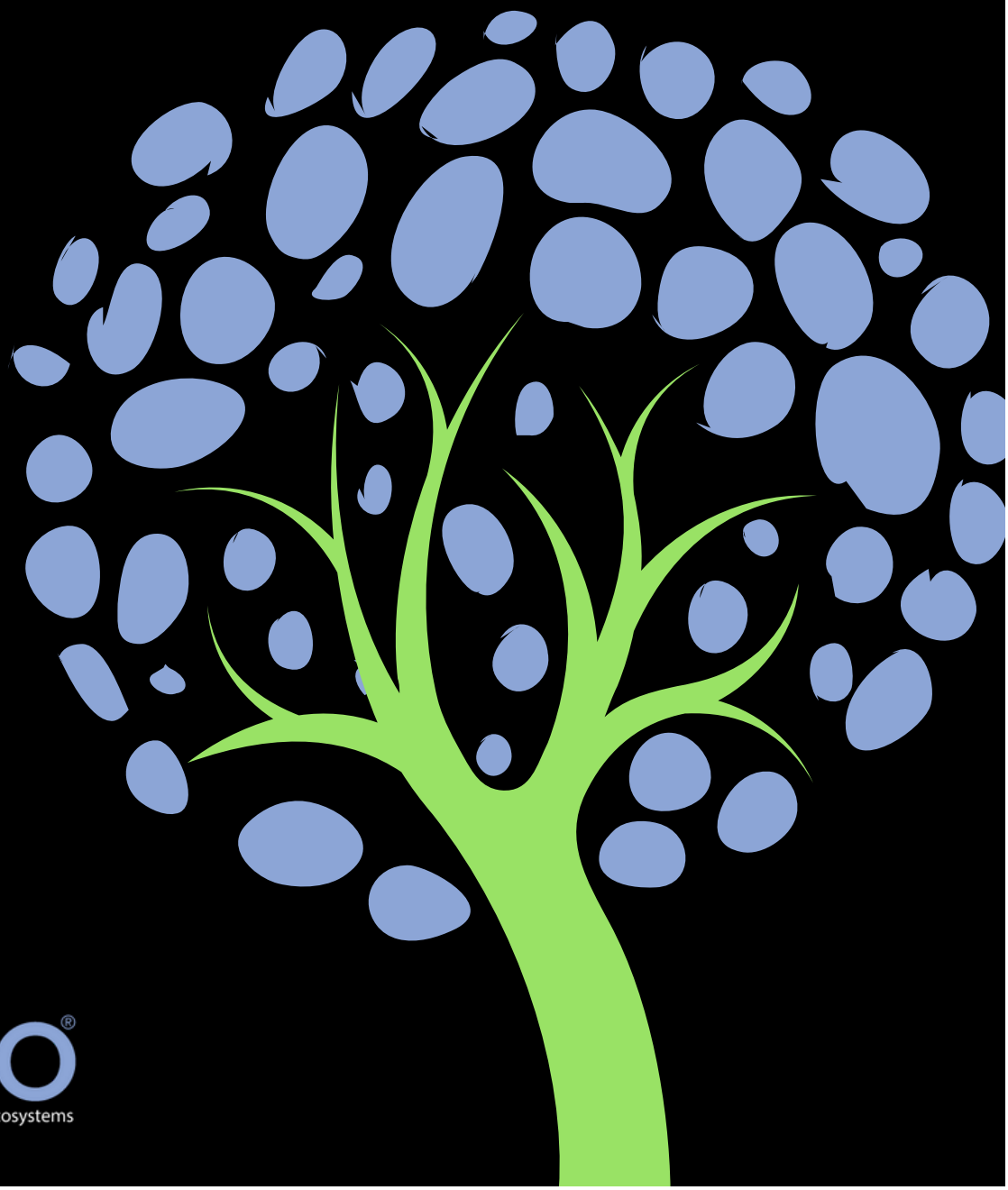
Design and Transform Value in Health

A Service Ecosystem Framework

by Chris Lawer



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Value Design in Service Ecosystems

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Summary

In this paper, I explain how a commonly used but often misapplied metaphor for health systems – ecosystems – can be applied more deeply and appropriately to better understand complex health system problems, find novel possibilities and opportunities, and design better strategies, interventions and solutions to address them.

Specifically, the paper describes how a deeper understanding and application of *ecological, natural ecosystem concepts* can help health designers, innovators and organisations to:

- Improve their understanding of complex health system problems, their root causes and consequences
- Explore wider, adjacent spaces of possibility outside of traditional contexts of problem search and design
- Identify a portfolio of opportunities and value propositions, prior to investment or commitment in actual solutions
- Co-create superior ecosystem interventions, technologies and solutions (of any kind) with actors, and improve the potential of existing ones in development
- Build capabilities and lead more adaptive, creative organisations that do all the above repeatedly

The paper introduces a *Health Value Design®* framework, consisting of four integrated components. Using a service ecosystem perspective, the framework supports organisations and designers to:

- *Frame* individual health service ecosystems and complex problems for enquiry purposes
- *Understand* how health ecosystems function in order to analyse their parts and discover hidden problem patterns and opportunities
- *Determine* the structure of health ecosystems in order to see their complexity and diversity, and identify and foresee trends in their evolution
- *Learn* how health ecosystems adapt and evolve and use this insight to design value propositions, ecosystem strategy, interventions, plans, products and technologies that have a better chance to succeed.

Who is this paper intended for?

This paper is intended for designers, educators, innovators, managers and policymakers in industry (whether pharmaceutical, biotech, medical device, health IT or a services company), provider, academic, government and social innovation organisations seeking to find novel means to address complex health system problems, overcome risks and uncertainty, and improve outcomes with novel interventions, technologies and solutions.

Now more than ever before, organisations need advanced capabilities for understanding complex problems, finding improvement or transformational opportunities, designing compelling value propositions, developing ecosystem strategy and creating valued social, product, technology and service solutions. If you wish to successfully design and deliver superior value and innovate outcomes in your ecosystem, then this paper is for you.

About Umio

Umio helps pharmaceutical, medical device, IT, care provider, social innovation and government organisations to design value and transform outcomes in their therapeutic area, health market or social context.

Introduction

Most healthcare systems continue to suffer from poor outcomes, growing costs and high patient burden. With increasingly scarce resources, the sustainability of the structures, institutions and practices created to prevent and treat illness is under mounting threat from multiple pressures and numerous complex and persistent system problems.

They are all too familiar and easy to recall: Rising incidence of chronic, lifestyle conditions and diseases; an increasingly vulnerable very elderly population; high levels of unnecessary care and the related over-prescribing of medicines, sometimes leading to addiction or drug resistance; inequalities in patient access and the quality of care; enduring risk of infection and sickness in hospitals; a lack of preventive focus on the social determinants and risk factors of disease; mismatched provider incentives and payment systems together with misaligned pharmaceutical and industry practices and pricing, and too many cases of avoidable patient harm, amongst many others. Despite ongoing improvement and intervention efforts, and high rates of treatment and technology innovation, there remains a great struggle to improve health outcomes significantly, widely and at scale. Frustration continues to build whilst underlying problem root causes become more hidden from view and more distant from action.

The challenge of complex health system problems

Complex health system problems have several root causes that are typically hard to identify and difficult to separate from their effects. This means that attempts to address one cause can sometimes worsen another; they simply push it onto another stakeholder or into a different part of the system. Similarly, like squeezing one end of a balloon, cost savings made in one care setting or disease area can lead to bigger cost increases elsewhere. Often, problem owners and stakeholders disagree over the nature or even existence of a problem; they assign different meaning and interpretation, they give them varying priorities, and they experience conflict over how to address them. Intervening to improve or more boldly, transform complex health system problems is a challenge itself, with high failure rates. Typical causes include limited problem understanding, a lack of system-wide vision, an absence of common language, entrenched behaviour and assumptions, and misaligned innovation, strategy and change management plans and action.

In the last decade, greater onus has been placed on technology, especially digital technologies, as the panacea that will drive transformation and cure complex health system problems. Yet to date, such technologies have experienced only slow adoption and have not been deployed at scale. Great effort is required to gain the commitment of patients, clinicians, regulators and payers to use or approve them. Despite more upfront collaboration with stakeholders, it seems that resistance rather than acceptance is the norm upon implementation. Too often, health technologists and entrepreneurs are learning the painful lesson that complex health problems cannot be addressed through forces of push and technology alone.

Design thinking and systems

When making interventions in complex health systems, it is necessary to identify, engage with and satisfy the needs of multiple stakeholders. A health designer seeking to create new value must understand how complex systems adapt and evolve in response to the direct and indirect interactions of all stakeholders, the different goals they have, the diversity of resources they use, the outcomes they prioritise and often, the widely different (and sometimes in conflict) values they possess. Learning about a problem from only one or two stakeholder groups risks leaving important gaps in understanding, leading to the design of partial interventions and piecemeal solutions based on incomplete evidence. Rather like the parable of the learned blind men touching an elephant, focusing on just one part of a complex system problem only ever produces limited insight (especially if you are at the tail end). Such a narrow perspective is one of the main reasons why technologies and solutions fail to become adopted, or do not achieve the hoped-for scale of implementation.

In recent years, the emergence of solution-, product- and experience-oriented design thinking as the dominant problem-solving approach adopted by companies and taught in business schools, has struggled to deploy an appropriate systems perspective. It has a tendency to frame complex system problems too narrowly in exactly the way I describe above. With only a subset of problem insight, it then launches too quickly into a solution generation mode with just a handful of core stakeholders. From a complex systems viewpoint, this form of design thinking suffers from what I call the *5S Syndrome*. It has a tendency to address *symptoms* over causes; within narrow *silos* over systems; aimed at the *superficial* over scale; the *short-term* over sustainability and at its core, with a preference for leaping into *solution* mode over first acquiring deep objective, multi-stakeholder and wide context problem understanding. Whilst prototyping and iterating ideas, improving the patient experience and redesigning processes within a frame of current health system structures, pathways, journeys and institutions can deliver some impact, the current paradigm of design thinking lacks scale and wide perspective, and involves high risk. More fundamentally, it is simply not always possible to *learn by doing* in a design-like way due to safety, regulatory and ethical restrictions when prototyping with patients.

What can be done?

How can health designers enjoy more effective and sustained impact when seeking to address complex health system problems? How can they adopt a more strategic mindset to design multi-stakeholder interventions? How can they widen their frame of problem search to look into new adjacent spaces, contexts and possibilities beyond the status quo? What does value even mean from a systems perspective, and how should it be designed and delivered; is it enough to think in terms of technology, products and experiences alone? Can design thinking approaches rely solely on interpretive, divergent thinking? Or is there a need for them to embrace analytical methods too, and find an appropriate blend of right and left-brain process? Most of all, how is it possible to build and deploy an advanced systemic design capability, one that delivers much greater potential to address complex health system problems and in doing so, not only improves but also transforms outcomes for patients, clinicians, payers, government, industry and society overall?

Objectives and structure

In this paper, I explain how a commonly used but often misapplied metaphor for health systems – ecosystems – can be applied more deeply and appropriately to better understand complex health system problems, find novel possibilities and opportunities, and design better strategies, interventions and solutions to address them. Specifically, I will explain how understanding and applying *ecological, natural ecosystem concepts* can help us to:

- Improve our understanding of complex health system problems, their root causes and consequences
- Explore wider, adjacent spaces of possibility outside of traditional contexts of problem search and design
- Identify a portfolio of opportunities and value propositions, prior to investment or commitment in actual solutions
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My goal is not to survey and explain health system problems in any great detail (these are covered well elsewhere) but rather, to define a (eco-) systems design framework to do all the above. I call this framework, *Health Value Design*. It is formed of four components that I introduce individually after first describing some core concepts from ecology and natural ecosystems. Then I present the complete framework along with examples of its application and output before concluding with an explanation of the principles used to oversee its deployment.

A note on terminology

Before I proceed, I wish to explain two important pieces of terminology that I use in the paper.

Health

When using the term *health* in an ecosystem context, I am not limiting the discussion to just clinical care ecosystems, but also social care, public health and wellbeing ecosystems. Using "health" in this wide-angle context provides a broader canvas on which to design value (in the paper, I explain how it is possible and necessary to go even broader). Here is a short definition of each of these "meta-health" ecosystems:

- Wellbeing ecosystem – The overall ecosystem for improving or maintaining good mind and bodily health
- Public health ecosystem – The total ecosystem for disease prevention and monitoring, and the promotion and education of good health
- Social care ecosystem – The complete ecosystem relating to the provision of care and support services for vulnerable children and adults at risk, people with addictions or mental health problems, and to help people live more independent lives
- Clinical care ecosystem – The entire ecosystem for the provision of clinical health services, disease-condition screening, diagnosis, treatment and monitoring usually for individuals and their families

Health Designer

I use the term *health designer* to denote any individual or organisation seeking to address complex problems, design value and create value propositions and interventions within health ecosystems. They may be working in the ecosystem directly already such as clinicians, nurses, managers, payers or care providers; influencing the ecosystem such as government, regulators or other overseer bodies including professional associations; industry players from any sector, whether pharmaceutical, biotech, medical device, health IT or service provision, or a non-traditional new entrant such as a consumer electronics or telecommunications company. Finally, health seekers and patients making their own adaptations or working together in groups to develop ideas and make improvements are health designers too. In fact, in many respects, we are all health designers!

So to begin, I provide a primer on core natural ecosystem concepts.

A primer on core natural ecosystem concepts

Over a century old, the ecosystem concept is central to the science of ecology, or the study of interactions within and between species, and with their environment. In this section, I describe four core natural ecosystem concepts, each of which informs one core component or building block of the Health Value Design framework. Each concept addresses one of the following questions from an ecological point of view:

1. Identification: How do ecologists distinguish individual ecosystems for enquiry purposes?
2. Functioning: How do natural ecosystems function?
3. Structure: How are natural ecosystems structured internally?
4. Adaptation: How do natural ecosystems adapt, sustain and evolve?

Next, I discuss each of the concepts in turn.

1. Identification: How do ecologists distinguish individual ecosystems?

To identify individual natural ecosystems for study purposes, ecologists use just two variables. These are:

1) A *primary producer species* that converts abiotic environmental energy resources (light, water, heat, soil, radiation and others) into food resources through photosynthesis. Most primary producers are either plants, algae or certain water-based invertebrates and, second
2) The *type of environment* that itself determines the amount and nature of energy resources available to the primary producer species.

Using permutations of these two variables, ecologists are able to classify distinct ecosystems that exist in multiple separate locations, each of which is bounded by the shared flow of energy and food resources, starting with the primary producer. For example, the European environmental agency EUNIS distinguishes over 60 different terrestrial and marine natural ecosystems on the continent such as coastal dunes and sandy shores, tundra and coniferous woodland ecosystems.

FIGURE 1: The Daintree River drains agricultural land in Australia's Atherton and Evelyn Tablelands before entering the Great Barrier Reef between Cooktown and Cairns (Photo by Yann Arthus-Bertrand, courtesy Earth From Above/UNESCO).

Ecologists recognise that every natural ecosystem (defined using the two variables) is adjacent and connected to other natural ecosystems. When studying an individual ecosystem, ecologists look into these adjacent ecosystems to identify risk and examine factors that may be affecting the flow of energy resources. For example, the Great Barrier Reef (the world's largest coral reef ecosystem) is connected to fourteen adjacent ecosystems. These include adjacent estuaries, lagoons and open water ecosystems and also those on mainland Queensland itself, such as heath and shrublands, forest plains, river valleys and coniferous woodlands. When trying to understand the decline of the famous coral reef (sadly, 2016 was one of the worst years on record[1]), ecologists have concluded that not only are rising sea temperatures to blame, but

[1] In 2016, the Great Barrier Reef experienced its worst bleaching event in recorded history, with 93% of individual reefs affected and 22% of all the coral dying.

also factors arising in adjacent ecosystems. In particular, they have discovered that intensive cattle farming in river gullies in Queensland is causing excess sediment to run-off into the reef waters. These soil deposits are blocking sunlight, smothering marine organisms, affecting essential algae and reducing coral and sea grass growth. With the problem identified, there are now several collaborative innovation efforts underway involving farmers and multiple agencies to minimize cattle grazing damage, control erosion and prevent the run-off.

Next, I describe the second concept, concerning how natural ecosystems function.

2. Functioning: How do natural ecosystems function?

To survive and reproduce, species in natural ecosystems not only compete within their own population, and with other species, but also interact in mutual symbiotic relationships. In these, they share, interact with, integrate and use each other's resources, in effect co-creating their collective ability to survive and reproduce. When in balance with their environment, these dynamic interactions sustain the ecosystem. Figure 2 provides an idealized view of these forms of species interactions.

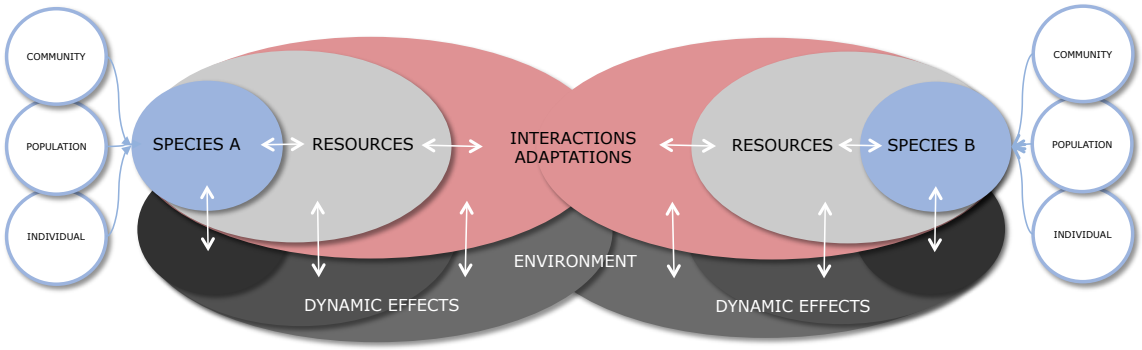

FIGURE 2 – Simplified dynamics of resource-sharing interactions and dynamic effects in natural ecosystems

Often, resource-sharing interactions occur in what ecologists call, functional service groups. These consist of multiple species sharing resources and provisioning services to other species irrespective of their taxonomic affiliation. From these functional service interactions, with some exceptions, all species involved benefit. For example, in the Great Barrier Reef, ecologists identify 14 fish and 11 coral reef functional groups performing different services, most of which make a positive contribution to overall ecosystem resilience and sustainability. Seen as vital to ecosystem recovery after an environmental or human-created crisis, functional service groups have become an important area of ecological enquiry in recent times. I describe specific examples of functional groups and resource sharing when I discuss the third concept below.

Whether within a single species population, within functional service groups or the whole community of many different species, individual ecosystems function, variously sustain and adapt through dynamic processes of resource sharing and interaction. Indeed, ecologists characterize ecosystems as *service systems of multiple species interacting with each other and the resources supplied by their environment.* The same is true of health ecosystems, or more correctly *health service ecosystems*. Multiple health actors share and integrate their own and others' resources to perform and obtain health services, as I explore further later.

