. John Ware. The accuracy however depends on respondents answering questions truthfully. Non-response will have to be handled by a combination of outbound calling, audio response technology for those unable to use a web-based response medium, or in some cases by scheduling a walk in appointment so that the population member can be coached in using the CAT instrument. The output of the CAT interaction is an updated observation of SF-36 scores by diagnosis category.

Initially a behavioral CAT questionnaire will have to be developed from published research on personality or character traits useful in identifying prevention-oriented members of the served population. Only time will tell if members of this cohort will maintain healthy and modify unhealthy behaviors as needed to stay healthy as long as possible.

2d -- Population and Patient Information System -- This subsystem is an electronic health records information system which maintains a combination of conventional health status and clinical information as well as related CAT data gathered periodically. Individual population reported outcomes as well as historical health records and patient clinical data are maintained and updated from all points of contact. Newly generated data from the Computer Adaptive Testing module above will be updated automatically. All clinic team members with valid security and access credentials would have access to these data commensurate with their level of access privileges.

3. Diagnosis and Resource Demand Forecasting

3a -- Population and Patient Analysis Subsystem – The analysis system will need to adapt and evolve over the first three to five years to meet a number of decision making needs. A small team of health statisticians and operations research analytics experts will be needed to prototype this subsystem.

The primary purpose the analysis subsystem must serve is identifying what this document will refer to as "population cohorts" or simply as "cohorts." Cohorts are groupings of individuals in the served population with similar health, life style behaviors and clinical histories and comorbidities. Other things being equal, members of cohorts may be expected to continue to behave consistently in the future. Also, the subsystem will have to estimate historical rates at which past cohort members developed clinical conditions that generate resource needs for diagnosis and treatment. That is, the clinic design assumes that the most likely future for people in a cohort is what happened to people in a similar previous cohort over an earlier time period. In other words, if nothing changes, the past will repeat itself within reason.

Major elements of this forecasting subsystem are based on direct marketing systems used to model customer response to catalogs and marketing messages. Customers are classified into groups by similarities in their past behaviors. Each such group is then tracked to understand its likely response to different actions. In this document such group will be referred to as a "cohort." Cohorts are groupings of population members sharing similarities in their past and current health status (assessed by behavioral CAT surveys) and behavioral tendencies. The cohort classification matches each individual in the served population with a historical cohort consisting of a group of patients with similar health statuses whose responses to treatments and other interventions are known to the extent of the history available on cohort members. In effect, a cohort is similar in concept to a community for insurance rating purposes, or a diagnostic cost group for a patient population with similar diagnoses and co-morbidities..

Once each member of the served population is assigned to a cohort, the analysis subsystem maintains updated and exponentially smoothed (weighted moving averages) scores from the Patient Reported Outcomes (PRO) data and other important heath and morbidity statistics on the cohort. Such a history may be used to make valid and relevant forecasts of the range and likelihood of health conditions, treatment needs and likely outcomes for a random individual in the cohort. When resource or treatment decision data are missing on any member of the population, an estimate based on the statistically appropriate estimate of the missing parameters for that member's cohort will be used as a substitute value in making decisions and allocating resource. Over time, as experience accumulates it should be possible to directly observe the forecasting errors of various cohorts, as a basis for estimating probabilities of statistical forecasting error.

As new population members and patients are added to the clinical population, their known historical data and CAT scores will be used to assign them to an initial cohort for new population members. This initially assigned "startup" cohort will be used for estimating missing data on population member characteristics. The initially assigned startup cohort will be relied on for tracking and forecasting purposes until sufficient individual data becomes available to reassign each population member into the empirically determined cohort which he or she best fits into.

As history accumulates for individuals in each cohort, data on actual longitudinal outcomes will be used in making resource allocation decisions such as which population members need to be seen by a resource person in order to reduce the likelihood of contracting a preventable condition. So the basis for decision making will be to use actual individual data as far as possible, but to default to the most likely estimates for individuals based on the values for members of a cohort of similar individuals on whom the data are available.

3b-- Patient and Population Data Update Subsystem – If data are insufficient to assign an individual to a cohort, this module creates a feedback loop to correct the data deficiency. In many cases this feedback loop would request an update from the Population and Patient Analysis Subsystem. An update request to that subsystem might generate an e-mailed survey to the individual, followed up with an outbound telephone call to those who do not respond to the e-mail. In some cases, members of the population might provide data on a visit to the clinic. If the missing data are clinical history from other care providers, practices and procedures will need to be developed during pilot testing to obtain updates from institutions that will be needed to include data on individuals into the scheduling and care processes of the clinic.

3c –Forecast Diagnostic Groups by Population Member and Time Period –An algorithm must be developed to use historical cohort data as well as the history accumulated on each individual to project near and long term changes in health status. This projection of projected health outcomes will be referred to as Δ0 (delta zero, the expected change in health if we do nothing) and their likelihood from experience of that individual's cohort. There are several possibilities for Δ0 in an individual case:

1. A preventable adverse health condition is probable, however an effective intervention exists which can mitigate some of the quality of life value destroyed if the condition goes un-prevented.
2. A specific diagnosis is established and confirmed implying that some specific treatment is needed.
3. No specific or preventable condition or change in condition is likely given the cohort's experience, and so no appointment need be allocated. However, if the individual served does become ill in this time period, he or she will have to take the initiative to walk into the clinic.

