



Consumer Health Care DSS

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“The consumer can act as the primary decision maker for personal or family health and is capable of making the correct decision and taking the right action if provided with adequate information, advice, and support.”

Why and What

- Why needed
 - Corporations are: cost shifting, minimizing liability and generally making consumers responsible
 - No more cradle-to-grave guarantees by employers
 - Consumers must make more choices
 - Critical element of overall independence
 - Destiny not tied to a single (or any) employer
 - More complexity!
- What is needed
 - Consumer-centric DSS
 - Analyze, select, and “size” from plan (and possibly provider) choices
 - Demand Management
 - Short term tactical decision making balanced by long term strategic considerations
 - Integration with financial planning systems
 - Educational tools identifying various plans, options and their real meaning

Consumer Objectives

- Maximize Health State
 - Enhance quality of life - reduce chronic illness impact
 - Avoid Adverse Health Effects
 - Reduce Lost Work
- Maximize Service Quality
 - Access convenience - Overall trust
 - Provider Care
- Expense management
 - Minimize total cost of experience, now and “down the road”

DSS Objectives

- Find a range of solutions that maximize (sum of) present value (health care cash flow) across time, subject to consumer specified constraints
- Demand management and modeling to achieve optimality
- Solutions are defined as an optimal set of health care plans and options, properly sized, and a guide on how the plan should be used and operated.
- Inputs and constraints limit or bound possible solutions, by specifying rules to guide the search for optimality.

Demand Management

Source: Managing Health Care Demand

- 4 x 3 matrix of Domains and Effects
- 7 Key Measures (KM) and Effects
 - KM can be categorized as ends vs. means
- 6 Stakeholders classes
 - Where do we (DSS architects, designers) fit?
- 4 x 7 matrix of Domains and Measures
- Change Management Approaches
 - Do we need to be concerned?
- Our role

Demand Management – A key component

Source: Managing Health Care Demand

Domains→ Effect ↓	Improve Health	Improve Decisions	Disease Management	Disability Management
Avoid Demand	<ul style="list-style-type: none"> •Health Promotion •Prevention •Risk Reduction 		<ul style="list-style-type: none"> •Lifestyle Changes •Reduction Chronic Condition •Prenatal Care 	<ul style="list-style-type: none"> •Occupational Safety •Ergonomics
Replace Demand		<ul style="list-style-type: none"> •Self Care •Urgent Treatment Choice 	<ul style="list-style-type: none"> •Self-Management •Co-op Care 	<ul style="list-style-type: none"> •Self Care in Condition Management
Reform Demand	<ul style="list-style-type: none"> •Early detection & intervention 	<ul style="list-style-type: none"> •Plan choice •Provider choice •Elective procedures •Urgent treatment •End of Life 	<ul style="list-style-type: none"> •Case Management 	<ul style="list-style-type: none"> •Provider choice •Condition Management

In the telephony world, affecting demand in a similar manner is known as [traffic shaping](#). Similar methods apply in this domain. Green is in scope; red is out-of-scope; orange (unclear).

Demand Management - Measures and Effect

Measures	Effect	Description
Participation	Means	Prevention, monitoring, and early detection to reduce morbidity and early mortality
Mind-states	Means	Improve consumer consciousness and motivation to engage in improved behavior.
Behavior	Means	Reduce or eliminate risk behavior; adopt, repeat, and continue desired behavior; improve self-care and self-management skills
Expenditures	Ends	Reduce health care and related expenses
Utilization	Ends	Improve appropriateness of health care use
Health Status	Ends	Maintain or improve health; reduce risk and morbidity
Added value	Ends	Benefits derived from health status and improved behavior (e.g. workplace productivity, spiritual)

Stakeholders

Stakeholders	Description	Motivation
Payers	Insurance companies	Reduce payout; maximize profitability; reduce prospective risk
Providers	Medical profession; hospitals; community-based services	Maximize revenue; apply skills where & when most needed; avoid liability
Employers	Provider of insurance benefits to employees; payer, direct or indirect	Reduce cost; transfer liability to employee; healthier employee is more productive; retention
Sponsors	Employers and payers	See above
Consumers	End-user; final payer	Improved health , quality of life, and expense management
Community	A specific demographic, geographic or other logical division	May align with providers and consumers
Taxpayer	Payers for entitlements and safety nets, such as Medicare and Medicaid	Minimize taxpayer outlay or liability