Next, I describe the third ecological concept of value to how we think about complex health system problems. This concerns how natural ecosystems are structured internally.

3. Structure: How are natural ecosystems structured internally?

As well as identifying and classifying individual (and adjacent) ecosystems, ecologists have discerned their internal structure in the form of a hierarchy of species and interactions. Using such a hierarchy, they are able to identify key ecosystem processes and services, study patterns of emergent, adaptive behaviour, and

determine the species that play the most important roles in maintaining ecosystem wellbeing and resilience (known as "keystone species").

There are eight levels in a natural ecosystem hierarchy (Figure 3) with each higher level consisting of a greater number and diversity of species and interactions. Using the Great Barrier Reef ecosystem as an example, I shall now describe each of the eight levels in the hierarchy. There are a lot of fish mentioned in this section, but their interactions are not only fascinating but also useful for how we think about health systems[2].

Level 1: Inside an individual species

At the lowest level of the hierarchy are the molecular, genetic, protein, cellular, brain (or nerve only in some brainless species) and tissue interactions that distinguish one species from another. These allow ecologists to identify unique species and classify them into taxonomic affiliations. For example, 1400 different *coral reef species* have been recorded on the Great Barrier Reef, of every shape and colour variety imaginable, and there are an estimated 95 different species of large teeth-bearing *parrotfish (a keystone species)* that feed off algae and dead coral, and which are preyed upon by other bigger fishes.

Level 2: An individual species

At level 2 are the interactions undertaken by an individual species with their own resources and their environment, such as a female *loggerhead sea turtle* using its magneto-reception sensing capabilities to locate and return to the beach on which it was born to lay her eggs. All species have some form of sensing capability to detect risks and danger, and adapt when faced with threats to their survival; not all are as sophisticated as being able to return to a breeding ground thousands of miles away, yet all have evolved and been fine-tuned through multiple adaptations over millions of years.

Level 3: Within a population

Level 3 in the hierarchy defines the interactions that occur within the same population of species. They can be between co-operating organisms of the same species such as a school of *bumphead parrotfish* heading out in the morning to search for algae in live coral, bumping it with their square heads, breaking it off, chewing it and then emitting the fine grains to form the white beach sand we like to lie on, or dream of, on tropical beaches. Often too of course, members of a species compete with one another, vying for food resources (such as highly territorial white tip sharks protecting their space from other white tips) or a mate (male loggerheads expend all their energy competing and do not care to return to the breeding ground).

Level 4: Between populations of two species

Level 4 of the hierarchy consists of more complex interactions between two different populations of species. These occur in four different varieties[3]:

1. **Competition** where separate species compete for resources (for example, *sea sponge* species compete fiercely with each other for space using toxic chemical warfare. Those with the most deadly toxins, which have evolved over millions of years, have the best ability to survive).
2. **Predation** where one species preys on the other (on the coral reef, lemon sharks like to eat particularly colorful *parrotfish* and *tiger sharks* prey on vulnerable, slow-moving *sea turtles* heading for their nesting site).
3. **Mutualism** where two species both benefit by interacting with each other such as between symbiotic algae and coral, whose relationship is essential to the wellbeing of the entire coral reef ecosystem.

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[2] I am hoping you never look at your tropical fish collection in the same way again.

[3] For more on the different types of interactions in coral reef, read here http://marinebio.org/oceans/symbionts-parasites/

The algae (a primary producer species) live within the tissue of coral and facilitate the conversion of dissolved calcium into the calcium carbonate that forms it. The algae create an alkaline environment in which calcium carbonate deposition proceeds easily. Also, they provide a very significant portion of a coral's energy requirements. In turn the coral provide a stable environment in which the algae can live and grow as well as a constant source of carbon dioxide that is required for photosynthesis. The recent "bleaching" of coral on the Great Barrier Reef has arisen due to the algae becoming intolerant to rising sea temperatures and the cattle eroded sediment run-off, throwing the whole ecosystem out of balance.

4. **Commensalism** where just one species benefits from interacting with another, such as a *clownfish* enjoying the protection of living in the stinging tentacles of *sea anemones*.

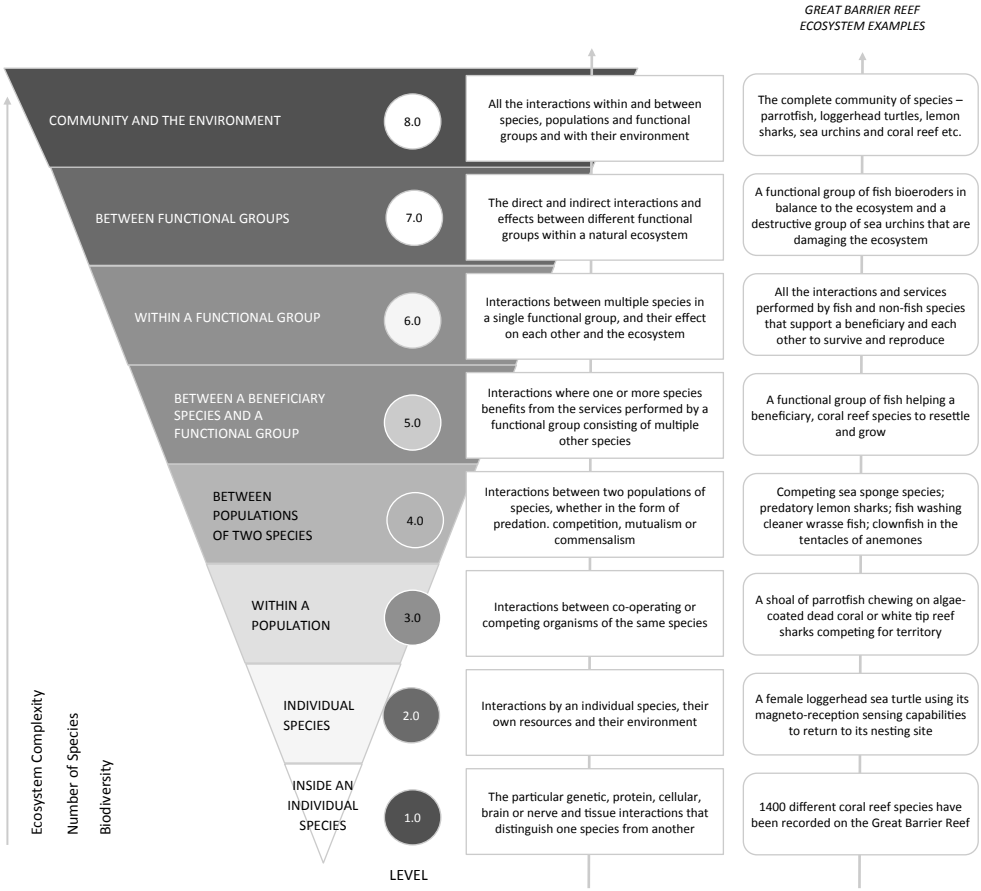


FIGURE 3 – The hierarchy of species and interactions in natural ecosystems

Level 5: Between a beneficiary species and a functional group

At level 5 of the hierarchy are interactions where one or more species benefits from the services performed by a functional group consisting of multiple other species. For example, a functional group of *surgeonfish, angelfish*es and *rabbit fishes* feed on a particular form of algae build-up that can restrict the growth of coral. By removing it, they help the coral (the beneficiary) to establish and flourish. Ecologists identify and distinguish individual functional groups by the service they perform. In this example, the functional group is called "grazers" because they graze on the algae[4]. Another functional group, consisting of multiple species of parrotfish that are more destructive, gnashing at and sometimes damaging live as well as dead coral, are

[4] Unlike the cattle grazing in Queensland, they have a positive effect on ecosystem wellbeing.

called "excavators". Other functional groups at work on the coral include scrapers and cleaners. The latter are fish who clean other fish on the edge of the reef, removing parasites and detritus to make their customers healthier and who benefit themselves from eating the unwanted material.

Level 6: Within a functional group

At this level of the ecosystem hierarchy, interactions are becoming more and more complex and less well understood. Here, ecologists are seeking to study the interactions that occur *between species* in a single functional group performing a service, as well as how changes in these interactions impact other species. In particular, they are keen to understand the impact of a loss of functional group diversity on their service performance and ecosystem effects. To date, this is an underserved area of ecological enquiry but nevertheless its importance is one that health designers should heed. They too must consider the role of functional group diversity in overcoming dominant logic, status quo thinking and the effect of routine practices on outcomes within health service ecosystems.

Level 7: Between functional groups

Getting near the top, level 7 are the interactions between more than one functional group performing different services within a natural ecosystem. Here, ecologists are concerned with understanding the dynamic effects, which may be positive or negative, of the services of individual functional groups on each other, and on the ecosystem as a whole. Some functional groups are co-creative such as the different fish groups that graze excess algae from the coral described at level 5; whereas others are more destructive, such as sea urchin groups that burrow beneath live coral on the reef and dislodge it. When existing in high densities, they can remove large sections of coral leading to a more fragile environment that other functional groups are unable to recover. In a health service ecosystem context, level 5 of the hierarchy guides us to think about the nature and effect of interactions between functional groups or teams, how they collaborate, the degree they are integrated and how the status of their relationship supports or hinders health outcomes. I shall discuss in greater detail later of course.

Level 8: A community and the environment

Finally, at the highest, most complex level of the hierarchy are the interactions within the entire community of all species in the ecosystem, and with their environment. Although complex, using the hierarchical structure, and rather like a scuba diver on the Great Barrier Reef, it becomes possible to dive down from level 8 into the ecosystem to locate specific risk factors and causes of ecosystem decline, reveal important functional service groups, and detect the effects of a loss of diversity on ecosystem resilience. Level 8 offers a whole ecosystem view. It helps ecologists to locate and study critical resource and service interactions within and between species in individual and adjacent ecosystems. With this insight, they can then design strategies for intervention, adaptation, conservation and management. Such strategies are underpinned by the fourth and final core natural ecosystem concept, which I now describe.

4. Adaptation: How do natural ecosystems adapt, sustain and evolve?

Natural ecosystems are in a permanent state of flowing or flux. At any given time, their wellbeing depends on the balance between the amount of needed environmental (energy) resources, the health of the primary producer species, and the diversity of species, populations and functional groups that provision and share services. When the primary producer species is diminished (such as the algae on the reef), then the ability of an ecosystem to recover depends on the diversity, adaptability and functional performance of other species. The more adaptable and diverse the species in an ecosystem, then the greater is its resilience to environmental crisis and perturbations and the higher is the chance of its sustainability.

In a natural ecosystem, species vary in their ability to adapt to changing environmental resources, and to variations in the resources and adaptations of other species. Furthermore, not all organisms within a species adapt equally, have equal capabilities or exhibit the same behaviour; diversity exists within any single

species as well as between them. This dynamic interplay between species, resources, (bio) diversity and adaptive capacity forms a central concept for analysing and understanding the sustainability and wellbeing of health systems, a point I shall return to later.

Summary: The natural ecosystem concepts applied

Above, I have described four core concepts in ecological thinking. To summarise, natural ecosystems:

1. Are classifiable and distinct, and also adjacent and connected to other ecosystems, where problem root causes may sometimes arise
2. Consist of populations and functional groups of species engaged in multiple types of resource interaction, with the services performed by functional groups being especially important in maintaining ecosystem wellbeing
3. Have an internal hierarchical structure made up of different configurations of intra-and inter-species resource-interactions; a structure that is useful to break down ecological enquiry and understand patterns and relationships
4. Evolve through ongoing resource variation, selection and adaptation, and display varying levels of resilience and sustainability driven by diversity

When applied to health systems, the four concepts together provide health designers with a fuller and more appropriate perspective for identifying root causes, interpreting complex health problems, framing new possibilities, designing strategy and interventions, building novel propositions and transforming value and outcomes. In Table One, I summarise the many applications of the four concepts when applied in a health service ecosystem context.

In the next four sections of the document, I explore each of these applied concepts in turn. Each informs one of the key components of the Health Value Design framework that I present later in the document. To demonstrate that I have not gone crazy snorkeling, briefly these components and associated questions are as follows:

Component One - Definition

How can we define and frame individual health service ecosystems for enquiry purposes? First, I describe how to identify and frame individual health service ecosystems for making enquiries into complex health ecosystem problems.

Component Two - Functioning

What constituent functional elements of health service ecosystems are there, and how can they be used for their analysis? Second, I explore the dynamic functioning of health service ecosystems and introduce a model of their constituent elements for analysis and co-enquiry with ecosystem participants.

Component Three - Structure

How are health service ecosystems structured internally? Third, I define a universal internal structure of health service ecosystems. This helps us to identify and map the main configurations of actors, resources and interactions in a health ecosystem. It provides a template for "seeing" ecosystem complexity and identifying and foreseeing trends in their evolution.

Component Four - Adaptation

How do health service ecosystems adapt and evolve through value propositions? Fourth and finally, I describe how health service ecosystems adapt and evolve in response to value propositions. I identify a model of value evolution consisting of seven classes of value proposition, and explain how this can be used to design ecosystem strategy, interventions, plans, products and technologies that have a better chance to succeed.

TABLE ONE – The four natural ecosystem concepts applied to health service ecosystems

CONCEPT	HEALTH SERVICE ECOSYSTEM APPLICATIONS AND BENEFITS
IDENTIFICATION *How to define individual health service ecosystems for enquiry purposes*	• Define health ecosystems as individual, connected service systems of multiple actors producing, sharing and integrating resources in efforts to improve outcomes • Organise problem enquiry using a natural orientation aligned towards the primary beneficiaries of ecosystem services – patients, their families, health consumers and seekers. • Identify and distinguish individual health ecosystems to frame more holistic, systemic complex health problem enquiry, leading to better understanding and interventions • Look wide into adjacent social and other service ecosystems (e.g., education, housing, transport, energy, communications) for more divergent problem understanding and enhanced discovery of root causes, risk factors and opportunities • Define families of individual health ecosystems and look for novel opportunities for improving their integration and/or transformation • Avoid falling into the trap of misusing solutions, existing silos or structures and ideas before fully learning the problem space
FUNCTIONING *How health service ecosystems function and the analysis of their constituent elements*	• Understand how health service ecosystems function to co-create (and sometimes co-destruct) outcomes • Determine the individual functional elements of health ecosystems and use these as primary units of analysis for studying complex health system problems, and revealing gaps, patterns and opportunities for improvement and transformation • Learn the priority outcomes of actors and how they differ, and link them to an understanding of actors, resources, interactions, contexts and values • Discover the reasons for outcome underperformance and use this insight to be more targeted and selective when choosing opportunities and developing value propositions • Find hidden segments of actors and match segments to define groups of similar actors for designing value propositions • Learn how values differ and their role in influencing service performance and outcomes
STRUCTURE *How health service ecosystems are structured internally*	• Determine the universal internal structure of health service ecosystems • Map pathways and linkages between practices in an ecosystem, and see where there gaps and integration or process improvement opportunities • See the entire ecosystem more clearly and design ecosystem-wide strategy • Define value at an ecosystem level including value-based pricing • Map the diversity of practices within ecosystems and compare them across different health systems • Discern patterns of evolution and trends and align with them to accelerate adoption of a new technology or other intervention
ADAPTATION *How health service ecosystems adapt and evolve through value propositions*	• Learn how to assess the overall adaptive capacity or sustainability of ecosystems for designing smarter, more appropriate and more valued interventions • Build a portfolio of value propositions that align with the dynamics of ecosystem adaptation and evolution • Design a future oriented evolutionary strategy for long-term success and do so without becoming locked in to one type of solution or technology

Component One: How to define individual health service ecosystems for enquiry purposes

The first component of the Health Value Design framework helps to define individual health service ecosystems in order to frame enquiry and analysis into complex health problems. Drawing on the natural ecosystem concepts described above, I define a health service ecosystem as *an open system of multiple actors interacting with resources to provision and obtain services for a particular health context.*

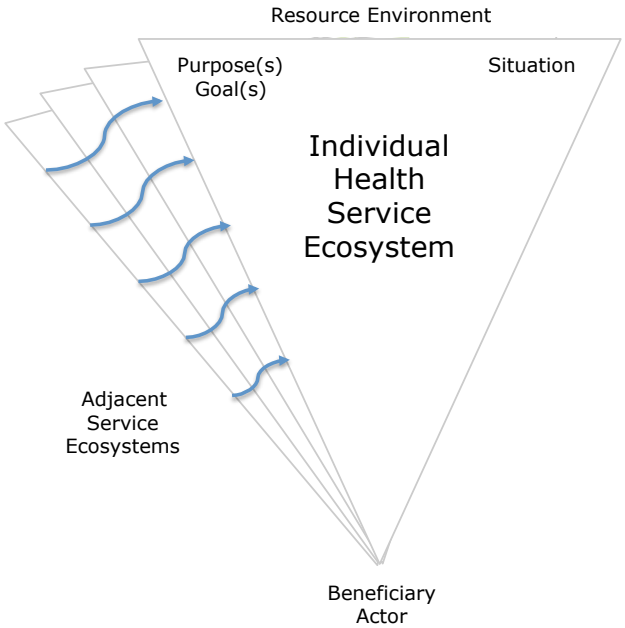


FIGURE 4 – Using combinations of context to define and distinguish individual health service ecosystems

To distinguish an individual health service ecosystem, as the above definition implies, we must use **context**. Context is important because we can only really begin to understand human behaviour and actions within the specific practical, applied contexts in which they occur. I identify four types of context that can be combined to provide a basis for developing this understanding. Next I describe these. They are shown in Figure 4 above and Table Two below lists further examples of each.

TABLE TWO – Further examples of each type of context

RESOURCE ENVIRONMENT	PURPOSE / GOAL		SITUATION / TIME	BENEFICIARY ACTOR
Low-Middle-High Income Western / non-Western Acute Care Community Care Family Ambulatory / outpatient Emergency Remote / Virtual Technology type / class	Identify Educate Assess Plan Prevent Screen Remove Protect Administer	Diagnose Treat Manage Monitor Recover Recycle Clean Detect Improve	Supra-national Country Region City / Town Community Institution Type Home Season Time of Day / Week Outdoor / Indoor	A patient defined by any disease area Trauma type Health risk Genetic risk Other risks Vulnerable group A population group by age Gender Ethnic group

Using contexts to identify individual health service ecosystems

The Resource Environment

The context of resource environment is the economic, regulatory, political and social-cultural environment in which a health service ecosystem is situated. This determines the amount and type of resources (or energy) available to different actors in the service ecosystem and range and quality of services available. A resource environment defines and bounds the context of services provided. For example, an acute care environment organizes resources to provide services aimed at sick patients. A community care environment does so to deliver more preventive and generalist health services.

It is possible to choose a particular or combination of resource environment contexts to frame an ecosystem. For example, an economic context would be to use a high-, middle- or low-income country context to define an ecosystem in tandem with the other contexts. Also, an ecosystem might be framed around a technological class or type such as drug or device or digital application, although care must be heeded when doing so, as I explain below.