3d –Translate Forecast Diagnosis for each Population Member into estimated Resource Need by Time Period –A data base of alternative responses to any likely diagnosis is needed to estimate a maximum, minimum and most likely need for each type of clinical resource. In this case, a resource is the need for an appointment with a particular type of resource for a specified length of appointment time.

3e –Forecast Expected change in future health by type of Resource and Time Period – An algorithm must be developed to turn projected diagnosis and use of clinical services into an expected treatment outcomes Δ1 (delta one). This change in health status, Δ1, along with the base case projection of health status Δ0 is the raw input to a first pass tentative allocation of resources to each population member. The greater the improvement in expected health outcomes based on Δ1 - Δ0 (estimated health value added), the greater the value of allocating needed resources to that population member. The alternative is to allocate zero resources to that individual for the time period and do nothing until the next allocation cycle.

The size and probability of Δ1 may depend on which type of a resource person sees the person and what treatment or other intervention is made to reduce the severity of Δ0. The more likely an expected preventable condition is, and the higher the success rate of the most effective treatment, the greater the health value added will be. The individual's relative ranking from highest health value added to lowest, will be the basis for a first pass allocation of resources. The ranking will rely on actual data for the individual being allocated, as far as possible. However, forecasts of future outcomes based on the use of resource allocations, Δ1, will default to the most likely estimates for individuals derived from experience of members of that individual's cohort.

3f –Forecast Expected Base Load and Walk-In Work Load by Resource – An algorithm must be developed to aggregate the forecasts of resources demanded by time period into a total resource demand by type. This projection must then be compared with resources available and an allocation process begun. Those individual's for whom the difference between no resources Δ0 (delta zero) and full allocation of resources Δ1 (delta one is below some tolerance are dropped from the resource allocation. These members of the population must wait until the next time they respond to a request for an update of their status as in 2.c above for a new allocation of resources, or if they become symptomatic or suspect a change in their health, they can make a walk in visit.

The expected volume of walk in visits is driven by the number and health status of served population who are not allocated resources in a time period. The forecasted rate of walk in visits for this block of the population would be estimated directly from their cohort data. As experience accumulates it should become possible to evaluate tradeoffs (if any) between routine screenings of asymptomatic or mildly symptomatic population members versus waiting for them to walk in voluntarily. This would allow the clinic to evaluate the best level of staff resources for a give served population.

4. Forecast Resource Availability by Type and Time Period

4a –Maintain staff schedules for each type of staff resource – Commercial off-the-shelf software would be used to maintain scheduled availability of each type of staff resource. This would probably be maintained at the individual staff member by workday and time-of-day level of detail.

5. Allocate Available Resources to Individuals by expected health value added and date

5a –Sort base load population from highest to lowest health value added and select trial cutoff points by resource— The file of population members needing resources is sorted from highest health value added to lowest. Then the running total of resource demand is calculated by adding each individual's resource need to the cumulative total need of all higher ranking individuals. The decision rule for each trial resource allocation is to select a cutoff point based on the actual resource available for base load. Those individuals whose expected health value added lies above the cutoff are tentatively allocated the resource indicated. Below that cutoff point each individual tentatively is allocated no resources.

5b –Apply ethical utility functions to improve fairness of tentative resource allocation — Next, an ethical utility function derived from survey data in 1b above is applied to the tentative resource allocation based only on expected health value added by resource type and time period. Resource allocations are checked against the utility function and changes in allocations are made to improve fairness with minimum loss of health value added. This activity may involve the use of mathematical optimization software, which is available off the shelf.

5c –Apply ethical utility functions to improve fairness of tentative resource allocation —In this processing step a check on the ethical fairness of the revised tentative resource allocation is run. Then a decision is made about whether or not to re-sort the list of population members needing resources to create a revised allocation. When successive revised allocations yield no further improvement in allocation fairness or gain in health value added, the allocation process stops. The final allocation is provided to a function that makes appointments. For example, appointments may be made in week 1 for week 5.

6. Make and Keep Appointments

6a -- Make Appointments

6b – Carry-out Appointments

7 Use Feedback on Customer Experience and Clinical Outcomes to Drive Continuous Improvements

Random intercept, post visit follow up and random sample surveys for customer feedback, as well as clinical outcome and cost measures as a byproduct of Electronic Health Records and accounting information will be used to provide timely feedback. Initial small sample customer tracking surveys could be used, supplemented with surveys of staff. Feedback at the individual provider level would be confidential to that provider, however would be shown in perspective against data from all other comparable providers. This way, each individual receives feedback on areas in need of improvement as well as an indicator of what level of improvement is possible. Over time, tracking and presenting trends will motivate professional development, much the way that a university registrar's feedback on student ratings of courses and instruction methods spurs teaching faculty to improve instruction.