DM – Domain x Measure

Domains→ Measure↓	Improve Health	Improve Decisions	Disease Management	Disability Management
Increased Participation				
Mind-states	In-scope	In-scope		
Behavior				
Expenditures	In-scope	In-scope		
Utilization	In-scope	In-scope		
Health Status	In-scope	In-scope		
Added value				

Sponsors typically want to develop programs or initiatives that make a positive and measurable contribution in one or more of these cells. Our DSS may be relevant to only a few of these cells.

Change Management – Stage Theory

Relevance to our DSS?

Prochaska's Stages	Motivation	Capability	Consciousness
Pre-contemplation	Possible		Awaken
Contemplation	Emphasize	Assess	Excite
Preparation	Emphasize	Assess	Excite
Action	Useful	Emphasize	Reinforce
Maintenance	Useful	Emphasize	Remind
Termination			Remind

Presumption: That consumers are unwilling or slow to respond to change initiatives (or willing to adopt helpful initiatives), therefore the need to adopt a theory of how to recognize consumer behavior and influence needed change.

A paradox – Resolved!

- If a consumer desires independence, why is it necessary for consumers to wait for sponsors to develop programs & initiatives?
- DSS needs to be consumer proactive and affirmative (even if it runs the risk of being industry unconventional or contrarian).
- Debatable: The DSS cannot assume that a consumer is unwilling to change. Implied relevance of Health Care DSS? Therefore, is Stage Theory (Slide 10) relevant?

Proposed DSS

- Critical Inputs
 - A consumer's Health State (Health Risk Assessment - HRA)
 - Health Care Plans
 - Health Care Plan Evaluation
- Health Care Cash Flow and Balance Sheet
- Consumer constraints
- Analysis Framework
- Demand modeling
- Servers (a.k.a. Health Care Plans)
- What the DSS needs to solve for
- Time Dimension
- DSS Proposed Solutions (Output) to Consumer
- DSS Role Summary

Critical Inputs or Factors

- Consumer's current health state, as it affects morbidity and health care demand
- Eligible health care plans (i.e. the “servers”)
- Consumer's financial current and future status
 - Cash flow limits, both current and future
 - Tax rates, as it might affect the benefit of an HAS
- Consumer's ability to control or reshape demand through lifestyle or investment in preventive care (a.k.a. Risk Score)
- Quality preferences
 - Freedom to choose provider
 - HDIS minimum threshold
- Volatility, uncertainty, and unpredictable

Client Health State – Current

- [Rand SF-36](#) method (primary, implemented)
- Optional resources which could help to extend concept
 - [CDC - National Center for Health Statistics](#)
- Survey results sometime report a person's health age relative to chronological age (morbidity) and to estimate mortality (as we ask in RP).
 - Score a client's health state from 1 (excellent) to 5 (poor).

Health care plans

Class	Type	Description
Entitlement	Medicare	A, Options: B, D, and Medicare supplements
	Medicaid	Both state and federal
Group coverage (rated)	Indemnity	
	PPO	
	HMO	
Individual coverage	Same as Group	Individually rated; open-market
Health savings accounts	HSA	Health Savings Account
	FSA	Flexible Savings Account (use it or lose it)
	Archer MSA	
New concepts	Universal Health Care	
	Time consistent insurance	

Health Care Plan Evaluation

- [NCQA Health Plan Scorecard](#)
- [HEDIS](#)
- [Rankings](#)
- [Plans that don't report](#)
- Tools would seem to help in identifying and selecting health plans