Purpose or Goal

A purpose or goal context describes the individual or multiple functions or objectives for which health services are required, provided or obtained in a particular health ecosystem. It is defined by the disease and wellness priorities of individuals and organisations, which are influenced by the resource environment. Common purposes include prevention, screening, diagnosis, treatment or management of disease or condition. Multiple purposes may be combined when framing a health ecosystem for study; it just depends on what makes sense in the context of the problem under consideration.

Situation and Time

A spatial and optionally a temporal context can be added to purpose along with the resource environment to narrow the framing of an ecosystem enquiry. These contexts define the space, place or time where services are performed in the ecosystem, such as a nation, region, community, town, setting or space within a setting, such as a hospital ward, an emergency room or a GP/PCP waiting area.

The Beneficiary Actor

The fourth type of context is the most critical and should be used in all ecosystem-framing definitions. Ultimately, all service ecosystems function to deliver services to support a beneficiary actor, whether a patient, health consumer or health seeking population. A beneficiary actor is akin to the primary producer species in a natural ecosystem. They are the reason the ecosystem exists. When ecosystem resources are out of balance, then the primary producer suffers; they are starved of needed resources and the ecosystem declines in wellbeing. Functional service groups exist to maintain the wellbeing of the primary producer (the coral and the algae in our reef example).

A beneficiary actor is defined using health, disease, illness type, therapeutic area or a population cohort linked to the purpose of the service provision. Examples of cohorts are vulnerable elderly or adults, pediatrics, addicted persons, neonates, or new mothers. It is best practice to define an ecosystem from the perspective of a beneficiary actor (which is why it is shown at the base of the model in Figure 4).

In Table Three below, I list example health service ecosystem frames and their contexts from past Umio programmes.

The importance of looking into adjacencies

When making enquiries into an individual health service ecosystem (just like ecologists do when researching the causal factors of decline of the Great Barrier Reef), it is important to be aware of the influence of adjacent

service ecosystems on actors, resources, interactions and outcomes in the health ecosystem of interest. This is especially important because the beneficiary actor in a health services ecosystem also interacts (and exists) in adjacent social ecosystems.

TABLE THREE – Example health service ecosystem frames and contexts (from past Umio programmes)

BENEFICIARY ACTOR	PURPOSE / GOAL	SITUATION / TIME	RESOURCE ENVIRONMENT
Obese Persons with Diabetes	Lose and Maintain Weight	Everyday Living Context	High-Income / Western Society Behavioural Solutions
Persons at Risk of Diabetic Foot Ulcer	Prevent, Diagnose, Treat a Diabetic Foot Ulcer	Home and Community	High-Income and Low-Income Country
Surgical Patients	Prevent / Reduce Infection Risk and Complications	Peri-Operative Surgical Environment	Hospital and Field Surgery Barrier Technologies
Neonates and Parents	Prevent / Reduce Neonatal Complications	Neonatal Specialist Care Facilities	High-Income Reducing Neonatal Resources
Frail Elderly Persons	Have Dignity and Freedom from Incontinence Issues	Nursing Home / Ling-Term Care Institutions	Public and Private Long-Term Institutional Care
Persons with a Chronic Long-Term Condition	Enjoy Greater Self-Sufficiency and Independence	Home Environment / Everyday Living Context	High-Income / Western Society Self-Medication Solutions
Persons with a Chronic Wound	Heal a Wound	None	High-Income Countries Changes in Wound Care Resourcing Advanced Wound Care Technologies

It is argued and there is much evidence to suggest that the majority of the causal factors of poor health and disease arise from people's living and working conditions in their community rather than from individual genetic, risk factors. These factors - the social determinants of ill health[5] - include low income, poor educational attainment, race and gender inequality and exclusion, food insecurity, poor sanitation and air quality, the work environment, family relationships and unemployment. Through an ecosystems lens, we can say that the root causes of ill health and disease such as these are found in adjacent *work, housing, transport, education, energy and physical environment* service ecosystems, to name a few. Even though resource deficiency, inequality, limited access and other factors in these adjacent ecosystems can frequently lead to poor health outcomes, they are often neglected, poorly understood or not properly integrated when framing complex health system problems for enquiry, or indeed to find opportunity. Too often, health designers take a narrow healthcare or clinical-only view of complex health problems and their causes. In doing so, they fail to discover adjacent possibilities for improvement by ignoring essential causal factors. For this reason, when making enquiries into a health service ecosystem, it is always best to use a wide-angle lens to look peripherally into adjacent service ecosystems.

A word of caution when using context

When defining service ecosystems, care is necessary when using any type, form or class of health solution or technology, institution, setting type or practice of care as a context. None of the above contexts need incorporate any solution-based definition such as these. This is because when using them, there is a risk of foreshortening problem understanding by setting up too narrow frames of reference based on established ways of thinking, status quo logic, and current normative assumptions about what should be or what works

[5] See for example Marmot, M. and Wilkinson, R.G (1999) *Social Determinants of Health*. Oxford University Press. Oxford

best. This can lead to the creation of solutions and interventions that merely reinforce current structures and systems of health practice, and which fail to make much a dent in complex health problems. They may only address symptoms not causes. For these reasons, my preference is to keep solution and technology context out of ecosystem definitions, although I recognise that from the technology creator or owner viewpoint this is not always practical or desirable. When it is used, it is possible to still capture divergent and objective inputs around the technology that reliably inform us of its fitness and potential value.

Now that we have defined an individual health service ecosystem for problem enquiry, we need to analyse them to be able to discover risk factors, problem causes and patterns and identify opportunities and themes for their improvement. In the next section, I define and explain these analytical elements that form Component Two of the Health Value Design framework.

Health Service Ecosystem Identification - Key Points

- Use the four types of context to define an individual health service ecosystem. These are the resource environment, purpose or goal, situation and beneficiary actor.
- Define an ecosystem as far as possible from the point of view of the beneficiary actor such as the patient or health seeker. They are the focus of service provision.
- An ecosystem without a beneficiary actor is not a service ecosystem
- Look wide of the ecosystem to include adjacent connected service ecosystems in the framing, where risk factors and causes of poor health outcomes are often located
- Avoid narrowing the ecosystem frame by using solutions, care institutions or existing systems or structures to define them. Understanding complex health problems in the context of current or proposed solutions or systems risks biasing the enquiry and missing important learning.

Component Two: How health service ecosystems function and the analysis of their constituent elements

Once we have defined an individual health service ecosystem, we need to know their constituent elements in order to understand how they function (or malfunction), and to be able to analyse them to discover patterns and opportunities. I describe the constituent elements and how they influence each other using the following statement, and depict them in Figure 5. Below, I explain each of the constituent elements starting with actors, with further examples of each shown in Table Four.

Influenced by values, human actors interact with resources and each other when performing services in an effort to co-create outcomes for a health context

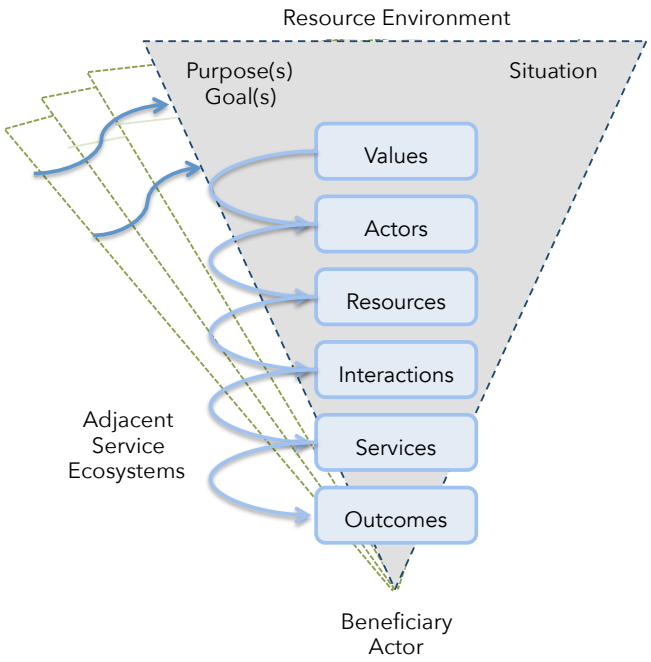


FIGURE 5 - The constituent functioning elements of health service ecosystems

Actors[6]

Actors are the individuals and groups that perform or obtain services in a health service ecosystem. They are either direct participants whether *beneficiary actors* such as patients and their non-professional personal carers, health consumers or health seekers, or *health service providers* such as clinicians, GPs, nurses, carers, support people and managers. Or they may indirectly participate or influence service provision; key opinion leaders, company CEOs, academics, government policy makers, lawyers and charity leaders for example. An actor is simultaneously an individual and belongs to a population, group or organisation such as a patient group, a care organisation, a community practice, a company, a university or a government department. In any health service ecosystem, there is a high diversity of actors with varying health and non-health purposes,

[6] The term actor is preferable to that of stakeholder as it better describes all the different individuals and groups who directly or indirectly participate in and influence outcomes in a health service ecosystem. Not all actors have a "stake" necessarily in outcomes, yet they can influence them. For example, sugary drinks manufacturers are not (yet) stakeholders in a 'prevent child obesity' service ecosystem; but they are influential actors who indirectly shape outcomes through their products and actions (or lack of).

not all of which are in alignment. Nevertheless, diversity and variation can be understood. It is possible to identify the different types of actors in a health service ecosystem, determine their health and non-health goals, segment and profile them, and understand the nature of their relationship and interactions within the defined context of ecosystem interest.

Resources

Resources provide the means or the capability for actors to obtain or perform health ecosystem services. They may be *tangible*, *intangible*, *environmental or financial*. Tangible resources include drugs, devices, data, information and health IT systems. Intangible resources are mind and body resources, including an actor's bodily and sensory function and capability as well as knowledge, cultural, social and spiritual resources. These are important to understand for all actors, not just beneficiaries. Emotions are intangible resources too; positive ones can influence engagement in activities, negative ones the opposite.

Environmental resources include water, air and light (similar to natural ecosystem abiotic components). Of course, important resources are financial ones. When undertaking a problem enquiry into an individual ecosystem, these are also captured and modeled, allowing us to determine total ecosystem costs and define value-based intervention and pricing strategies (see Figure 6 for an example of resource cost breakdown undertaken for an Umio diabetes study [NB: 2009 data]).

US resources by location and practitioner involvement by patient ulcer case type

CS1 Clinically Signed DFUs that develop an infection MILD / HEAL
CS2 Clinically Signed DFUs that develop an infection SEVERE / HEAL
CS3 Clinically Signed DFUs that develop an infection MINOR AMPUTATION
CS4 Clinically Signed DFUs that develop an infection MAJOR AMPUTATION
NCS1 NO Clinically Signed DFUs that develop an infection MILD / HEAL
NCS2 NO Clinically Signed DFUs that develop an infection SEVERE / HEAL
NCS3 NO Clinically Signed DFUs that develop an infection MINOR AMPUTATION
NCS4 NO Clinically Signed DFUs that develop an infection MAJOR AMPUTATION

RESOURCES
Direct costs only included e.g. practitioner costs at hourly rate
Costs based on average process steps timings as advised by practitioners
Practitioner costs based on salary only
Materials cost based on data provided by chief pharmacists & other practitioners
Where costs were patient prices, 50% of price included as cost unless full reimbursed
Mid range cost or conservative low range cost taken
Consistency of unit costs across all scenarios
Consistency of time to perform unit tasks across all scenarios
Treatment time periods consistent across countries and all same scenarios e.g. hospitalisation
Time to resolve periods varied with use of platforms only
Minor amputation costs were assumed at 50% of major amputations

PLATFORM USE ASSUMPTIONS
Platform 1a Infection Detection is easy to use by non specialists predominantly in the community
Platform 1a to be used on non-clinically signed wounds with some use on clinically signed yet uncertain wounds
Platform 3 ATS can be done by primary care GP or community podiatrist as well as acute care specialist practitioners

	Cost $	Cost £	units	CS1 MILD	CS2 SEVERE	CS3 MINOR	CS4 MAJOR	NCS1 MILD	NCS2 SEVERE	NCS3 MINOR	NCS4 MAJOR
Weeks in community				3	2	4	4	5	6	6	6
Pre hospitalisation											
Community Nurse Visits	44	30.70	0.5	3	2	4	4	5	6	6	6
GP appointment	110	76.76	0.75	1	2	2	2	1	2	2	2
Podiatrist appointments	55	38.38	0.75	1	2	2	2	1	2	2	2
Swab	50	34.89	1	1	2	2	2	0	1	1	1
Microbiologist (swab testing)	38	26.52	0.3	1	2	2	2	0	1	1	1
Dressings	10	6.98	1	3	2	4	4	5	6	6	6
Broad spectrum antibiotics (weeks course)	100	69.78	1	1	2	2	2	0	1	1	1
Narrow spectrum oral antibiotics (weeks course)	350	244.24	1	0	0	0	0	0	0	0	0
Weeks in hospital											
Hospitalisation and Recovery			weeks	0	2	5	8	0	2	5	8
Secondary Care Podiatrist (full assessment)	165	115.14	0.33	0	2	3	4	0	2	3	4
Secondary Care Podiatrist (monitor)	165	115.14	0.15	0	14	22	43	0	14	22	43
Consultant sample a wound incl lab & mats	500	348.92	1	0	4	6	8	0	4	6	8
Microbiologist (swab testing) n/a	0	0.00	0.3	0	4	6	8	0	4	6	8
Diabetologist (full assessment)	165	115.14	0.33	0	2	3	4	0	2	3	4
Diabetologist (monitor)	165	115.14	0.15	0	14	35	56	0	14	35	56
Vascular Surgeon (full assessment)	165	115.14	0.33	0	3	5	5	0	3	5	5
X ray	244	170.27	1	0	2	5	5	0	2	5	5
MRI scan	3000	2093.51	1	0	1	1	1	0	1	1	1
Dressings	10	6.98	1	0	14	35	56	0	14	35	56
Broad Spectrum oral antibiotics	100	69.78	1	0	1	1	1	0	1	1	1
Narrow Spectrum IV antibiotics (weeks course)	700	488.48	1	0	1	2	2	0	1	2	2
Narrow Spectrum oral antibiotics (weeks course)	350	244.24	1	0	1	2	3	0	1	2	3
Amputation - minor	15000	10467.53	1	0	0%	1	0	0	0%	1	0
Amputation - major	30000	20935.05	1	0	0	0	1	0	0	0	1
Hospital nurse (monitor)	44	30.70	0.2	0	21	105	168	0	21	105	168
Hospital days	3000	2093.51	1	0	14	35	56	0	14	35	56
Outpatient / Clinical care			weeks	0	4	12	20	0	4	12	20
Repeat outpatient Visits	165	115.14	1	0	2	6	10	0	2	6	10
Community Nurse visits	44	30.70	0.5	0	8	24	40	0	8	24	40
Community Podiatrists	55	38.38	0.5	0	4	12	20	0	4	12	20
Dressings	10	6.98	1	0	8	24	56	0	8	24	40

FIGURE 6
Resource use and cost analysis showing resource inputs, frequencies and measures for eight diabetic foot patient pathway scenarios (Source: Umio study)

As with actors, diversity and complexity arises from the multiple different resources owned, used, available to, and shared by actors in health service ecosystems. It exists within actor groups too. For example, persons with diabetes have a wide range of symptoms and co-morbidities, have varying condition management resources and capabilities and will prioritise different outcomes, if at all. Any one professional group of clinicians will also possess or have access to a wide range of tangible and intangible resources and

capabilities. Nevertheless, despite the wide variation, and just like actors, resources used in health service ecosystems can be identified, profiled and mapped onto an analysis of actor types, their interactions and the pattern of outcomes achieved. Doing so reveals insight into types or segments of actors with resource deficiencies, or gaps in their capability to achieve desired outcomes.

TABLE FOUR – Further examples of each of the ecosystem elements

ELEMENT	EXAMPLES		
ACTORS	Health-seekers, patients, residents, clinicians, nurses, support staff, family members, non-professional caregivers	Patient groups, patient forums, communities. Providers, agencies. Professional bodies, unions.	Insurers and payer / funding bodies, regulators, standards bodies, national and state-local government
RESOURCES	Tangible Drugs, devices, data, information, money or finance, hardware and software, medical supplies, guidelines.	Intangible Knowledge, bodily and sensory capability as well as emotional, social and cultural resources; spiritual resources	Environmental Clean water or air, adequate sanitation, access to care, transport. Financial
INTERACTIONS	Relate Examine Assess Engage Experience	Collaborate Combine Communicate Integrate Negotiate	Learn Propose Decide Receive Comfort
SERVICES	Identify Educate Assess Plan Prevent Screen	Diagnose Treat Monitor Recover Recycle Clean	Remove Protect Administer Detect Finance
CONTEXT	Resource Environment Situation	Purpose Beneficiary Actor Adjacent Contexts	
VALUES	Patient-first Control Safety Risk Relational Cost-First	Efficiency Community Mind Social Family Autonomy	System Outcomes Value Independence

Interactions

Actors **interact** with their own and other actors' resources in health service ecosystems. They do so when creating, obtaining, deciding, preparing, sharing, applying and integrating resources, directly and indirectly when performing or obtaining a service. Multiple resource interactions are undertaken in the performance of a service (see Figure 7 for an example map of a diabetes nurse interacting with resources to diagnose an infection). An actor may interact alone with their bodily, emotional and cognitive intangible resources, a tangible resource such as a drug or device, or interact with other actors, as when a doctor consults with a patient.

Importantly, value is only realised when actors share or integrate their own resources with others' resources. A drug in a medicine cabinet has no intrinsic value until it is taken (although its presence may offer emotional reassurance); a doctor with first-hand and unique experience of treating a rare disease has no value for patients with that disease unless consulted; and a surgeon only derives value from a scalpel when it

used to make an incision. Even when an actor interacts alone with a resource, a drug company or a device manufacturer has co-created value indirectly with a patient taking their drug, or a clinician using their device. In this way, *value is always and only ever co-created* when a resource is applied to do something or is integrated with another resource by the same or another actor. This "do something" is the service, which is the next functioning element in the model.

