Sustainable healthcare services through digitalinnovation (part 2)

January 7, 2016

This is the second part of a previous post "**Sustainable healthcare services through digitalinnovation (part 1)** ", in which we identified that as for most industries, the Healthcare industry must "Do More with Less" due to demographics megatrends, economic crisis, possible secular stagnation forcing both public services/governments and private healthcare providers/payers to rethink the Architecture of the whole system to ensure it will remain sustainable.

We suggested that the "cloud architectural patterns" could be one way to address these challenges, as the "Cloud" was designed to "Do More With Less", to increase the economic (and eventually thermodynamic) efficiency of these systems through (among others) consolidation for a better utilization, automation for an increased productivity, standardization to reduce SKU variability and errors...

So how a "cloud architectural pattern inspired" Healthcare Services architecture might look like ?

Reframing the system using cloud architecture patterns

Directly inspired from the Cloud definition given by the NIST, we suggest the following diagram to "reframe" the healthcare system.

Cloud Definition given by the National Institute of Standards and Technologies (NIST)
http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf

The NIST's definition of the Cloud architectural attributes.

As stated previously, while mutualization is needed but consolidation might be "unfair" to people who live too far away from major consolidated medical platforms. We need to rethink the system, starting with what it has to deliver.

- *Standardized catalogue of managed services:* Leveraging the International Classification of Diseases Database (ICD10-CM for diagnosis and ICD10-PCS for procedures), it is possible to structure analytically the medical service delivered to patients. That is the infamous "medical activity coding" which most of the time triggers the payment of healthcare providers. While the "root enabler" (ICD10) is there, it still needs to be integrated in the healthcare providers IT system and business processes.

Patient clinical check-in and check-out is important as it has to demonstrate the clinical improvement of the patient and it must be assessed continually during the stay. Obviously, clinical observations are a must, but medical devices (IoT) can supply additional data to support this clinical improvement once the data quality, relevancy, security and governance challenges will be genuinely addressed. As an example among million others, Microsoft XBOX Kinect has been used in rehabilitation to measure the improvement in articulation mobilization, through gamification and patient's scores.

- *Self Service healthcare & Pay as you use:* To achieve zero marginal costs in diagnosis, health service industry should rely on the Internet of Things (IoT). Using self-quantifying devices; feeding big data; having machine learning doing diagnosis every millisecond, night and days without any fatigue; increasing its proficiency; would enable the birth of the "Ultimate Clinical Assistant Artificial Intelligence" (UCAAI). Obviously such a component would rely on high quality standardized data and well structured, ambient, EMRs. For the people who cannot afford these IoT home medical devices, it is possible to consolidate them into a specific "semiotic cabin", deployed in medically deserted areas.

Other example of technology enablers are:

o   To take an example of IoT in a simple, most widely used family medical device nowadays, we can consider the thermometer. We can envision the "thermometer" of the future leveraging "DNA/RNA chipsets" for advanced diagnosis (just as **Theranos**), and either connection to a local station (**Freestyle** for diabetes for example), with the possibility to share the local cache with your doctor remotely if needed.

o   3D-printing for orthopedics (and some other parts in the future) makes it available anywhere without the need to have different prosthesis in inventory and no perfect fit for the patient.

o   Robots (either humanoid or not) can ensure patient handling and transfer from care stations to care stations and bedroom. It will spare the backs of nurses and address some of the healthcare professional demographic issues.

Besides that, leveraging the clinical check-in/out to accurately define the "clinical improvement" and hence the medical service delivered you can enable new business case optimizations:

o Pay only if there is improvement (Pay as you use.. when what you use is worthy),

o Meaning if there is no more improvement, as the healthcare supplier will not be paid, it has to transfer the patient downstream to a long stay, or back to home,

meaning if the improvement slows gradually, that it is time to transfer the patient from Acute to Rehab, or from Rehab to Long stay...