Health Cash Flow Elements

Element name	Definition
Insurance premium (-)	Cost to insure against health care costs
Savings plan funding (-)	Contribution to health savings plan
Health expenses (-)	Out-of-pocket charges for health related expenses, including self-pays, deductibles and co-pays
Insurance benefit (+)	Credit or reimbursement for health related expenses
Taxes (+ or -)	A tax credit or debit
Reimbursement (+)	A credit for good health experience
Investment growth (+)	Savings plan provide for this component

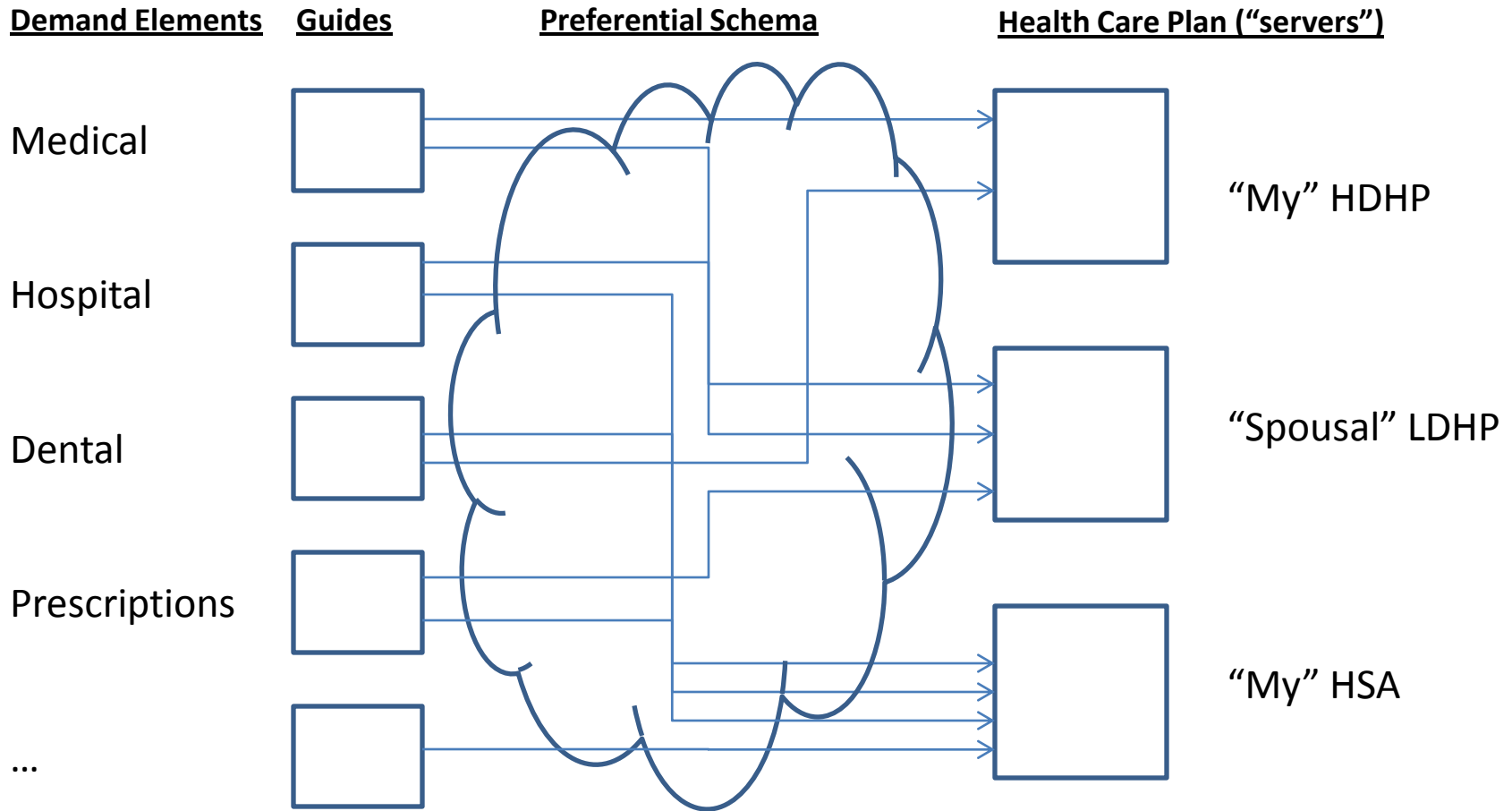
Health Care Balance Sheet

- Health Savings Accounts (that carry-over) have balances
 - In fact, these balances can be used for non-health expenses that are subject to a 10% excise penalty
 - Not all savings accounts have carry-over (e.g. FSA), therefore have no end-year balance
- Health insurance contracts do not have balance accounts in the standard sense
 - However, insurance contracts have a notion of balance for lifetime caps (but this is not the balance we are referring to in this slide)

Constraints

- Consumer specified constraints
 - A limitation (cap) of current or future cash flow dedicated to health expenses
 - Only certain options & action courses are available to a consumer, partly due to their health rating (underwriting)
- External constraints
 - Plan exclusivity – Example: If a person is covered by a LDHP in a given year, then they cannot fund an HAS
 - Some plans are [not] accessible due to age (Medicare), work status, or income/asset level (Medicaid)

Analysis Framework (Single Time Instance)



EXAMPLE – Self pay is that which is “blocked”

Single Time Instance – Analysis Framework

- Single Time Instance – Think of a single year (current year, future year)
- Expense Categories (EC) are assigned to guides (the 5 left hand blocks). Demand by EC is important.
- Health Care programs (the 3 right hand blocks in the foil) serve the expense needs
- The preferential schema illustrates both the programs and order to be used for each guide.
- The schema should be canonical (i.e. in its most reduced form)

Product Design : Choosing the level of Demand Granularity

- Options considered and reviewed
 - IRS Publication 502 provides (too) fine grain decomposition, but is representative of the Demand Universe
 - Other methods rely on industry taxonomies, such as that described in “Managing Health Care Demand”
 - MEPS groupings