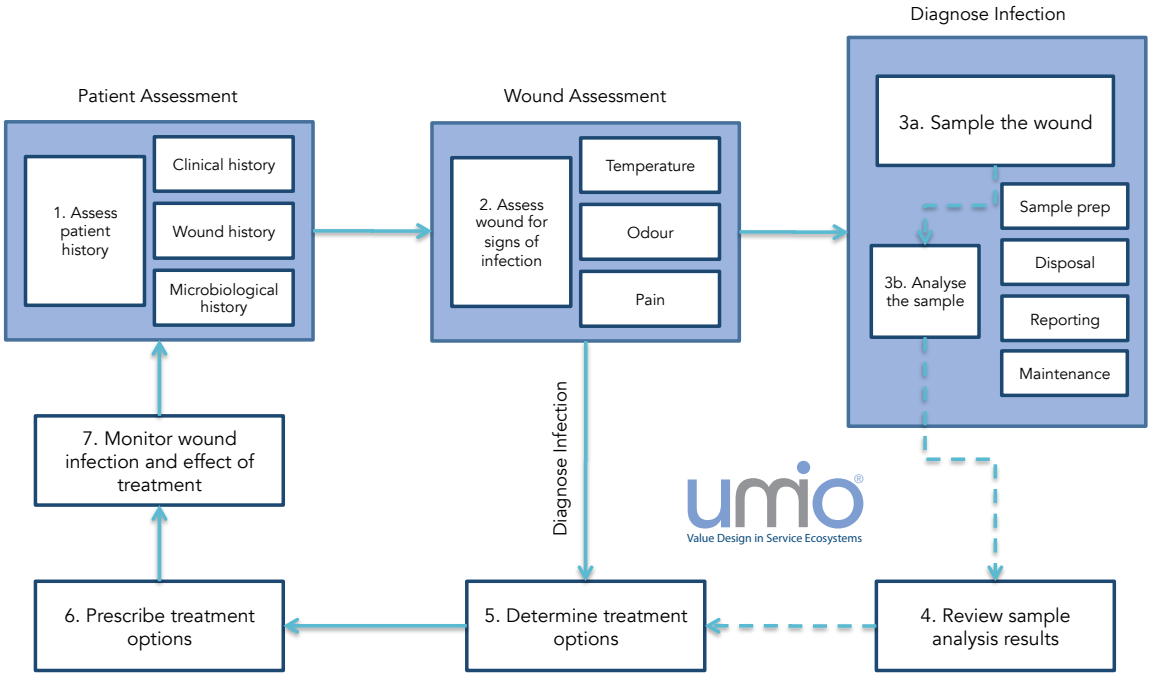


FIGURE 7 – Simplified Interaction Map for a Community Nurse interacting with their own and others' resources when diagnosing a patient infection (the service being provided).

Services

Resource interactions by and between actors in health ecosystems are undertaken to perform or obtain **services** for the defined ecosystem context. As I described when discussing context, service defines the purpose or goal that an actor wishes to achieve or realise. For example:

- When a patient *swallows a painkiller* (interaction with a tangible resource), they are doing so *to alleviate pain* (the service provided by the drug manufacturer)
- When a patient *consults with a doctor* (interaction with a resource), they are doing so to *obtain a diagnosis* (the service provided by the doctor)
- When a nurse assesses a patient (interacting with their own intangible knowledge resource, in this case their clinical judgment) they are doing so to *check for signs of infection* (the service provided by the nurse)
- When a surgeon *inserts a scalpel into the abdomen* of a patient they are doing so to *create an incision* (the service provided by the scalpel manufacturer)
- When a scrub nurse places a suction device next to the fresh incision, they are doing so to clean the wound.

When defined using the four contexts, an individual health service ecosystem will usually consist of multiple services, performed by many different actors interacting with a diversity of resources and each other. Some services are performed repeatedly and are routine; others are more variable and random. It is the health designer's task to understand these, and particularly to identify factors and outliers that are causing the occurrence and persistence of complex system problems.

Contexts

Contexts, as we have already seen, influence what services ecosystem actors are required, need or wish to provide or obtain. They also shape the resources used and the interactions undertaken.

A complication is that actors react differently to the same context, which are themselves influenced by other contexts. As described in the preceding section, a combination of the resource environment, situation, purpose, the beneficiary actor and adjacent ecosystem contexts are used to define an individual health service ecosystem. Yet at any given time, there will be local contextual variations as well as newly emergent contexts of service adaptation *within an ecosystem* too. Identifying and understanding these, along with contexts where services are underperforming in terms of outcomes not achieved, provides valuable inputs into later design activity. Through a structured approach, it is possible to identify dominant, local, emergent and/or underserved contexts to inform themes and opportunities for intervention.

Values

The next and the most important element in the model is that of **values**. These are health ecosystem actors' ways of seeing and sensing the world. Values inform, guide and give belief and meaning to context and the performance of service. They embody the tacit knowledge of actors, and shape their ethical, justice and social position, norms, assumptions and outlook. Values are expressed in the way people see, interpret and prioritise health problems, and obtain and perform services in health ecosystems.

The values of actors influence all the other elements in a health service ecosystem; what problems are prioritised, how actors interrelate, what services are sought or performed, which resources are used, which actors get involved, and what outcomes are measured. Shared or aligned values can socialize actors to engage in service ecosystems; *values conflicts* can prevent them from doing so. Just like emergent contexts, new values provide opportunities for improving, transforming or eliminating activities within service ecosystems. As for the other elements, the task of the health designer is of course to discover them and relate them to outcomes, the final element in the model.

Outcomes (value realised)

Finally, **outcomes** are the dynamic effects of the interplay between all the above elements in health service ecosystems. They are *value realised*. They are measurements of the consequences of interactions, resource availability and efficacy, actor capability and service performance. Actors learn from their experiences of sharing, integrating and interacting with resources and will measure their performance by the outcomes attained. When outcomes are not met or are misaligned, they may seek alternative resources or make resource adaptations. As in a natural ecosystem, ongoing adaptation arises from the desire of actors to acquire, improve or modify their own and others' resources to achieve better outcomes.

Analysing the elements

All the elements described above are used to analyse a health service ecosystem. Using them, we can produce problem specifications, resource and cost profiles, capability gap models, personas, service segments, interaction maps, outcomes landscapes and many other analytical and interpretive enquiry outputs. Analysis may be undertaken directly with ecosystem actors through structured interviews and observations to discuss their resources, interactions, contexts, the values they adhere to and the outcomes they can or wish to achieve. In addition, quantitative enquiries can be completed to add measures and precision to qualitative inputs, helping to reveal hidden patterns and relationships and determine priorities. This builds a deeper evidence base of risks, problem causal factors and opportunities. Later in the paper, I show some examples of Umio analysis outputs.

Solution- and assumption-free enquiry

Just as for the contexts I described in Component 1, each of the seven functioning constituent elements is also solution- and assumption-free, meaning that any enquiry into complex health problems can be undertaken without any pre-conceptions or assumptions of what health systems, structures, technologies and solutions are the most valid or relevant for improving outcomes. In this way, health and adjacent ecosystems can be analyzed objectively and without bias, providing a better ability to identify and understand problems, find opportunities, discover possibilities and design interventions and transformations.

Next, I describe how the third natural ecosystem concept can be used to discern the internal structure of health service ecosystems, and I explore the benefits and applications of doing so.

Health Service Ecosystem Functioning – Key Points

- All value in a service ecosystem is service value. It does not matter whether a drug, device, digital app, or a person, all exist to provide or obtain services
- Value is only realised when actors share or integrate their own resources with others' resources
- All value is co-created
- There are seven dynamic functioning elements in health service ecosystems – Actors, resources, interactions, services, outcomes, contexts and values
- Each of these not only explains how individual ecosystems function but also acts as a unit of analysis for enquiry into problems. Using them in combination, it is possible to reveal deep patterns and insight into risks and causal factors, and uncover gaps and opportunities.
- There is high diversity of actors and resources within a health service ecosystem. It is possible to understand this diversity and determine the key dimensions or factors around which it varies.
- Outcomes are value-realised
- Just as for contexts, each of the elements is solution-, assumption- and structure-free, meaning it is possible to examine problems and opportunities without using a solution or frames of existing practices, beliefs, values, systems or technologies

Component Three: How health service ecosystems are structured internally

Just like the hierarchy of species and interactions that defines the structure of a natural ecosystem, I identify a *hierarchy of actors and interactions that defines the structure of an individual health service ecosystem,* consisting of the same eight levels (depicted in Figure 9; note that each level corresponds to the eight levels in the natural ecosystem hierarchy).

Like a Russian doll, the higher levels in the hierarchy incorporate the lower levels. As in nature, each level denotes a particular configuration of health actors sharing, integrating and interacting with their own and others' resources. Each level is a functioning adaptive entity driven by the dynamic interplay of the seven constituent elements defined in component two, and as shown in Figure 8. After practice theory, which emphasises how human actors engage, interact and act within a common context in social systems, each level in the hierarchy can be described as a particular type of **practice** in an individual ecosystem. More correctly, given that all value is co-created by actors in the use of their own and others' resources (as I described on page 20), each level is best described as a type of **co-creation practice**[7]. Thus, I will use this terminology when describing the levels in the hierarchy from hereon in. Through a co-creation practice lens, we can see how the sustainability and resilience of an entire health service ecosystem is determined by the cumulative dynamic effects of co-creation practices arising not only within individual, but also between all practices up and down the hierarchy.

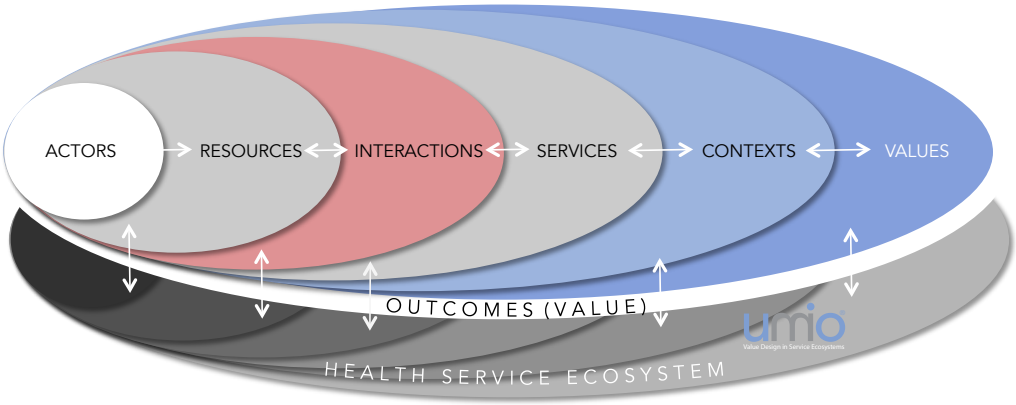


FIGURE 8 – An individual co-creation practice and the seven dynamic functioning constituent elements

Studying individual and multiple co-creation practices in the hierarchy provides deep insight into complex health system problems. It provides the means to assess and understand diversity within the ecosystem. It helps us to see the sources, nature and direction of evolution within and between co-creation practices. It paints a clearer picture of emergent practices and where they are occurring. It reveals the degree of integration between practices, and opportunities for improving connectivity. In conjunction with the elements described in component two, a hierarchy of co-creation practices helps us to identify root causes, detect resource gaps and reveal opportunities for improving outcomes. It allows a holistic system-wide assessment of overall ecosystem wellbeing.

With a more holistic understanding of problems, including those in adjacent ecosystems, the hierarchy also informs the choice of the most appropriate strategy for addressing identified problems and designing tailored interventions. This is because each co-creation practice lends itself to a certain *design approach* that is

[7] This characterization of the hierarchy levels as co-creation practices draws on the second concept – "dynamic functioning" - in the primer on natural ecosystems on page 8. Here I stated how ecologists conceptualize species as co-creating their collective ability to survive and reproduce, and when in balance, sustain the ecosystem.

relevant to the configuration of actors, resources, interactions, values and outcomes in that practice. By surfacing problem understanding across multiple co-creation practice levels, the hierarchy helps to select the most appropriate *combination of design approaches* for addressing the problem, helping to shape a complete *ecosystem design strategy*.

Before explaining the eight levels of co-creation practice and the design approaches individually, here is a brief summary of each of them.

1. **Level 1. Bodily and Mind.** This level consists of the biological, chemical, physical, cognitive and psychological interactions within the body ecosystem of beneficiary actors.
2. **Level 2. Beneficiary Actor Personal.** At this level are the co-creation practices undertaken when a beneficiary actor interacts alone with resources such as drugs, devices and medical information.
3. **Level 3. Beneficiary Actor with Family, Social and Peer Actor.** These are co-creation practices consisting of interactions between two or more beneficiary actors, such as in a patient support group, as well as between a beneficiary actor and family, friends, peers and colleagues in social settings.
4. **Level 4. Beneficiary Actor with a Specialist-Skilled Actor.** This level defines a form of co-creation between a beneficiary actor and an individual actor who is providing specialist, skilled or professional services, such as when a patient consults a doctor.
5. **Level 5. A Beneficiary Actor with a Functional Service Group.** Level 5 are co-creation practices that occur between the beneficiary actor and multiple actors in a single functional group, such as when a patient visits a clinic or emergency room and interacts with several different clinical, specialist and support actors.
6. **Level 6. A Functional Service Group of Actors.** This level defines a type of co-creation that occurs between all actors in a single functional group, such as all the clinical staff and support teams in an emergency room, or within a surgical team.
7. **Level 7. A Single Organisation of Functional Service Groups.** At level 7 are co-creation practices that take place between two or more functional service groups of actors in a single organisation. For example, the collaboration that occurs in varying degrees between emergency, ward and medical teams in a hospital.
8. **Level 8. Multiple Organisations.** Finally, these are the co-creation practices existing between multiple organisations within the overall health service ecosystem, such as between a hospital and community care organisations, between regulatory bodies and industry providers, or between companies.

Describing each type of co-creation practice below, I use the example health service ecosystem (defined from the beneficiary actor point of view) of *Improve Lifestyle when Living with Type 2 Diabetes*. This ecosystem also incorporates adjacent, overlapping, (and traditionally seen as) non-health service ecosystems related to food, transport, work and the built environment. Note that the example is in summary form and does not include many other actual examples of individual and groups of actors at each level. Typically, producing a map of co-creation practices consisting of all actors for any individual health service ecosystem takes time and care.

Level 1. Bodily and Mind

The biological, chemical, physical, cognitive and psychological processes within the body ecosystem

The first level of the co-creation practice hierarchy is made-up of the biological, chemical, physical and psychological interactions that influence, and are influenced by genetic, environmental, behavioural and lifestyle choices of actors. For example, the pancreatic functions (pertaining to fat processing, insulin and glucagon production) in a person with diabetes are influenced by a complex combination of genetic factors, lifestyle choices (e.g., exercise, food intake), environmental factors and mental status (e.g., stress).

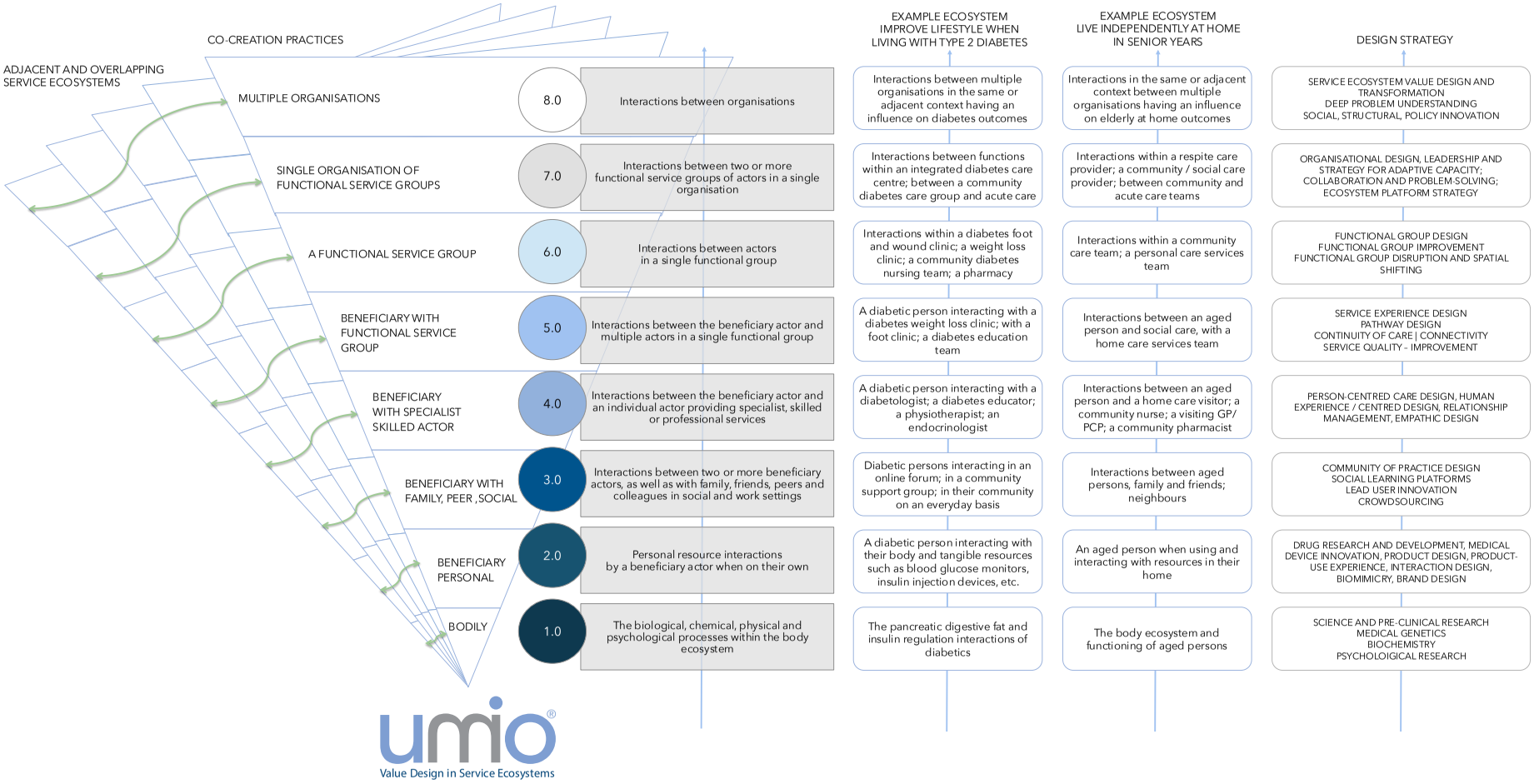


FIGURE 9 – The hierarchy of co-creation practices in a health service ecosystem

Even though the dynamic effects of these occur within the body and may become manifest in conditions such as obesity, cardiovascular disease, ophthalmological and renal disease, value in the form of better outcomes may be co-created by an actor by making *different* lifestyle, activity, mental or behavioural choices that may prevent, mitigate or control certain bodily interactions. In the last decade, there has been an increase in understanding of the mind half of the mind-body interaction, leading to the emergence of new mindful wellness practices and a consequent shift from traditional medical-based bodily interventions. *Bodily and Mind* is the foundation co-creation practice level in a health service ecosystem.

Level 1 Design Approach

Science, (pre-) clinical research, medical genetics, biochemistry, psychological research

Design approaches in Level 1 co-creation practices seek to improve functional and clinical outcomes by obtaining new knowledge of bodily and cellular mechanisms and their interaction with neurological, physiological, psychological, energy and activity processes. Pre-clinical research, medical genetics, biochemistry and psychological research are the primary forms of design enquiry at this level of the co-creation practice hierarchy.