8. Clinical Team Ongoing Professional Development and Learning

Feedback on customer experience and clinical outcomes must be linked to appropriate learning and improvement activities to which the feedback pertains. Some of these activities may be corrective and preventive in nature. Others will seek to deliver improvements to population members as opportunities to improve patient satisfaction and willingness to refer other health-conscious population members to the clinic. The mix of professional backgrounds and behavioral traits needed for various improvement teams and sub-teams will have to be determined through experience gained from setting up and operating a pilot clinic.

Open issues

- What are the ethical considerations of treating members of the clinic's population, and not treating non-population members? If a walk in patient who is not a member of the clinic's covered population walks in ten minutes before closing time, who decides whether or not to treat that patient? On what basis would the decision be made – pragmatic, moral or "black and white" logic?
- What are the most likely conflicts of self-interest versus population members and non-members?
- Risk based escalation processes from early service levels to the medical area. What are the health and decision criteria?
- What layout design optimizes ability to adapt as volume and mix of Dx's vary?
- What outcomes, What inbound morbidities; What is the scope of the Apple Store Clinic, and is it an just an extension of a CVS Health Stop--type walk in clinic or a new intake front end for specialists at a general hospital? Or a standalone clinic operating out of a former supermarket location?
- Is the Ideal Clinic stand alone or is it part of a larger healthcare complex or provider network? Can it be the ACO for patients that become hospitalized? Do the criteria for being an ACO depend solely on share of patient spending on healthcare?

- If served population members are assigned to specific resource people such as physicians, nutritionists and others, scheduling and resource allocation must be done at the individual resource level.
- The idealized design team needs to survey representative member of each stakeholder category and compile a list of requirements for each stakeholder type.
- What is the clinic's ownership and governance structure? Would it be possible or desirable to have patient, doctor, nurse, third party insurers, state medical society, as well as local government advisory boards who dialog with and advise the clinic management on issues and concerns outside of the clinic's normal purview?
- Impact of geriatric patients on amount of preventive care possible among the served population. Estimates of the reduced cost of preventive care suggest that savings of medical resources through more aggressive prevention may be relatively small.
- Social, Political, Economic, Governmental and Professional opposition to a new form of healthcare maintenance and primary care delivery.
- Can the VA EHR data base be used to validate the use of cohorts for setting up base rate estimates of primary care diagnostic and treatment workloads?

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Martin F. Stankard of Westford, Mass, is a well-known author, speaker, coach and consultant on process improvement and performance excellence. His latest book, *The Art and Science of Process Improvement* is the first comprehensive University graduate-level textbook written on the subject of Process Improvement. He has authored three other books on organizational performance and management systems. In over 30 years of management consulting and coaching he has helped over 300 clients, including many leading banking, consumer credit, insurance, manufacturing, military, retailing, research and development organizations in the U.S. and internationally.

Since 2005 Dr. Stankard has been a member of the Affiliated Faculty of the Center for Organizational Dynamics of the University of Pennsylvania and a Lecturer in Penn's Graduate School of Arts and Sciences. At Penn he teaches graduate-level courses in Process Improvement and Leadership from the Middle. In addition, he developed and taught Boston University's Presidential Briefing on White-Collar Productivity. He developed and was the lead instructor for The American Society for Quality's (ASQ) National Seminar on Baldrige Assessment for Service Businesses and he served for over 10 years as a member of the examiner-training faculty for the Massachusetts Quality Award.

At Productivity Development Group, Inc. (which he was President of until 2008); he developed and delivered courses on Lean Sigma Process Improvement, Process Re-engineering, Software Engineering Process Improvement, Baldrige Assessment, Group Facilitation Tools and Skills, Creating a Culture of Continuous Improvement, Value Added Auditing and Process Improvement Sponsorship for Executives. Motorola University certified him as an instructor for its Six Steps to Six-Sigma program. He has led training programs for over 7,000 management attendees, including courses given in The Netherlands, Sweden, and The People's Republic of China.

Before entering consulting, training and publishing, Dr. Stankard was a Lecturer in Statistics and Operations Research at the Wharton Business School of the University of Pennsylvania, and on the staff of Wharton's Management Science Center. While at Penn, he earned a Ph.D. in Statistics and Operations Research, as well as an MBA in Industrial Management, and a B.S. in Mechanical Engineering. He was a member of the 16th cohort of the Harvard School of Public Health professional education program on Healthcare Outcomes Measurement in 2011.

Dr. Stankard has served on the Malcolm Baldrige National Quality Award Board of Examiners for 1991 - 1993, 1999 and 2000 Boards of Examiners. He chaired ASQ's Banking Industry Committee in 1990-1991. He helped organize the Massachusetts Quality Award, patterned on the Baldrige. He also served for over 10 years on the Board of Directors of MassExcellence, Inc. a non-profit corporation dedicated to raising awareness and understanding of Performance Excellence in his home state of Massachusetts, and a member of the Board of Directors of the Business Ethics Foundation. He is a member of several academic and professional societies.