- Level of granularity
 - A dozen or less groupings seems reasonable & appropriate
 - Best method: Adopt MEPS for its brevity, availability of population data, and overall modeling utility
 - Most insurance plans cover only a subset of the Demand Universe

Health Care Demand Notion

- A consumer has expected demand by EC or guide, depicted in the diagram as (λ, σ, τ) ; this demand is then offered to his/her preferential scheme
- Demand predictability may be known with certainty (i.e. plan to use preventative care) or with a low degree of confidence, as with many health care hazards
 - A developing science and art. Analysis and decisions can be heavily weighted on the near-term using information decay function (e.g. $\text{Exp}(-\tau/\mu)$).
- Technical tools for analysis – Sources: “[Hazard Function Technology](#)”; other actuarial studies on morbidity;
- [MEPS](#), as a primary source on health care expenses
- **Projecting a client’s future needs - “fuzzy” and “volatile”**. Primary R&D effort: Pick any reasonable set of theories (e.g. “Compression of Morbidity”) model, integrate, and revise.

Expression of EC Demand

- Average expected cost of care or treatment by EC demand, linked to a client's (current, future) health state benchmarked against MEPs data.
- These can be further described by statistical distributions (e.g. Pareto, shape=1.31)
 - Variance and uncertainty can be simulated.
 - How many simulation trials are necessary (TBD)?
- Research question, not yet answered: Can demand shaping improve consumer results as quantitatively measured against consumer objectives (Slide 3)?

Unified Morbidity Modeling – Under consideration

- Unified: ($\sum \omega_I * M_I$, where $\sum \omega_I = 1$)
 - Model A (Implemented, Version 1)
 - Score client status (e.g. Rand SF-36 and its derivatives) and compare against population mean; determine health age or status
 - Establish benchmark (World-class athlete, refer to “Compression of Morbidity”, p18) – as a predictor to physical age of chronic onset
 - Use population mean and distribution of health care expenses by demand type (MEPS - National Health Care Expenses in the U.S. Civilian Non-institutionalized Population)
 - Differentiate chronic (predictable) vs. acute (random)
 - Project expenses as a function of projected health status
 - Model B
 - Reverse engineer insurance premiums to determine insurance industry expectation of consumer health care expenses