Level 2. Beneficiary Actor Personal

Personal resource interactions by a beneficiary actor when on their own

Level 2 in the hierarchy is a form of co-creation practice characterised by an individual actor's interactions with their own bodily (e.g., sensory and physical capabilities), cognitive (e.g., information processing, knowledge, decision-making) and emotional resources, with tangible resources, and also with resources in their physical and built environment. For tangible resources, typical services obtained by actors at this level are learning how to use, set-up, prepare, execute, monitor, manage, report and (sometimes) dispose of drugs, devices, supplies and IT.

In our diabetes ecosystem example, co-creation practices include when a person with diabetes interacts with an insulin injection device, a blood glucose meter, a weight loss plan, or with the built or physical environment such as when walking, at a gym, at home or using a grocery store.

As patients develop more capabilities based on greater understanding of their condition aided by simpler, more informative technologies, they are able to build higher self-proficiency and achieve increased autonomy from practices higher up the ecosystem hierarchy. The same applies for clinicians too. Capability advances as knowledge trickles down the hierarchy of co-creation practices from specialist practitioners in practices in centralised locations to generalist actors in practices contexts closer to the patient.

Level 2 Design Approach

Drug research and development, medical device innovation, product design, product-use experience, interaction design, biomimicry, brand design

Design approaches in Level 2 co-creation practices focus on improving or eliminating poor health outcomes through drug, device and other technology innovation. Also, they seek to design better interactions with tangible resources based on deeper understanding of beneficiary actors' intangible resources. Doing so requires obtaining empathic insight into user (patients and professional) contexts and circumstances of product and technology use, the different capabilities of actors, their unmet needs (real and perceived), their desired functioning (what they want to be or do in their lives if they can manage, eliminate or alleviate their health condition) and their target goals and ideal outcomes. Thus, the design approach at this level of the practice hierarchy spans clinical research, technology, product, interaction and experience design.

Level 3. Beneficiary Actor with Family, Social and Peer Actor Interactions

Interactions between two or more beneficiary actors, as well as with family, friends, peers and colleagues in social and work settings

Level 3 in the service ecosystem hierarchy are co-creation practices consisting of two or more of the same actors on a family, peer or social basis. Typically these practices involve providing and receiving care, support and knowledge as well as learning from others' experiences to gain motivation and confidence from belonging to a group of people with similar situations or problems. Also, actors may derive personal value by exchanging insights and data with others.

Examples of this type of co-creation practice from the diabetes service ecosystem include online or community diabetic support groups and weight loss clubs. They may also include co-creation through the networked use of technologies that help persons with diabetes to make better decisions (e.g., insulin dosing calculations) as they go about their everyday lives, derived from crowdsourcing the decisions and learning of other people with diabetes. Also in this level of the hierarchy are interactions between family members or caregivers and general social interactions, such as when a diabetic person is shopping for food.

Level 3 Design Approach

Community of practice design, social learning platforms, crowdsourcing, lead user innovation

Design approaches at Level 3 of the hierarchy seek to build opportunities for greater collaboration, peer learning, social networking and communities of practice amongst actors. Here, value is realised when beneficiary actors facing similar problems share a resolve to improve their resources and drive adaptation. They may collaborate virtually or physically to exchange knowledge, provide mutual support, and sometimes develop new ideas, solutions and prototypes. An example in the diabetes ecosystem is the *We Are Not Waiting* health hacker movement of patients that are impatient to find new solutions to the diabetes data burden and who wish to help and spread the word to other users. They aim to develop a device-agnostic, cloud-based platform for persons with diabetes.

Level 4. Beneficiary Actor with a Specialist-Skilled Actor

Interactions between the beneficiary actor and an individual actor providing specialist, skilled or professional services

Level 4 in the hierarchy is a form of co-creation practice characterised by interactions between a beneficiary actor (e.g., a patient or a consumer or generalist caregiver) and an individual actor with specialist knowledge and/or skills (e.g., a clinician or nurse, a pharmacist or a professional caregiver). Less personal, peer- and social based than those in Level 3, these interactions typically involve the communication, sharing and integration of specialist information and skills from one actor to another. Often interactions are episodic, time-limited, functional, routine and regularly repeated by specialist actors, and more infrequently obtained by beneficiary actors.

Examples of specialist-beneficiary interaction from the diabetes service ecosystem include a diabetic person obtaining a diagnosis of a foot ulcer infection from a specialist wound care nurse, co-creating a diet plan with a nutritionist, or discussing their A1c levels with an endocrinologist to evaluate their insulin drug.

Level 4 Design Approach

Person-centred care design, human experience / centred design, relationship management, empathic design

Design approaches in level 4 co-creation practices seek to increase access to specialist care, improve the level of individualised care and deliver a better continuity of care experience for beneficiary actors. They emphasise the emotional and experiential aspects of professional and care interactions. For clinicians, they can take a person-centric view, seeking the improvement of human outcomes such as respect and dignity in addition to clinical measures. They aim to widen their perspective from a symptomatic, disease-condition

view of a patient to take into account the whole person, their multiple conditions, their lifestyle, their work and family circumstances, their relationships, and the environmental factors that may impinge on their ability to obtain health, take their treatment, lead a healthy lifestyle or manage their condition. Interventions may also seek to shift the person from being a passive recipient of care and treatment to an active, empowered, informed agent with choice. In short, the goal is to improve the capabilities of the patient to self-manage and self-determine their personal health outcomes or in other words, move them to Level 2 in the hierarchy, unless it is a particularly vulnerable individual. For clinicians and caregivers too, health designers may co-create technologies and services that relieve or diminish the emotional as well as functional burden of delivering care. The ideal would be to design professional and care interventions that deliver symbiotic outcomes for both health seekers and patients, and clinicians and caregivers.

Level 5. Beneficiary Actor with a Functional Service Group

Interactions between the beneficiary actor and multiple actors in a single functional group

Level 5 in the hierarchy consists of co-creation practices between a beneficiary actor and a functional service group of specialist or role-defined actors (the service group is Level 6 of the hierarchy and is itself a co-creating practice of actors). Here, value is co-created through resource sharing, integration and use in the interactions that take place between the beneficiary and the functional service group. It is realised through the performance of services along a pathway or a series of linked service encounters.

In the diabetes service ecosystem, co-creation at this level occurs when a diabetic patient interacts with different, multiple actors in a GP practice (e.g., the receptionist, the doctor, the practice nurse on a single or repeat visits) or with vascular surgeons, podiatrists, wound nurses and diabetologists in a specialist diabetic foot outpatient clinic.

Level 5 Design Approach

Service experience design; service quality improvement; pathway (re)design; continuity of care and enhanced connectivity

Interventions in Level 5 co-creation practices (which remember also incorporate Levels 1-4) are concerned with patient journey or pathway, and service experience design and quality improvements. They seek to improve the access and flow of people into, within and out of services performed by functional service groups. They aim to improve or redesign the journeys and the quality of experience that beneficiary actors encounter before, during and after the service sought and obtained. The latter includes monitoring of patients when away from the service group, for example in their own home. A designer may seek to build a connectivity solution that installs and maintains a new service that identifies and responds to critical events or anomalies in the patient's condition. In addition to the value co-created for the beneficiary, designers should be concerned with the workflow, tasks and the emotional labour of actors providing the service to the beneficiary actor in the functional service group. Often, the human aspects of the service provider are neglected in such design considerations.

Level 6. Functional Service Group of Actors

Interactions between actors in a single functional group

Level 6 in the ecosystem hierarchy are the co-creation practices that occur between a group of multiple actors performing a functional service for a beneficiary actor and defined by a specific, shared purpose of context. Unlike Level 5, which includes only the direct interactions between service group actors and a beneficiary actor, Level 6 incorporates the co-creation of value between all the actors in the functional service group. In these, actors provide services to other actors supporting the beneficiary actor, such as when a scrub nurse interacts with a surgeon operating on a patient, or a practice nurse with a GP/PCP who is performing a diagnostic test. In these interactions, actors make value propositions and adaptations for one another, not always directly connected to or for the benefit of beneficiary actor. For example, an

administrator in a patient records function in a hospital or clinic may never have any direct interaction with a patient. Rather, they only interact with information and IT resources in order to gather, process and distribute patient data to clinicians within the hospital or clinic.

Examples for the diabetes health service ecosystem include a community diabetes education team and the adaptations it makes when faced with growing patient numbers and reduced funding or other resources, or a diabetic weight loss clinic and the adaptations made by nutritionists when considering whether to deploy new knowledge about the inefficacy of carbohydrate-focused diet plans in their patient advice. Typically, functional service groups are located in a single spatial context or setting (like a "habitat" or niche in an natural ecosystem) though not always. Virtual functional service groups may be more geographically dispersed when enabled by telemedicine services or other remote care technologies. Online forums that allow diabetologists to share latest practice innovation and discuss the treatment efficacy of a new drug or for nutritionists to co-develop diet plans is a form of co-creation practice at this level too.

Level 6 Design Approach

Functional group design / creation; improvement, adaptation, disruption and spatial shifting

Design approaches for Level 6 in a health service ecosystem span several possibilities. These include the creation of new service groups altogether for a new unmet or priority health context (e.g., a new rectal cancer screening service); the shifting of activities to a new physical or virtual location (e.g., any service that moves from a central location to the community or the home); the disruption of an existing service group by a new technology that allows a less specialist or skilled actor to perform one or many tasks of the group (e.g., less specialized and costly cardiovascular surgery following the invention of the stent), or more simply, making ongoing improvements in service group learning and the adaptation of routines, roles and activities. All these interventions require understanding of actor types and roles, their resource diversity, their interactions, power relations, values, outcomes and the source and nature of any conflict.

Level 7. Single Organisation of Functional Service Groups

Interactions between two or more functional service groups of actors in a single organisation

Co-creation between two or more (Level 6) functional service groups within the same organisation defines Level 7 of the health service ecosystem hierarchy. Although each service group has its own function or co-creation purpose in the service ecosystem, a service beneficiary type (e.g., geriatric patients), or a support role (e.g., administration, research), all belong to a single organisation under common leadership that defines strategy, allocates resources and assigns responsibilities. A hospital is a good example. It is a collection of co-creating functional service groups, consisting of multiple specialist teams and departments sharing a location and under the same management, each servicing one another as well as beneficiary actors. A network of primary care practices in a city or community under common management or ownership is another example. A pharmaceutical or medical device company is also a collection of functional service groups, such as R&D, manufacturing, market access, sales, pharmacovigilance and so on.

In our diabetes ecosystem example, there are many types of organisations consisting of multiple service groups that co-create value. These include multi-disciplinary diabetes care centres, diabetes charities, diabetes food manufacturers and companies that specialise in diabetes treatments and diagnostics.

Level 7 Design Approach

Ecosystem-aligned organisational design; leadership and strategy for adaptive capacity and learning; collaboration and problem-solving; ecosystem platform creation and partnering; open innovation

Design approach at Level 7 in the service ecosystem is concerned with organisational change, and particularly the requirement to align an organisation's leadership, strategy, capabilities, people and operational model with a service ecosystem perspective. In the broadest terms, this requires the development of *organisational adaptive capacity* or the ability to sense, respond, learn and adapt to environmental, market

and ecosystem risks, problems and opportunities with value propositions for other ecosystem actors. To improve its adaptive capacity, an organisation may also form an ecosystem platform strategy consisting of alliances and partnerships with other ecosystem organisations, such as patient groups, clinical trial research organisations, market research companies, charities and sometimes even competitors, should the problem they seek to tackle be big enough.

Ecosystem-aligned organisations ask a different set of questions in the pursuit of more open learning, problem-solving and adaptive capabilities for co-creating superior value. These include:

- How do we better sense environmental and ecosystem risk, problems and opportunities?
- How do we ensure we learn from success as well as failure?
- How do we develop a new leadership model that shifts from old-style command and control standards and procedures to one that embraces adaptation and the autonomy of teams and individuals to choose and tackle problems?
- How do we design a form of strategy that encourages a future view of the ecosystem and allows more space to try solutions, create redundancy and resilience, and promotes ongoing learning and co-creation of value?
- How do we scope and design service ecosystem interventions, and secure a better chance of achieving scale in their adoption?
- Should and how do we build and sustain a more open co-creation innovation model to source diverse perspectives to address complex problems?

As the final question suggests, an organisation is often not capable of addressing complex challenges on its own. To make effective interventions in a service ecosystem, it relies on co-creating with other organisations such as academic institutions, clinical research organisations, professional services companies, regulatory bodies and government departments. It must also learn from ongoing co-creation practices with beneficiary actors such as patients, clinicians and payers in its normal operational context. These interactions between diverse actors define the final Level 8 of the service ecosystem hierarchy.

Level 8. Multiple Organisation Interactions

Interactions between multiple organisations within the ecosystem

Finally, the highest level of the hierarchy goes beyond a single organisational context. It denotes the interactions (that occur directly or indirectly, or not at all) between multiple organisations in the health service ecosystem. Level 8 incorporates the previous seven levels consisting of all the co-creation practices that take place within and between organisations, between groups in those organisations and with individual beneficiary actors.

At Level 8, the wide diversity of actors, the great variety of resources used, the multiple interactions and activities undertaken and often, the many conflicting or misaligned values of actors lead to a highly complex picture. Here, some ecosystem actors may not even be aware of the effect of their practices on other practices in the ecosystem; effects that are not always co-creative but frequently co-destructive. For this reason, at Level 8, the causes of complex health problems are much harder to isolate, they are buried deeply under layers of interdependent practices and multiple past organisational and individual efforts at improvement through technological, system and structural change.

Level 8 Design Approach

Service ecosystem value design and transformation; deep problem understanding; social, structural and policy innovation

At Level 8, the design approach is inherently whole ecosystem focused. It must seek to understand the highly diverse, complex picture of multi-level, dynamic interactions taking place between thousands of different

actors of all types and sizes up and down the hierarchy. Some interactions are mutual and symbiotic, and some are competitive. Some are emergent whereas others are tied to long-established routines and practices.

The hierarchy of co-creation practices helps to organise and structure a view of ecosystem complexity. It allows a health designer to distinguish the individual effects of practices at each level on overall ecosystem wellbeing and outcomes. Some interactions and effects are positive, many are negative; some are immediate in effect, others have long-term impact. However, by using the hierarchy in conjunction with the constituent elements as units of analysis and problem enquiry, root causes of poor outcomes can be identified. It is possible to locate risk and other problem factors, understand them, see their linkages and then design an overall multi-practice ecosystem strategy for tackling them.

Summary

Using the hierarchy in conjunction with the two other framework components, namely the ecosystem context definitions and the constituent units of analysis, it is possible to create new frames of problem enquiry, to identify and understand causal factors, patterns and opportunities, and then to design value propositions consisting of new resource configurations for actors to improve or transform outcomes. However there is one final component to our Health Value Design framework we need to add. These are the different classes of value proposition that a health designer may seek to create within a health service ecosystem. Next, I explore these.

Health Service Ecosystem Structure – Key Points

- There is a universal internal structure to all health service ecosystems
- This is in the form of an hierarchy that corresponds to the same hierarchy in natural ecosystems
- Each level in the hierarchy denotes a particular form of co-creation practice.
- Each practice can be analysed using the seven elements defined in Component Two
- Moving up the hierarchy of practices, diversity and complexity increases
- Each level of the hierarchy denotes a particular design approach to understanding the problem, and produce solutions and interventions
- The co-creation practice hierarchy helps to determine the structure, nature and pattern of co-creation within health service ecosystems, and to determine how and where it is changing

Component Four: How health service ecosystems adapt and evolve through value propositions

In an ecosystem context, I define a value proposition as a *novel configuration of resources bearing a promise made by one actor to another to co-create improved outcomes or value*. In this respect, a value proposition can be regarded as a bundled combination of tangible, intangible, financial and sometimes, environmental resources which actors deploy to adapt their resources to perform and obtain services. Hence, all value propositions are service propositions; it does not matter whether they are drugs, medical technologies, supplies, experiences, data, money, or a human caring for another human; they all represent configurations of resources for actors to co-create improved outcomes.

The seven classes of ecosystem value proposition

In a health service ecosystem, I identify seven classes of value proposition that may be designed and introduced, whether individually or in combination. These are: *Value-in-function, value-in-experience, value-in-sensing, value-in-learning, value-in-flow, value-in-diversity and value-in-transformation*. Each is distinguished by the purpose, nature and form of the value embodied in the proposition, and the nature of outcomes or value that may be realised. Together the seven value classes constitute the fourth and final component of the Health Value Design framework. Before describing them individually, I summarise each as follows:

- **Value-in-function** – These propositions allow actors to attain or improve core functional or clinical outcomes for a service for a health context, such as prevent disease, diagnose a condition, treat an illness or manage a condition, amongst others.
- **Value-in-experience** – Propositions in this class focus on creating or improving the experience that actors have when interacting with resources, with other actors and when performing or obtaining services in health service ecosystems.
- **Value-in-sensing** – This class of value enables actors to sense and detect patterns, identify, respond and adapt to risks, changes, problems and opportunities. They provide a greater peripheral and predictive capability to deal with problems.
- **Value-in-learning** – Learning propositions help actors to better understand cause and effect, remember patterns and relationships, provide instruction and guidance, co-create new knowledge and help actors assimilate it to allow them to make smarter and better adaptations.
- **Value-in-flow** – Flow is an important class of proposition. These offerings seek to connect actors within and across practices up and down the hierarchy in an ecosystem, and in doing so, amplify the flow of learning, sensing, experience and functional value. Flow propositions support the sharing of knowledge within and between practices and across ecosystems; they enable collaboration and monitoring, and boost adaptive capacity. Also, they may increase access of actors into ecosystem services, and reduce inequities in service provision.
- **Value-in-diversity** – Diversity value propositions support actors to be more creative, allowing them to respond to unique situation and adapt services to their particular circumstances. They promote variation and divergence from established routines and standard ways of "doing things around here". A lack of diversity is often the reason for health service ecosystems becoming stuck and complex health problems arising and persisting. Building diversity through *values* innovation, adaptive technology and organisational design leads to greater ecosystem resilience. Also, divergent contexts may be introduced into a service ecosystem from adjacent ecosystems, changing the boundaries of service context, enabled by new connective (flow) technologies.
- **Value-in-transformation** – Finally, transformation value propositions overhaul individual or multiple practices, or whole health service ecosystems. They may seek to shift services at one level of co-creation practice to another, to combine practices from within or from adjacent ecosystems, to eliminate ineffective practices, or redesign new service ecosystems altogether. Transformative

propositions are needed when the adaptive capacity of an ecosystem is no longer sufficient to address complex persistent system problems. This can occur when there is a dominant, entrenched logic that persists, is routinised, and where outcomes plateau or worsen.