- *Elasticity / Infinite Capacity "illusion"*: It is a Global Supply chain with "inbound supply chain", patients asking for Healthcare Services, and "outbound supply chain", e. the aggregation of all downstream structure requests made by upstream structures.

o Remote consultations, self-service healthcare, ubiquitous access to the UCAAI described above will reduce the pressure on the inbound end, especially the Emergency Care Units at General Hospitals, and for the General Practitioners in medical deserts. At any moment, a remote "human consultation" could be triggered leveraging Unified Communications and medical call centers with embedded expertise. Safe diagnosis will be made, prescription will be sent to the nearest pharmacy ready for pick-up, or even drones could deliver drugs in the future: Zeroing marginal costs of family healthcare and diagnosis,

o Geo-localization of demand and supply of healthcare services will provide better insights for capacity planning at the local/regional and national scale,

o SKU consolidation to limit variability can be done. Instead of having beds of cardiology, pulmonology... leverage the ICD10-PCS to group similar procedures for Homogeneous Groups of Patients (sharing alike clinical presentations) and define "technical level" for beds. The cost model will be easier to sketch, and the "bed spillage" from one service to another would be easier to manage as you will not consider anymore "medical services", but "Homogeneous Groups of Patients" which requires similar technical/procedural response.

o With the assistance of the UCAAI, and the mapping of available beds per technical level, per hospital, along with geolocalization, it will be possible to achieve a better patient routing, *i.e.* the right bed (technical level), the appropriate hospital (nearest). Furthermore, anticipating recovery kinetics sketching, it will be also possible to "pre-book" downstream infrastructure to handle the patient end to end: patient's entire healthcare trajectory will be designed in the system, and monitored as the patient will walk the path: Broken leg – Acute Stay (1/2 day), Rehabilitation (6 days), Homecare (3 weeks), Remote Medical Watch (not in Patient's health insurance, option +150€). As for a journey, options could be upsold along the way (single room, premium hospitality, etc...).

PERVASIVE ARTIFICIAL INTELLIGENCE FOR BETTER SYSTEM THERMODYNAMICS: ZEORING MARGINAL COST OF HEALTHCARE SERVICES THROUG BETTER CAPACITY UTILIZATION & MANAGEMENT
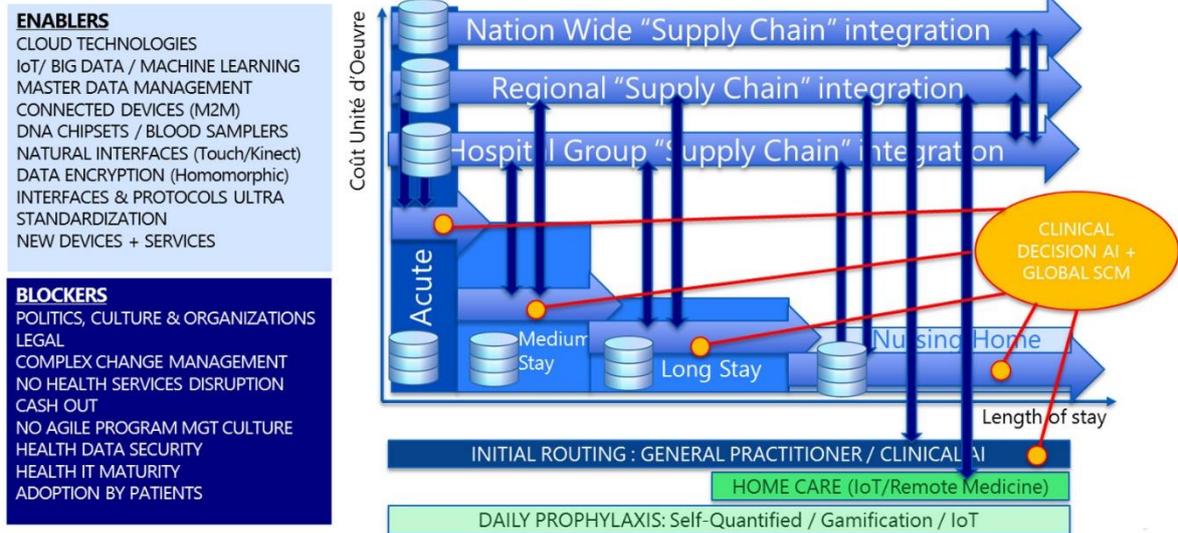
- *Anywhere, anytime, equal access to services*: Due to demographics (ageing population) and the rise of neurodegenerative diseases (Alzheimer, Parkinson, ...), the dependency of the Elders will increase while the availability of family members to manage this dependency will decrease (everybody's need to work to get money to pay for nursing houses). Homecare will become prevalent and will be made possible by all the technology mentioned previously. IoT as an accelerometer to detect a potential deadly fall and warn assistance teams with geolocalized data. IoT as a Geolocalization tracer with geo-fencing to allow dependent people to walk around their neighborhood and warn assistance teams when they exit the geo-fence. This could also be done in acute/medium/long stay care structure for patient isolation (infectious diseases) or to find "lost patients" (due to neurological / psychological disorders). As stated previously, combined with hospital mapping, and care trajectories, robots can take care of patient manutention leveraging in building geolocalization.