Projecting Random H.C. expense from MEPS data

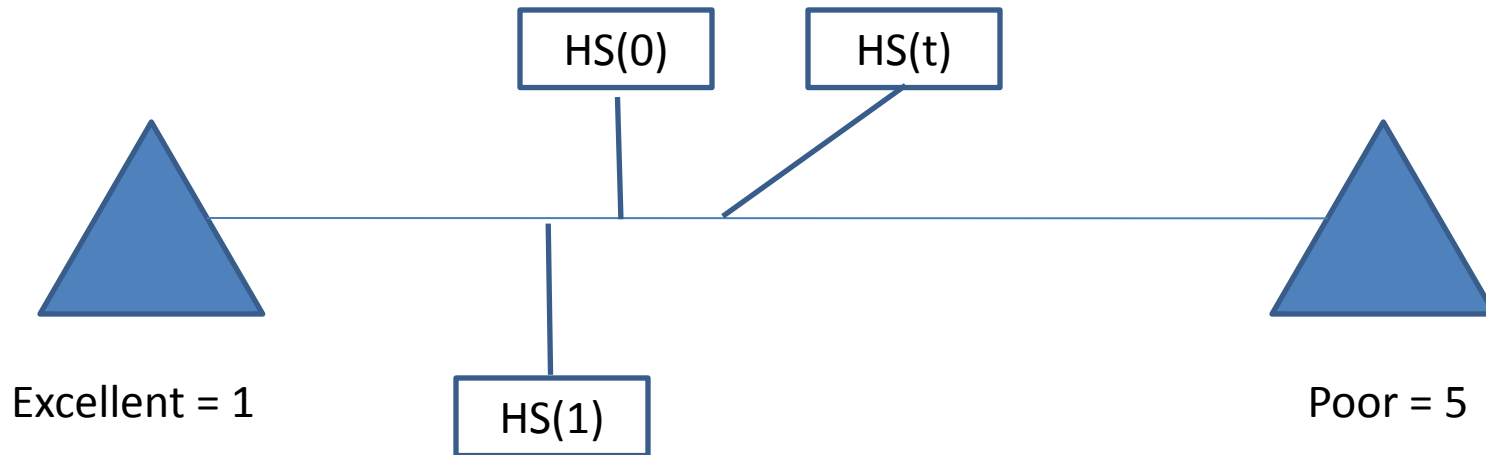
- MEPS Table data organization is key
 - For each 5 year age band (from 20 – 70) x the 5 Health States, the population mean and [decile](#) H.C. expense results are maintained
- A projected HC expense is randomly drawn from a Pareto distribution.
 - Client age and projected health state (next slide) are input into method that uses interpolation to yield a blended mean and percentile

Dynamic Health State

$HS(t)$, client's health state is limited to axis [1..5].

$HS(t) = F[HS(t-1), \text{Health care expenses}(t-1), \text{Client Risk Score}]$

$HS(0)$ = current or "beginning" health state, from SF-36 survey.



$HS(t)$ may "bounce" (i.e. increase and decrease as time increases). Due to its functional dependence on "health care expenses" (randomly generated), a different HS vector is generated for each simulation trial.

Projecting (simulating) Client's Health Status (HS)

- $HS(yr) = F(yr, HS(0), HS(yr-1), \text{Stat Recording}, \text{Client Risk Score})$
 - $HS(0)$ is client's current or baseline HS
 - Stat Recording contains the result of this year's random expense drawn from Pareto distribution and the distribution itself
 - A "high" expense (e.g. $> \text{mean}$) suggests deteriorated health status; "low" expense (e.g. $< \text{median}$) suggests better improved status
 - The projection factors the baseline and last year's HS using "weighted decay", the baseline HS having a declining effect.
 - Client Risk Score (fixed) relates to lifestyle and preventive care choices which effect future HS. The client risk score acts to set a floor on HS projections.
- Function form suggests a dynamic, feedback model.