The Service Ecosystem Evolution Spiral

The sequence of the seven value proposition classes listed above is significant. Each successive class of value in the list expands the total amount of value co-created in each and all of the preceding classes. In other words, each class moving through the sequence holds greater value co-creation opportunity within a health service ecosystem. This *value-intensifying dynamic* is expressed as follows:

> *Function enables a service to be performed or improved or disrupted for a purpose and beneficiary actor; Experience enhances and may differentiate function; Sensing allows actors to detect problems, risks and opportunities; Learning reinforces the ability and memory to sense and adapt; Flow connects interactions and co-creation practices and enables collaboration; Diversity builds wider perspective, and boosts adaptive capacity, and Transformation is needed when adaptation has reached its limits, an ecosystem becomes unsustainable or in crisis.*

I illustrate the seven classes in the form of a logarithmic or golden spiral (see Figure 10), a frequently occurring pattern in natural ecosystems found in multiple species and environmental contexts[8]. I call this the Service Ecosystem Evolution Spiral (this applies to all service ecosystems, not just health). I use a spiral metaphor as it represents a universal path of ecosystem evolution that any health designer can pursue to know where and how to co-create value. In any ecosystem at any time, multiple value propositions in each class are being co-created, introduced, adapted and used. A health designer can study the mix, status and efficacy of the different classes of value to identify improvement and transformational opportunities.

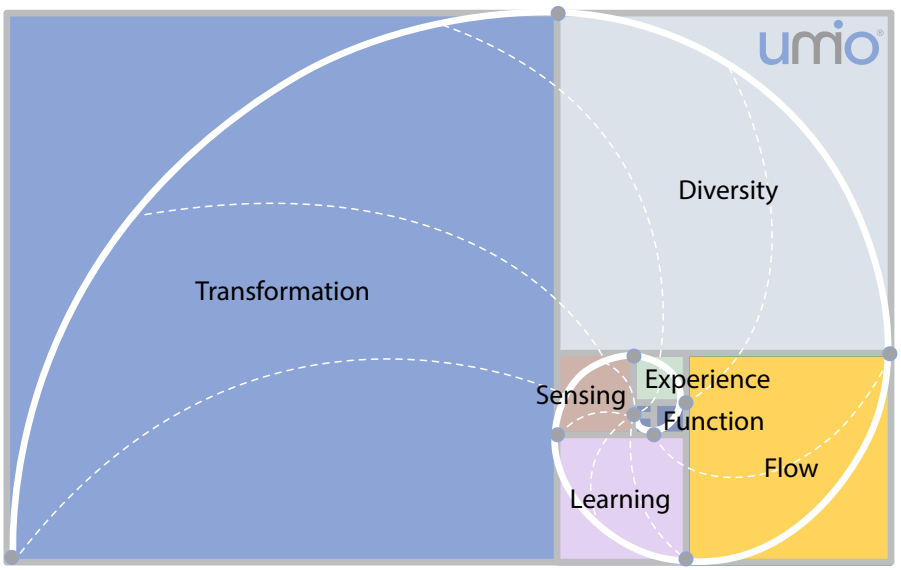


FIGURE 10 - The Service Ecosystem Evolution Spiral

The following is a fuller description of each of the value proposition classes, with a particular emphasis on the final three propositions as these have particular relevance to ecosystem thinking. In Table Five, I list some examples of each class.

[8] Examples of the golden spiral in nature include sunflower seed heads, pinecones, snail and nautilus shells, spiral galaxies, hurricanes and the aerial spiral formed by a peregrine falcon when stalking its kill.

TABLE FIVE – Examples of solutions in each value proposition class

CLASS	EXAMPLES
FUNCTION	• Drugs • Drug delivery devices • Breakthrough functional therapy (e.g., immunotherapy, dementia drug) • "Dumb" analog medical devices • Medical supplies and equipment • A building
EXPERIENCE	• Patient and Family experience • Pathway experience • Practitioner experience • Energy, effort and emotion • Interaction with technology • Interaction with another actor
SENSE	• Diagnostics • Biomarkers • Algorithms • Artificial intelligence • Smart pills • Smart buildings • Self-Monitoring technologies (e.g., wearables) • Remote monitoring technologies (e.g., ECG, blood glucose, symptoms monitoring, detection of movement / motion, etc.) • Pattern and anomaly detection systems • Enhanced decision-tools • Reminders automation (e.g. medication reminders).
LEARNING	• Communities of practice / learning • Patient groups • Big data and analytics • Smart assistive technologies (e.g., inhalers, Parkinson's tremor spoon) • Checklists and Guidelines • Digital dashboards • Signs and symbols • Organisational learning systems • Healthcare education technologies
FLOW	• Crowdsourced decision-making tools • mHealth and connected health technologies • Digital, collaborative and communication technologies • Electronic health data systems
DIVERSITY	• Complex problem challenges • Adaptive organisational design and teams • Personalisation technologies
TRANSFORMATION	• Disruption of a centralized service • Collapsing of a service ecosystem hierarchy down to the beneficiary actor • Transformational care models • Major problem collaboration • Social and policy innovation

Value-in-function

Value-in-function propositions enable actors to attain functional, clinical, activity or process outcomes for a health service context. They are typically product-centric such as novel drugs and drug delivery mechanisms,

medical devices, diagnostics, digital technologies and health equipment and supplies. All value starts with an actor's need to do something, to achieve something; in other words, a purpose or goal or objective. Function propositions may improve outcomes for a core purpose. Disruptive functional propositions allow an actor to perform or obtain a service at lower cost, more conveniently, with fewer complications or without the support of others actors. Over time, disruptive propositions are augmented with the subsequent classes of value as designers seek to differentiate their propositions.

Value-in-experience

The next variety of proposition is value-in-experience. These aim to differentiate functional propositions by offering new, or improving existing, experiences of actors when interacting with tangible resources, with other actors and when obtaining or performing services in co-creation practices. They seek to realise personal, social, relational, emotional, energy- and effort-related outcomes. The predominant focus of value design in the recent past has been on improving the patient experience in health service ecosystems. Even in clinical trials (the *clinical trial research service ecosystem*), differentiating on the patient experience of trial participation is seen as increasingly necessary to attract and recruit patients.

Value-in-sensing

Sensing is a vital capability of all species in natural ecosystems. It allows them to detect and assess risks from predators or environmental crises and then take swift appropriate action to evade them. It also enables them to discover opportunities for resource sharing, as when forming symbiotic relationships and functional groups with other species. Risks and problems arise up and down the co-creation practice hierarchy in health service ecosystems. These may be bodily in the form of clinical risk, or personal, social, group, organisational or ecosystem overall, where they are particularly complex. Value-in-sensing propositions provide enhanced capabilities for ecosystem actors to identify risk, prioritise problems and discover opportunities for taking appropriate action to mitigate or address them.

Value-in-learning

Sensing risks, problems and opportunities without an ability to learn, interpret signals and patterns and most important, remembering how to respond can lead to actors repeating the same mistakes. Learning propositions enable actors to avoid becoming stuck in routines in practices. They seek to improve actors' capabilities to see patterns, store and retain knowledge, learn and know how to respond to risk, problems and opportunities. Learning propositions are delivered through technology and also through new social networks and media. Social platforms and communities for groups of actors, particularly patients, to share experiences, sensed risks and problems in order to learn from one another are an increasingly widespread form of co-creation practice in most health service ecosystems. They are useful as sources of knowledge to inform complex problem understanding as well as new ideas and innovation, through crowdsourced methods.

Value-in-flow

Value-in-flow propositions are critical for scaling adaptive capacity within health service ecosystems. They increase the overall capability of a service ecosystem to learn, sense problems and opportunities, and to respond with a higher variety of adaptations. They link practices up and down the hierarchy and connect actors, allowing them to collaborate and share data, knowledge and insight. They also may bring in disconnected or disengaged beneficiary actors, thereby reducing inequalities in service provision. Examples include mhealth and connected health technologies, digital, collaborative and communication technologies and electronic health data systems.

Although flow propositions enable efficacy and efficiency in individual co-creation practices and ecosystems, there is a risk they fail to drive ecosystem-wide adaptation at scale. Flow can sometimes lead to a loss of diversity when actors become locked into a particular way of obtaining or performing health services. In such circumstances, a health service ecosystem may be shaped by a pervasive set of values – a

dominant logic - that has overall influence on co-creation practices, the services of ecosystem actors, the resources they share and the outcomes they wish to improve.

Ecosystem actors express and sustain a dominant logic when they share values, and perform services using similar types of resources to achieve commonly accepted outcomes. For example, within the *Diagnose and Treat Infection* service ecosystem, the dominant logic for the past sixty or so years has entailed the widespread use of antibiotics dispensed through established co-creation practices of diagnostic lab testing and human clinical assessment. Patients and prescribers relied on this one form of, seemingly highly effective, resource (the antibiotic) that became deeply embedded in established practices to achieve their infection-related outcomes. But when actors in adjacent service ecosystems of *food production*, *animal welfare* and *veterinary health* also began to use antibiotics widely, the undetected problem of antimicrobial drug resistance accelerated.

Today, the dominant logic and resource use in co-creation practices of antibiotic prescribing have ultimately led to negative outcomes, low symbiosis and poor wellbeing of the *Diagnose and Treat Infection* service ecosystem. All actors are now struggling to adapt and overcome this crisis. In many respects, the long-term ecosystem destabilizing effect of excessive antibiotic use is akin to the introduction of a non-native species into a natural ecosystem. When the cane toad (seen as useful resource) was brought to Queensland in North East Australia to control pests for example, it unwittingly overwhelmed and upset the sustainability of the local ecosystem – with disastrous consequences[9].

A dominant logic may exist at the overall health ecosystem level too. It could be said that the logic of most western healthcare systems today is one of "make sick care more efficient" as opposed to "prevent sickness and disease through behaviour change". In US healthcare, the dominant logic is now beginning to shift from "volume-provision" to "value-based care". In *Care for Mental Health* service ecosystem in the UK, the dominant logic changed in the 1980s from "institutional care" to "community care", though it is now shifting again to that of "enabling mentally ill persons to participate in the community" as many people became isolated, lonely and more sick when transferred to the community from institutions.

Value-in-diversity

Value-in-diversity propositions promote greater diversity of action and co-creation, framed by a deeper understanding of complex health problems. They aim to increase the problem-solving capability and adaptive capacity of actors, practices and the ecosystem overall. As such, diversity propositions seek to nurture adaptation *at scale* by overcoming the risks of dominant logic described above. Ultimately, ecosystems adapt and evolve, and practices emerge, from greater diversity of knowledge, and perspective applied to a deeper understanding of causes and consequences of complex problems in health service ecosystems.

Within individual health service ecosystems, value-in-diversity opportunities can arise when a dominant logic no longer serves the values of particular actors. When this happens, new diverse co-creation practices may emerge in opposition to or at the edges of the dominant logic. For example, in a recent Umio study of the *lose weight, maintain weight* ecosystem for obese diabetics, we found that the dominant logic was defined by linear "diet and exercise education, planning and measurement" services at Level 5 of the hierarchy. But when we spoke to persons with diabetes, we learnt that many avoided these practices (and the clinicians who recommended them), as they were deemed irrelevant to the realities and contexts of their daily lives. Instead of relying on barely personalized diet and exercise plans produced in a few short and impersonal appointments with a nutritionist or a physiotherapist at a central location, people wanted tailored help to make the right decisions and perform the right actions when faced with difficult, anxiety-inducing, food, drink, exercise and social choices *as they went about* their normal daily lives. In other words, we

[9] It is not yet known if the cane toad is having any negative effect on the decline of the Great Barrier Reef, but if it is found to do so, then you heard it here first.

discovered an emergent diverse practice of "contextual on-demand behavioural advice", the discovery of which revealed many new opportunities for stimulating and nurturing adaptation with novel value propositions.

Emergent forms of a particular co-creation practice generate positive and negative responses on the part of some ecosystem actors. In some cases, conflict arises, for example between hospital managers and clinical teams, between patients and their PCPs/GPs, between doctors and their government contract holders, and between patients and other family members even. It may also arise within the same actor group, for example when a professional care team disagrees on a diagnosis or treatment.

When actors have competing goals and hold a different view of priority outcomes, especially when enshrined in their values, deep actor paradoxes can arise leading to stuck, irresolvable problem situations. As complexity increases up the hierarchy, such paradoxes multiply, making it more difficult to design value propositions and intervene with clarity or confidence. In such circumstances, knowing the path to adoption of a novel technology or other proposition is fraught with uncertainty. Few interventions have clear mutually acknowledged value held by many actors; most are regarded differently, often skeptically. Against this backdrop, health interventions may exacerbate conflict and further deepen actor differences, presenting particular challenges to health leadership. It seems that many health ecosystem interventions take insufficient account of conflict and paradox in the design of their value proposition.

In essence, value-in-diversity propositions aim to deepen understanding of problem paradoxes and especially the values of actors and those that influence them. Unlocking constraints and paradoxes is a very difficult task. Encouraging teams of professional clinicians from different specialisms and backgrounds to collaborate is challenging. Yet doing so is essential to nurture adaptation at scale and achieve a step-change in ecosystem performance and outcomes. For this reason, much of the opportunity to achieve value-in-diversity sits within the organisational level of health service ecosystems. It requires health system, government, regulatory, clinical and industry leaders to redefine their leadership, strategy and health design and delivery models. This is an exciting yet under-developed domain of the applied ecosystem perspective.

Value-in-transformation

Finally, transformation value-propositions transcend all previous six classes. They are needed when deep problem paradoxes exist or are stuck, leading to irresolvable health situations and negative outcomes, and when the adaptive capacity of a service ecosystem is no longer capable of overcoming entrenched difficulties and paradoxes.

Transformational value propositions may be made at different scales from within individual practices in the hierarchy, across multiple practices, or at the level of an overall ecosystem. They can arise for a variety of reasons: From a political rationale to inject new values into ecosystems (for example, affordability within the US, or market forces within the UK); to reduce inequalities in access to, and engagement in health practices (such as in Sweden); from a desire to better address the social determinants of ill-health (for example the UK's obesity strategy); from a desire to offset cost and resource pressures at higher-levels of the hierarchy and to push co-creation practices down the hierarchy to lower-cost settings. To identify and address transformational value propositions, health designers must be able to:

- Develop a deeper understanding of complex health service ecosystem problems, their causes, linkages, parameters, components and dynamic effects (for example the causes of obesity, antibiotic resistance, medicine overprescribing, opioid addiction, elderly loneliness, winter crises and so on)
- Go wider into adjacent social ecosystems and divergent contexts to fully identify the social determinants of health, making new connections with organisations, partners and beneficiary actors in order to develop alternative perspectives to address them
- Further identify the nature of conflict and problem paradox that is preventing adaptation and the potential for transformation, and then design approaches to overcome them

- Design and frame new ecosystem possibilities that shift ecosystem boundaries, merge practices, align values, change dominant logics, build on emergent practices or flip or invent new contexts
- Develop these new possibilities into multiple value propositions *across all six classes* through enhanced collaboration with ecosystem actors
- Develop overall ecosystem strategy to orchestrate the value propositions into resources and their delivery
- Stimulate adaptation and co-creation of new solutions by accelerating regulatory approval in target areas, setting-up problem-solving competitions and challenges, offering grants and incentives and setting up new investment funds

Before synthesising the four components and presenting the overall Health Value Design framework, first I provide an overall perspective on the forces of evolution and adaptation within health service ecosystems.

Sources of adaptation and evolution within health service ecosystems

At any given time, a service ecosystem is in a state of dynamic adaptation. I identify four adaptive patterns or evolutionary forces that are always operating concurrently, each functioning at a different pace of change and having a variable degree of influence on outcomes achieved. These are: Within a practice, between adjacent practices, top-down, and bottom-up.

Within a practice

Within practice adaptations are the ongoing co-creation of value by actors in individual practices in the hierarchy. They arise when actors seek to make adaptations in response to new or unexpected contexts, changing or conflicting values, new learning and unwanted or desired dynamic effects and outcomes. They also occur in response to value propositions made by other actors within practices and by outside actors such as industry or government. Actors reconfigure services, adopt new interactions and acquire new resources at different paces of evolution. Understanding the nature of such *within practice* adaptation is an important task for a health designer when thinking about value and where and how to intervene.

Between practices

Value is co-created and flows up and down between practices in the hierarchy as well as within them. Value propositions made in one practice often affect actors, resources, interactions and services in practices in the level below or above. For example, value propositions consisting of remote monitoring or treatment technologies that enable distributed care will shift the spatial context of a practice from a central to decentralised locations such as patients' home. This will adapt the service ecosystem by reducing resources and actors in co-creation practices in the central location (for example in functional service groups at Levels 5 and above) and by repurposing and reconfiguring the practices below. Value co-creation may flow up the hierarchy between adjacent practices too. For example, a novel point-of-care urinary tract infection diagnostic used by a community nurse in a nursing home (at Level 4) may lead to more elderly frail persons being admitted to hospital for treatment, which in turn leads to a new configuration of a Level 6 co-creation practice such as a specialist vulnerable elderly care ward.

Bottom up

In the service ecosystem hierarchy, there are always bottom-up adaptive forces in play. Service ecosystems evolve from ongoing bottom-up interactions of actors using resources in practices to co-create value. Working within the constraints and priorities of social and health policy and institutional structure, health service providers seek to improve coordination, reduce risk, approve, allocate and configure the flow of financial, human and technological resources within health service ecosystems. Industry actors too, also exposed to the same structures, function within vertical markets, invest and innovate resources to improve efficiency and efficacy, maximize economies and derive returns from their interventions. People and patients themselves seek out better resources, acquire knowledge and build capabilities to adapt and improve their personal health outcomes to meet their goals.

At lower-levels of the hierarchy, through new value propositions, beneficiary actors (patients, health consumers and seekers), as well as more generalist, less-specialised health professionals seek out new resources and capabilities in the form of enhanced or new knowledge, products and technologies. This means that the flow of knowledge and capability is always trickling down the hierarchy to individuals, social groups and practices at the lower-levels, which over time leads to the disruption of higher-level practices.

A health designer may focus on accelerating the pace of bottom-up disruption through lower-level interventions but to do so successfully, they must understand their impact on, and the likely resistance from, higher-level practices. Much digital health innovation is occurring at lower-levels of the hierarchy (by placing new capability into the hands of patients) yet one of the main reasons for its slow pace of adoption is the resistance from practices (undertaken by professional clinicians) at higher-levels. Often too, technologies are not adopted widely simply because they do not align well or connect into the practices at higher-levels.

Top-down

Top-down adaptive forces are also always at work within the service ecosystem hierarchy. These arise from ongoing efforts to reconfigure or transform entire health service ecosystems as well as integrate adjacent ones into new, more effective or better-aligned practice arrangements. Adjacent ecosystems may include related disease or therapeutic areas (reflecting the shift to whole-person rather than disease-centred care), as well as overlapping yet non-integrated clinical, wellbeing, social care or public meta-health ecosystems, or non-health ecosystems such as food, transport, housing or the built environment.

Typically, the cultural, legal, political, economic and technological resource environment decides, shapes and informs the creation, configuration, evolution and sometimes, the elimination of health service ecosystems. Numerous international, national and local regulatory and approval bodies, professional associations, government and non-government functions establish societal and health values and goals, set standards and administer guidelines for their organisation and function. They also define the health and other context priorities and determine the allocation of resources and the form of institutions to address them.