Conclusion

A possible big picture of new healthcare services architecture could be the one below (to build on the similarities of NIST Cloud Definition).

CONSOLIDATION IS NOT ENOUGH … NEED TO RETHINK ARCHITECTURE END TO END… HEADING TO « DYNAMIC HEALTH SERVICES »	Patient Clinical Assessment Check-in / Check out Ultra-standardized medical service catalogue / Diversification on Premium hospitality services Rationalization of healthcare offerings	SELF SERVICES / PAY AS YOU USE	-End to End nation wide ERP to balance demand and supply (Global SCM) - Clinical Artificial Intelligence to assist practitionners coupled to global patient routing -Bed mutualization based on "technical level" pooled in "spillage pools"	ANYWHERE, ANYTIME, EQUAL ACCESS TO SERVICES
	STANDARDIZED CATALOGUE OF MANAGED SERVICES	Remote Medecine & Self-qantified medical devices (IoT + DNA/RNA Chips + sensors) + back-end services (AI) for diagnosis Billing base line spot on genuine medical service delivered as defined at check-in and updated regularly.	ELASTICITY / INFINITE CAPACITY « ILLUSION »	- Local deployment of "diagnosis cabins" coupled to cloud expert systems -Decoupling "data acquisition" from "data utilization/interpretation" - Regional patient routing to the most adapted and available care unit -Hybrid health: clinic/homecare

Once again, technology is here to "mutualize" resources. Like in the cloud, an application does not need every second, high compute, high memory, high disk usage… so when it does not require it, let's have them used by another application. Same here… dependent people do not need physical presence of their home care person/team, but we need to know when they will really need it, and be able to intervene within safe time limits. We cannot invest in human staff for watching over people because it is not scalable, it is not sustainable, and human can fail.

To zero marginal costs, and have a better utilization of resources, it is all about:

o Know when to engage the appropriate resources: technically enabled watch with IoT, geolocalization, smart data, insights with machine learning,

o Standardize your services to limit variability of SKU and manage the whole as a Global Supply Chain with integration at every layer,

The zeroing of marginal costs is mandatory due to demographics and the expected load increase on healthcare providing systems and the shift in the nature of pathologies to address. If we do not achieve this modernization of healthcare services, future generations will have degraded access to these services and us, as future elders will go through hard end of lives.

One country which is badly hit by demographics has pretty much understood this: Japan. Not only did they invest in pervasive digitalization… a hospital distributed Artificial Intelligence (Pharmacy ERP, Electronic Medical Records, Pictures Archiving and Communication Systems…), with mobile devices exhibiting humanized interfaces: Robots! (See appendix 6).

The digital transformation revolution of Healthcare Services must be coming. Get prepared to be disrupted and dematerialized either ways: transformation or degradation.