The Notion of Servers

- Servers may be thought of as health care plans, each of which have unique properties and behaviors that allow offered expenses (e.g. submitted claims and expenses) to be met (i.e. paid for or reimbursed).
- Among server properties are: (1) Account balances (for HSAs), (2) Deductibles, (3) Co-pays, (4) Percent coverage, (5) plan caps , (6) overall server “eligibility” to cover one or more EC demand groups
 - Example: An HSA will pay an expense no greater than its current account balance. An HSA balance will carry-over to the next year.
 - Example: Most insurance plans have deductibles, such that the initial offered expenses are not “met” by the insurance contract.
- Not all offered expenses to a health plan (server) are “met”; some or all of the offered expenses may overflow to alternate servers for particular demand (as 2nd, 3rd, etc. choices)

Health Care Server combinations

- Consumers often have multiple plan type choice:
 - Access to his/her spousal's group health coverage
 - A health care savings account in addition to his/her own group health coverage (or an FRS, Archer MSA).
 - An individual health insurance plan
 - Medicare B, a Medicare supplement, and Medicare D for those aged 65 or over
- Plan type combinations are non-static
 - Group plans while employed; otherwise, individual plans
 - Pre- and post-Medicare
- Excluded combinations
 - Contributions to certain health savings accounts are not possible dependent on use of low deductible insurance plans

What needs to be solved

- Patent 2 Isomorphism
 - The selection problem: What set of plan types (“servers”) makes the most sense given a consumer’s demand expectation?
 - The sizing problem: What properties and behaviors of these servers make the most sense?
 - The ordering problem: What is the best scheme that makes use of the servers in a way to deliver maximum consumer benefit?
 - The assignment problem: How should consumers link their health expenses to the scheme?
- Above & beyond: Traffic or Demand shaping: How can a consumer manage demand to improve results?

Time Dimension

- The health care problem cannot be viewed in “single time instance”
 - Consumers have health state changes from current age to mortality; the onset of unanticipated care needs
 - Considerations of guaranteed issue, as a client’s life situation changes
 - Medical savings accounts accrue over time – changing account balances represent a change in present value
 - “Eligible” plans shift – e.g. Medicare available to those 65 and older, but additional funding of HSAs is not
 - Some consumers do (or expect to) bare risk, willingly or not, during gap periods. How should a consumer plan or manage this expectation?

Dynamic components

- Consumer EC demand is expected to change over time
- Server eligibility, property, and behavior may change over time
- To ensure long-term financial management of the health domain, an assessment of a client's future state is necessary
- Characteristic of all strategic decisions involving dynamic components, there are both: (1) contingent, deferred decisions, and (2) anticipatory decisions affecting the “upstream”.
 - What are the ways that clients can lock-in reliable future states without having dependency (e.g. on employer)?

Analysis of Future Time and States

- Factors (probabilistic, prediction science)
 - Consumer demand expectations, dependencies: (1) consumer's current health state, (2) general insurance industry hazard models, and (3) other models
 - Plan type trends
- Analysis of future time (t) fundamentally yields $E(t)$, consumer's expected health expense, net of tax effect
- Convert $E(t)$, for all years, back to present value
- Find a range of solutions that provide the smallest (negative) present value
- Success probabilities -- i.e. a single simulated trial may or may not meet consumer (cash flow) constraints

Proposed solutions

- Immediate (tactical) solution – generally meaningful to all consumers
 - What plans do I select now from the choices available to me subject to my constraints?
- By considering strategy, the approach discussed hopes of eliminate tactical choices, which might appear “optimal” that, however, would create a future hazard
- Parametric weightings can be applied to quantifiable alter the emphasis (confidence) on near-term projections and decision making -- more so than fuzzy future states.
- One could apply a parametric weighting that would give no or limited credence to future scenarios, although this is not advisable since this limits the DSS to a tactical tool.

DSS Role

- “The consumer can act as the primary decision maker for personal or family health and is capable of making the correct decision and taking the right action if provided with adequate information, advice, and support.”
- DSS ROLE: It is vital decision making tool that provides adequate information, tactical & strategic analysis, and advice.