Whether intervening in one type of co-creation practice in the service ecosystem, or pursuing a multi-practice transformational objective, a health designer must consider the individual and combined effect of all four of the adaptive forces described above. They must determine if their assumptions, designs, models and strategies for intervention are in flow with, or are pushing against these evolutionary trajectories in the ecosystem. If they are pushing against, then their chances of success are likely to be significantly more limited. Fortunately, the synthesised Health Value Design framework allows them to design and plan interventions and strategies with greater clarity and certainty. Next I introduce the complete framework.

Health Service Ecosystem Adaptation and Evolution – Key Points

- There are seven classes of value proposition in a service ecosystem. Each class builds on the preceding class to co-create increased value
- In any ecosystem at any time, multiple value propositions in each class are being co-created, introduced, adapted and used. A health designer can study the mix, status and efficacy of the different classes of value to identify improvement and transformational opportunities.
- There are four evolutionary, adaptive forces operating at any given time in a health service ecosystem: Within practice, between practices, top-down and bottom-up.
- A health designer must consider the individual and combined effect of all four of the adaptive forces. They must determine if their assumptions, designs, models and strategies for intervention are in flow with, or are pushing against these evolutionary trajectories in the ecosystem

Synthesis: The Health Value Design Framework

To date, I have described separately the four components of the Health Value Design framework. These are:

1. ***Component One*: Identification** helps to define and frame individual health service ecosystems for enquiry purposes.
2. ***Component Two: Analysis*** identifies the constituent functional elements of health service ecosystems and describes how they are used to analyse them.
3. ***Component Three*: Structure** defines a hierarchy of co-creation practices that defines the internal structure of health service ecosystems. This provides the means to map configurations of actors, resources and interactions and acts as a template for "seeing" ecosystem complexity, discerning patterns and trends in their evolution and scoping overall design strategy.
4. ***Component Four: Adaptation*** describes the evolutionary dynamics of service ecosystems and defines how they adapt value propositions. I presented the spiral model of ecosystem evolution consisting of seven overlapping classes of value proposition and explained how it can be used to design ecosystem strategy, interventions, plans, products and technologies.

Figure 11 draws the components together to depict the complete Health Value Design framework. Briefly, the main components of the framework are as follows.

1. The co-creation practice hierarchy of actors and interactions

On the left-hand side is the eight-level co-creation practice hierarchy that defines the structure of an individual health service ecosystem. Moving up the hierarchy, each higher level incorporates the lower levels.

2. Adjacent service ecosystems

Next to the hierarchy are the adjacent connected service ecosystems, the choice of which to explore depends on the nature of the ecosystem problem enquiry, or the direction an enquiry takes.

3. The seven classes of value proposition

Along the bottom of the framework are the seven value proposition classes, ordered in sequence to the Health Ecosystem Evolution Spiral and the value-intensifying dynamic. Given the limitations of a 2D document, I am unable to show these in spiral form but rather lay them out side-by-side. Each value proposition class moving along the bottom of the framework from left to right incorporates and augments the preceding class.

4. Value design opportunities

In the centre is the matrix for populating value design opportunities for each level of co-creation practice and per value proposition class.

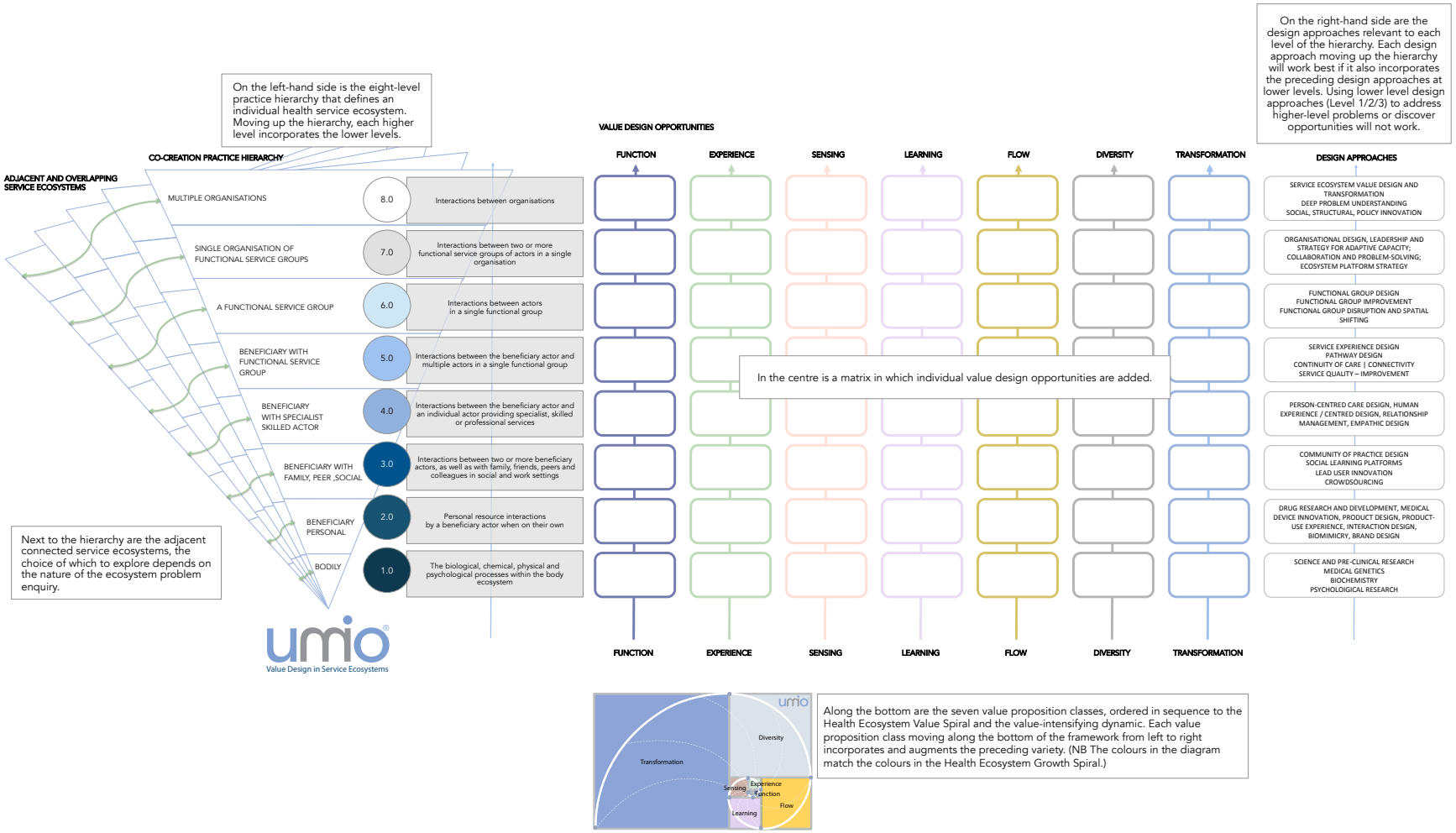
5. Design approaches

On the right-hand side are the design approaches relevant to each level of the hierarchy. Each design approach moving up the hierarchy will work best if it also incorporates the preceding design approach at lower levels. Using lower level design approaches (Level 1/2/3) to address higher-level problems or discover opportunities will not work.

Next, I discuss the core design principles embodied in the framework.

Figure 11

The Umio Health Value Design Framework



Using the Health Value Design Framework: Core design principles

In this section, I summarise the core principles embodied in the Health Value Design framework, together with some example outputs from past Umio studies (Note these contain modified data).

Avoid the pitfalls of framing within existing structures, assumptions and solutions

Today's health systems, structures and institutions are not permanent entities that exist outside of our imagination. Rather, they are the sum of multiple human interventions, designs and adaptations made over a long time period; they are a product of our collective imagination. This means that health systems can be remade and reimagined; they can be transformed. Institutions such as hospitals, clinics and even doctors are all solutions that were once made and imagined to deal with earlier health problems. Yet that does not automatically mean they are the best solutions for dealing with today's complex health problems.

Consider a hospital, a particular practice configuration of surgical, ward care, outpatient, emergency room, supplies and administrative functional services (at Level 7 in the hierarchy), with actors bounded by mostly shared values of control, co-ordination, specialization and efficiency. However, as health contexts change (for example, an increasingly elderly frail in-patient population, susceptible to falls and infection), hospitals are increasingly becoming burdened, struggle to deliver outcomes efficiently and some argue less suited to the health contexts which they try to deal with; in other words, they are not necessarily the optimum practice configuration.

By their very nature, health service ecosystems are open and fluid systems. They are complex adaptive entities, subject to the evolutionary forces of context shift, resource flow and change, both within and from outside adjacent ecosystems. However, when overlaying an ecosystem perspective onto current health systems, we inherently adopt a transformational, adaptive frame to problem solving. Through the objective nature of the four components of the framework, it is possible to overcome status quo thinking when seeking to design or transform value in health service ecosystems. This is because none of the components assume any current, idealistic or naturalistic structure, system, institution or practice configuration of actors and resources. Each contains independent units of analysis for assessing problems, finding opportunities and making interventions. Using them, we can find novel possibilities for designing and transforming health service ecosystems *independent of existing system and solution frames*. We can reframe and pursue new opportunities free of assumptions of the validity and persistency of existing practice configurations such as hospitals.

For industry providers, a health service ecosystem is a better way of defining a health market, particularly as previously distinct health markets such as pharmaceutical and medical devices are beginning to converge as their boundaries blur. This is a development that relates to the next core design principle embodied by the framework.

Look wide for adjacent possibilities

Just like natural ecosystems, all health service ecosystems are open and connected to other service ecosystems. Each level in the co-creation practice hierarchy is influenced by adjacent co-creation practices occurring in other service ecosystems, not always positively. As I have described, many of the social, economic, cultural and environmental determinants of poor health arise in adjacent service ecosystems related to work, food, transport, the built environment and education. In fact, practices in adjacent service ecosystems can often be the sources of *co-destruction* of value for individual actors in health service ecosystems, not co-creation. For example, poor access to healthy, nutritious, affordable foods will restrict an obese person's ability to lose weight; a lack of exercise facilities in the local built environment will limit their ability to get outdoors. It is the health designer's job to understand the nature, influence and causes of problems arising in adjacent service ecosystems in order to discover and design new possibilities.

Understand ecosystem diversity

Health service ecosystems exhibit diversity in two primary forms, *within practices* and *between practices*. When moving up the practice hierarchy in the framework, the level of diversity and complexity increases due to the greater number of actors, resources and interactions in practices at each higher level. Remember that each higher level incorporates the preceding lower levels. Nevertheless, using the analysis elements described in Component Two, it is possible to assess this *within practice* diversity and determine the most important dimensions by which practices differ at each level.

Between practices diversity arises from variation in the number and distribution of practices in a service ecosystem. Although all practices belong to one of the eight levels defined in the hierarchy, some ecosystems have actors and resources concentrated in fewer, more centralised practices, such as in 'big box' one-stop care provider facilities (in levels 5-7 of the hierarchy). Other service ecosystems have a greater number of practices distributed lower down the hierarchy, for example within communities or organised around a preventive health, social or family-based care model (in levels 2-4 of the hierarchy, as in Cuba for example).

To better understand complex health system problems, a health designer can map, compare and assess within and between practice diversity in a service ecosystem and then use this insight to guide learning and decisions about where, how, whether and when to intervene to improve or transform it. Without revealing the full picture of diversity, there is a risk of designing "one-size-fits-none" solutions within narrow frames of problem insight.

Separate problem learning from solution design

Many organisations struggle to even identify let alone address complex health system problems. Whether industry, government or provider, they lack problem understanding and system-wide vision, they suffer from an entrenched outlook, they lack innovation process and they are unable to manage change effectively. To increase the chances of success when facing a complex health ecosystem challenge, a core principle embodied in the Health Value Design framework is to make a greater separation between problem learning and solution design. Implicitly, it advocates more rigour and discipline in problem evidence generation and interpretation by first revealing deep opportunity patterns, gaps, contexts and paradoxes from the problem space.

Using the framework, health designers can step back and explore deep problem insight from a wider perspective. They can look outside of health into other service ecosystems; they can apply "what if" tests to current practices and configurations; they can create new themes of opportunities and they can flip current contexts and dominant logic. Through creative interpretation of deep problem insight beyond status quo thinking, problem-solution separation produces wider frames of reference and a greater number of opportunity themes for addressing complex health system problems not thought of previously. A health designer adds depth to complex problem understanding and widens the scope, creativity, value and fitness (to ecosystem actors) of new value propositions, ecosystem strategy, technologies, products, and services. Figure 12 is an example map of a problem space produced in a previous Umio study.

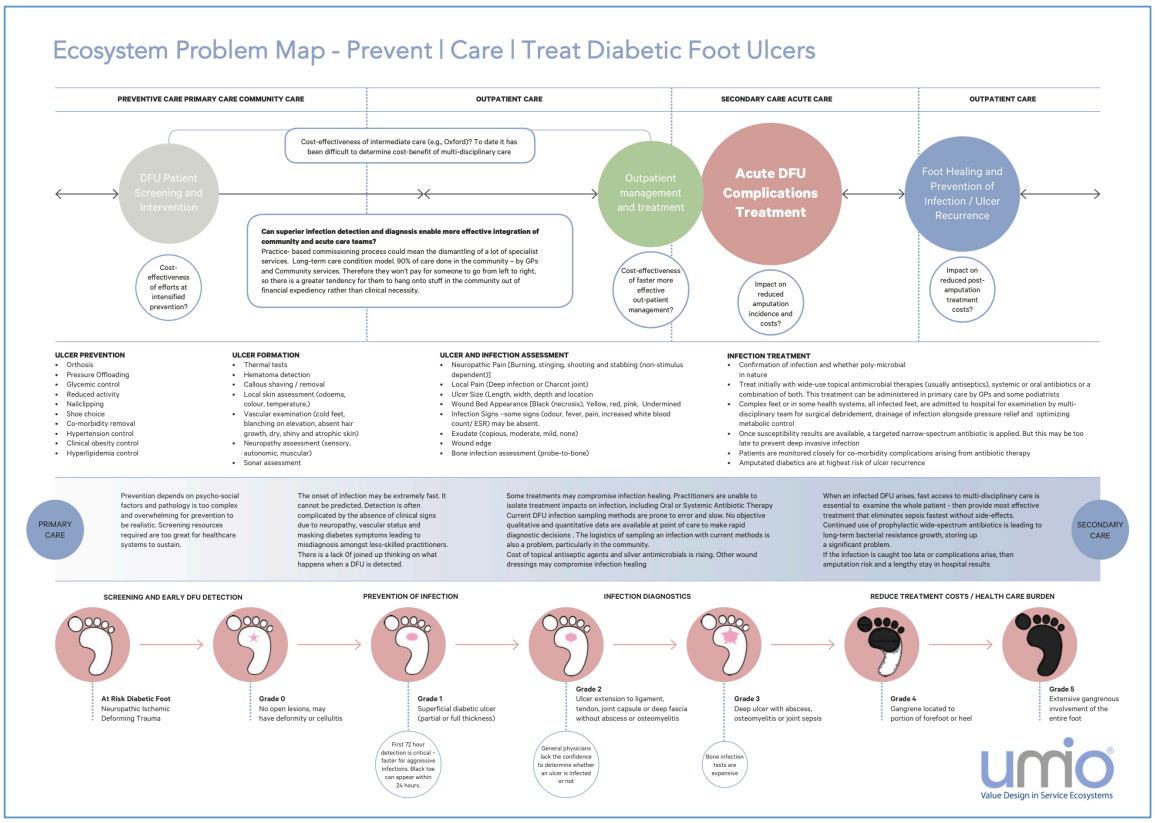


FIGURE 12 – Example Umio map of a complex health system problem space

Design Value Frames to theme a portfolio of opportunities

Separating problem learning from solution design affords greater opportunities for building creative redundancy into the health design approach as well as within practices in health service ecosystems. Creative redundancy is when health designers as well as ecosystem actors have a wider variety of options to intervene in or adapt responses to different complex problem situations. Given the diverse and complex nature of problems at higher levels of the hierarchy, a single design intervention or resource is often inadequate or may not be useful for all actors. Rather, having several options allows ecosystem actors to respond to different contexts and situations. Such redundancy is a vital aspect contributing to ecosystem sustainability.

At Umio, we embody creative redundancy in the form of a Value Frame, a thematic statement of possibility used to design multiple value propositions and ecosystem strategy and ultimately, to co-create or refine solutions. Each Frame defines problem evidence, actor unmet needs, ecosystems resource gaps, constraints to overcome, emergent contexts, priority outcomes and problem paradoxes as well as measures of potential value, whether commercial or health system. An early business model design may be included in each Frame too. Value Frames allow for further dialogue, collaboration and engagement around opportunities with both internal and external stakeholders.

Several Value Frames are designed in each Umio programme, creating a portfolio of possibilities that may be used to frame an overall organisational purpose and strategic effort for an extended duration of time. Too often innovators define opportunities using a limited frame of a solution or a technology. As I have stated above, this can introduce bias, lead to narrow thinking and produce short-term solutions. Figures 13 and 14 show two example Value Frames from past Umio programmes.

Value Frame For Home-Based Diabetic Osteomyelitis Detection

Qualitative PoC indicator of chronic neuropathic osteomyelitis to reduce stress burden on community nurses arising from failure to detect and facilitate faster referral of patients to hospital / clinic for initial treatment, and reduce complication costs.

TARGET CAPABILITY GAPS (OPPORTUNITY INDEX)	
Avoid osteomyelitis spreading to other bones in a diabetic foot (occurs in estimated 30% of cases)	81
Reduce the time it takes to detect osteomyelitis in a diabetic foot (within 2 days)	80
Reduce the time it takes to detect that a diabetic foot ulcer extends down to a bone (within 11 minutes)	79
Avoid contaminating a bone sample when testing for osteomyelitis with soft tissue wound organisms (contributes to 20% of false positives estimated)	77
Reduce the time it takes to remove infected bone from a diabetic patient (within 20 minutes, able to perform in GP or community wound clinic?)	76

SOLUTION CO-CREATION CONSIDERATIONS

- Active infection to be distinguished from colonisation
- Can a host infection response marker(s) provide positive and negative infection diagnosis from a single-point test?
- Is it possible to use bacterial load + host marker? POC bacterial load characterisation not likely to be feasible on short development timescales
- Stakeholder development partners?

KEY FUNCTIONS AND FEATURES

- Yes / No indicator of active infection in soft-tissue and bone
- Negative predictive value as well as positive tests
- Results within timescales of a patient appointment
- Low cost
- Ultra portable, suitable for community care
- Reduce sample contamination
- Reduce user contamination
- Unambiguous and actionable results readout

ADJACENT VALUE FRAMES

Wound Healing Monitor.
Risk Imager
Bone Sampler
Neuropath Checker
Antibiotic Regime Dashboard

Click on above to go to Frame

Market Size (Settings) 12.5k
Market Spend (Euro) 1.5bn
Cost Saving Target 0.5bn
Expected. Investment EU 45m
Euro Spend per setting 120k
Target Price per Installation EU 25000

umio® Transforming Value in Health

PRIMARY PREVENTION | RISK ASSESSMENT - SCREENING | CONDITION DIAGNOSTIC | THERAPY TARGETING

SETTING USE PROFILE - COMMUNITY DIABETIC WOUND CARE NURSING ECOSYSTEM

FUNCTION | EXPERIENCE | SENSING
LEARNING | FLOW | ADAPTATION
TRANSFORMATION

RESOURCE PROFILE

- Increasing resource deficiency due to continued annual increase in DFU incidence of 1-2%
- Limited resources need to be spread more effectively to higher-risk patients yet risk profile uncertain due to lack of evidence base

STRATEGIC FIT AND ECOSYSTEM TREND CONTEXT

- Aligns with strategy to upskill general practitioners in core high-risk areas, whilst enabling centralised monitoring of activity and response performance

COMPETITIVE SITUATION

- Two early-stage companies working on COD looking at combinations of ulcer depth and CRP or ESR measurements could provide a useful indicator of early-stage osteomyelitis (see REF 2)

PAYER PROFILE AND JUSTIFICATION

- Payers looking to decentralise DFU care and reduce costs in centralised locations; yet seeking upskilling of community nurse teams whilst ensuring contingency for high-risk cases in multi-disciplinary back-up teams; payer case must reflect this risk trade-off
- Shift to patient self-care slow paced due to risk factors in DFU and rapidity of decay of wound

CONFLICTS AND RISKS

- Experienced podiatrists (particularly in the US, about 33% of population) concerned and likely to be resistant about distributed infection diagnostic practices
- Evidence base for osteomyelitis uncertain with guidelines still in development, exp. 2015 update

TARGET ACTOR SEGMENTS 3 | 1 | 2 | 4

- Segment 3 (a primary-care located segment that sees a high number of diabetic foot ulcers) and Segment 1 (diabetic foot disease treatment specialists that are seeking superior methods to identify, diagnose, treat and heal diabetic foot ulcers) are key target segments and their needs, particularly Segment 3, should drive feature development
- Ultimately may be patient-self administered test

POC Antimicrobial Diagnostic Dashboard

A point-of-care antibiotic decision-making and monitoring system to enable enhanced evidence-based treatment selection and efficacy assessment

VALUE CASE DATA (EU5) Yearly-Euro
Market Size (Settings) 12.5k
Market Spend (Euro) 1.5bn
Euro Spend per setting 120k
Target Price per Installation EU 25000
Cost Saving Target 0.5bn
Expected. Investment EU 45m

TARGET CAPABILITY GAPS (OPPORTUNITY INDEX)	
Reduce the time it takes to detect an increase in specific antibiotic use within the community	84
Profile individual clinic settings for antibiotic use against caseload	83
Reduce the time it takes to adapt treatment guidelines for a community antibiotic treatment programme	82
Determine the base clinical criteria underpinning antibiotic decision-making for DFUs	77
Integrate view of antibiotic use across multiple therapeutic areas	76

KEY FUNCTIONS AND FEATURES

- Systems that gathers that reads PoC device use, readings and actions taken
- Data gathered centrally and distributed through decision-maker dashboard
- Potential to add on additional data to profile antibiotic use patterns linked to condition – disease incidence

SOLUTION CO-CREATION CONSIDERATIONS

- Secondary revenue stream by providing dashboard data to biomarker developers and running clinical trials
- Need to integrate different tests; is it possible to gather and categorise data from multiple methodologies; and return it empirically to justify more objective decision-making
- All developments must closely anticipate PoC test evolution and introduction to the market.

ADJACENT VALUE FRAMES

Wound Monitor.
Risk Imager
Bone Sampler
Neurochecker
Closer to the Bone

Click on above to go to Frame

BACTERIAL INFECTION TREATMENT ECOSYSTEM

PRIORITY CHAPS OUTCOMES AND PERCENT ACTOR IMPORTANCE	
Avoid growth in antibiotic resistance due to ongoing use of wide-spectrum antibiotics	87.2
Minimize the use of wide-spectrum antibiotics used to treat infection in a diabetic foot ulcer	78.2
Respond to unwanted changes in antibiotic use within the community	75.2
Reduce the volume of false positive infection referrals for patients with DFUs	69.2
Improve ecosystem actor antimicrobial knowledge exchange	59.5

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PATHWAY - SETTING PROFILE

HOME | INSTITUTIONAL CARE | SOCIAL CARE
GP | DIABETIC CLINIC | TRANSFER
EMERGENCY | IN-PATIENT | ICU

RESOURCE PROFILE

- The shift in the burden of antibiotic resistance from Gram-positive to Gram-negative infections is of some concern. HAIs are a major public health problem in Europe. HAI prevalence was the highest in patients admitted to intensive care units (ICUs), where 19.5% patients had at least one HAI

CONFLICTS AND RISKS

- Transition to PCR tests by less specialist staff will require close monitoring and careful handover of responsibility. Developments are likely to be piecemeal and risks need to be managed with enhanced evidence, and increased oversight. Role conflicts are likely to arise and these need to be carefully considered as part of any implementation (see conflict summary in detailed report.)

STRATEGIC FIT AND ECOSYSTEM TREND CONTEXT

- Aligns with strategy to link increasingly distributed, decentralised diagnostic and theranostic technologies through new forms of dashboard monitoring
- Most attention is focused on the development of biomarkers for near- and POC diagnostic technologies. Few are considering the opportunities for innovation / new unmet needs arising from a more fragmented ecosystem

PAYER PROFILE AND JUSTIFICATION

- As near point-of-care antimicrobial detection technologies come on-market in the next 3-5 years, payers will need greater evidence of their relative efficacy and use to justify cost as well as the value of new innovations.
- An antibiotic regime dashboard provides the reliable evidence for them to make smarter approval decisions
- Local commissioners will also require ongoing evidence to influence and determine prescribing patterns

TARGET ACTOR SEGMENTS 1 | 2

- Segment 1 (diabetic foot disease treatment specialists that are seeking superior methods to identify, diagnose, treat and heal diabetic foot ulcers) is the primary target for this platform and Segment 2 (active infection specialists who are keen to develop wound and infection management best practices and are concerned with the growth of antibiotic resistance) are key targets for this Value Frame
- Strategic-oriented microbiology managers
- Infection control managers within hospital settings
- PoC biomarker developers and investors

FIGURES 13 and 14 – Example Umio Value Frames

Build an ecosystem-aligned organisation

To be able to design value repeatedly in health service ecosystems, and address complex health problems, organisational leaders must seek to nurture adaptation, promote diversity and continuously challenge internal status quo thinking. After all, an organisation functioning within an ecosystem is part of the ecosystem itself, and subject to the same forces of adaptation and evolution as all other actors. To build an ecosystem-aligned organisation, leaders and designers must ask and pursue answers to a different set of questions, such as these:

1. What are our service ecosystems of interest? Do we focus on one ecosystem or several?
2. How wide do we go when looking for problems causes and risk factors, which are opportunities for value creation? What adjacent service ecosystems do we search in and who should we partner to explore them? What variety of actors (groups, individuals, public bodies) should be engaged?
3. How do we build a deeper capability for complex problem learning? What insight do we obtain from human sense making and what is derived from data and analytics pulled? How is this learning combined for action?
4. How do we synthesise deeper problem learning with activities of solution design and co-creation? Which problems can we solve through a process of prototyping-iteration and which require greater separation from solutions, involving a deeper dive into the problem space beforehand?
5. What classes of value-proposition do we design? How do we evolve our strategy to capture new classes of value and deliver it continuously?
6. How can we avoid a tendency to jump to assumptions about the problems we should look at?
7. Similarly, how we can avoid jumping to assumptions about the solutions or the types of solutions we should build or source?
8. How do we take a future rather than past view of opportunity and value, and not get locked in to a " if it is not broken, don't fix it" mentality?
9. How do we design an evolutionary, ecosystem view of strategy that is representative of the ongoing value we wish to create, rather than tied to a solution?
10. How do we harness complexity instead of trying to eliminate it?
11. How do we organise all the above into a repeatable yet flexible framework for innovation and strategy, one that enables ongoing problem learning, opportunity discovery, value design, representative strategy and the exploration of future possibilities?

Next, I present some example Health Value Design Strategy Maps, an important output of the Umio approach using the framework.

Using the Framework – Core Health Value Design Principles

There are six core design principles embodied by the Health Value Design framework. These are:

1. Avoid the pitfalls of framing with existing structures, assumptions and solutions
2. Look wide for adjacent possibilities
3. Understand ecosystem diversity
4. Separate problem learning from solution design
5. Design Value Frames to theme a portfolio of opportunities
6. Build an ecosystem-aligned organisation

Example Umio Health Value Design® Strategy Maps

Over the next four pages are examples of Health Value Design Strategy Maps. Each of these depicts a an ecosystem strategy consisting of a series of linked Value Frames and value propositions, in sequence to achieve a transformational or improvement ecosystem objective. Each strategy is informed from deep enquiry into a complex problem situation using the Health Value Design framework, and the six core principles listed above.

The four Strategy Maps shown are for the following health service ecosystems, complex problems and transformational or improvement goals.

1. IMPROVE QUALITY OF LIFE WHEN LIVING WITH CARDIAC DISEASE

Transforming cardiac disease monitoring by shifting services to the patient's home

How might we shift the monitoring of a patient's cardiac disease from a central functional group service to their home, and when they are away from home?

2. PROVIDE-OBTAIN SERVICES TO SUPPORT A PARTICULAR DRUG TREATMENT

Designing pharmaceutical value-added services

How might we provide value-added services to augment and differentiate our me-too clinical drug value proposition?

3. IMPROVE PATIENT OUTCOMES IN AN ACUTE CARE SETTING

Hospital inter-professional collaboration

How might we go beyond functional inter-professional collaboration to achieve better patient, nurse and clinician co-ordination and outcomes in hospitals?

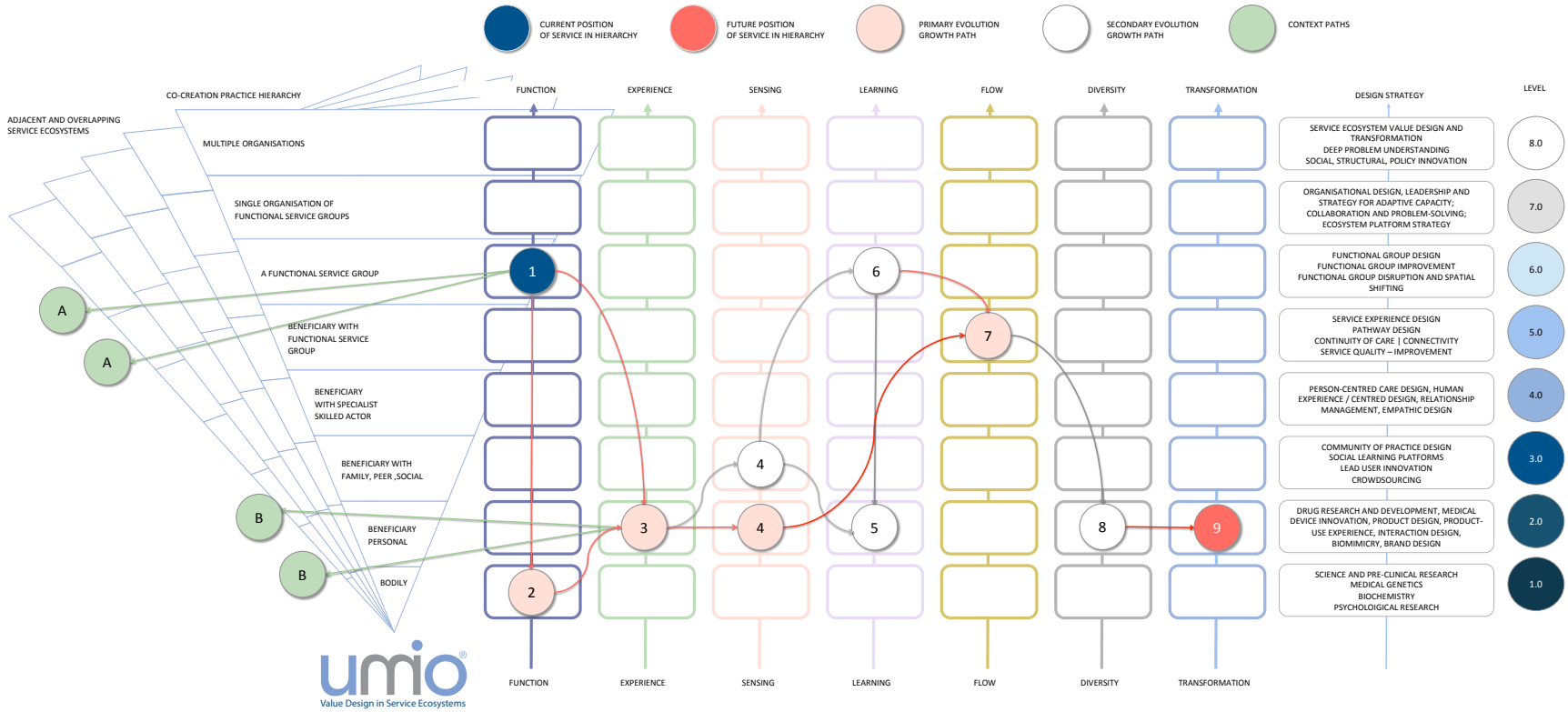
4. **ADDRESS A COMPLEX HEALTH ECOSYSTEM PROBLEM**

Complex health ecosystem problem collaboration

How might we collaborate with outside partners to deeply understand a complex health ecosystem problem, and come up with a portfolio of value proposition options?

Transforming cardiac disease monitoring by shifting services to the patient's home

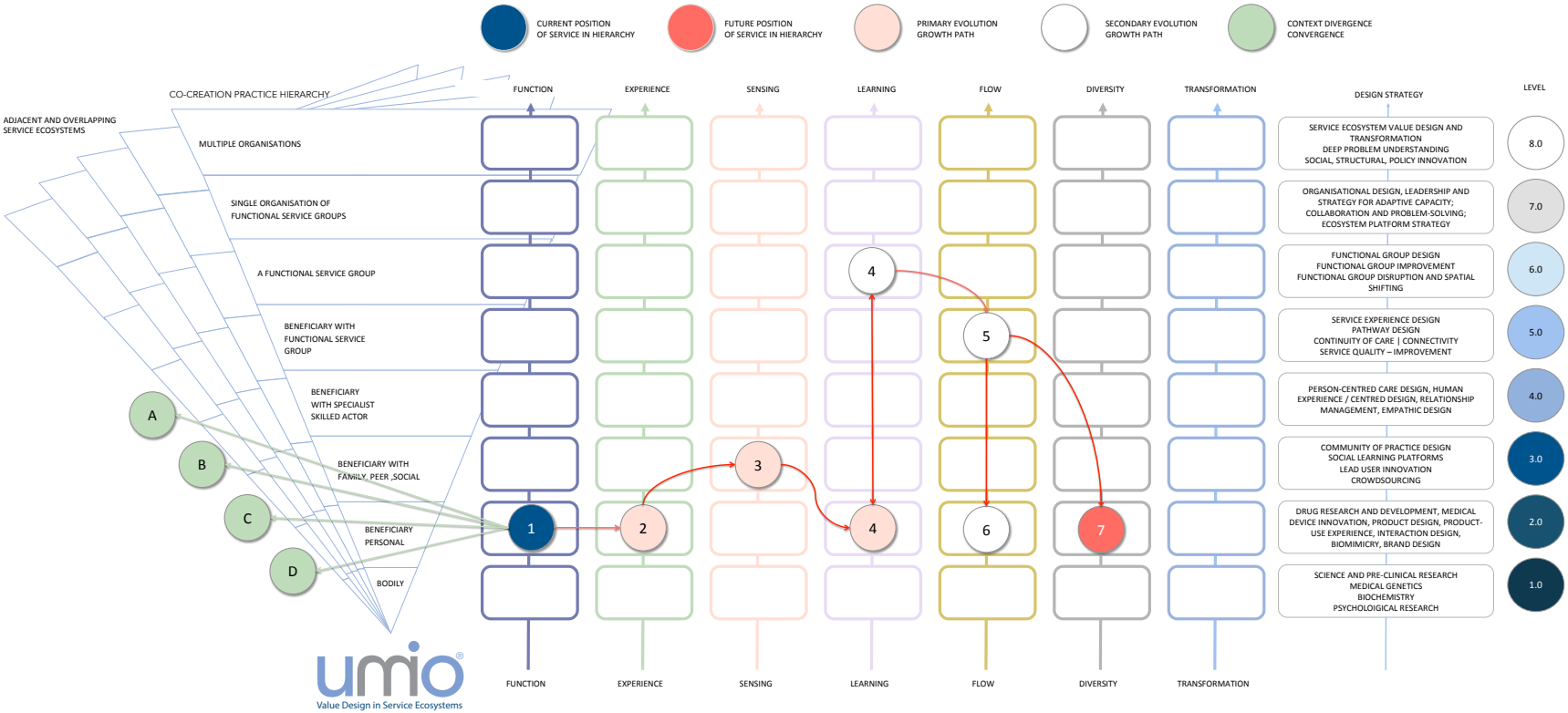
How might we shift the monitoring of a patient's cardiac disease from a central functional group service to their home, and when they away from home?



1	Define the current service ecosystem. Map actors, resources, interactions, services, outcomes and values. Explore patterns, opportunities and diverge to adjacent contexts for deeper understanding of patient experience, goals, functioning and capabilities. Define financial model and outline health economic case. Design new possibilities with actors, avoiding jumping into solutions.	5-6	Define internal and system data analytics capability to learn about patient behaviour and response, risks; share learning with functional service groups in the form of value-add services to advance ecosystem knowledge of patient self-monitoring experience and exceptions
A/B	Explore adjacent service ecosystems for contexts that influence patient capability to host a service at home. Determine which patient segments are most capable and use this insight to design interventions and shape technologies.	7	Design flow / connectivity services (personal records access, secure messaging, remote monitoring etc.) to link patient with functional service groups and to build collaborative learning, risk monitoring and adaptive capacity overall. This expands the patient population and adoption potential of the service
2/3	Design Value Frames around possibilities focusing on each or combination of value class, e.g. function-experience-sensing in this case depending on the problem / opportunity findings. Link to patient and provider segments.	8	Expand reach of service to more diverse patient groups through functional variation (e.g., simplification, new contexts) and extend ecosystem adaptive capacity by including patient groups and divergent perspectives in ongoing problem enquiries.
4	Create sensing Value Frame for a patient – peer – social group and link into the core functional – experiential Value Frame, to aid collective sense-making and crowdsourcing of solutions and innovative ideas to problems	9	Final position is Level 2.0 – the shifted formerly centralised service now firmly installed in patient homes.

Designing pharmaceutical value-added services

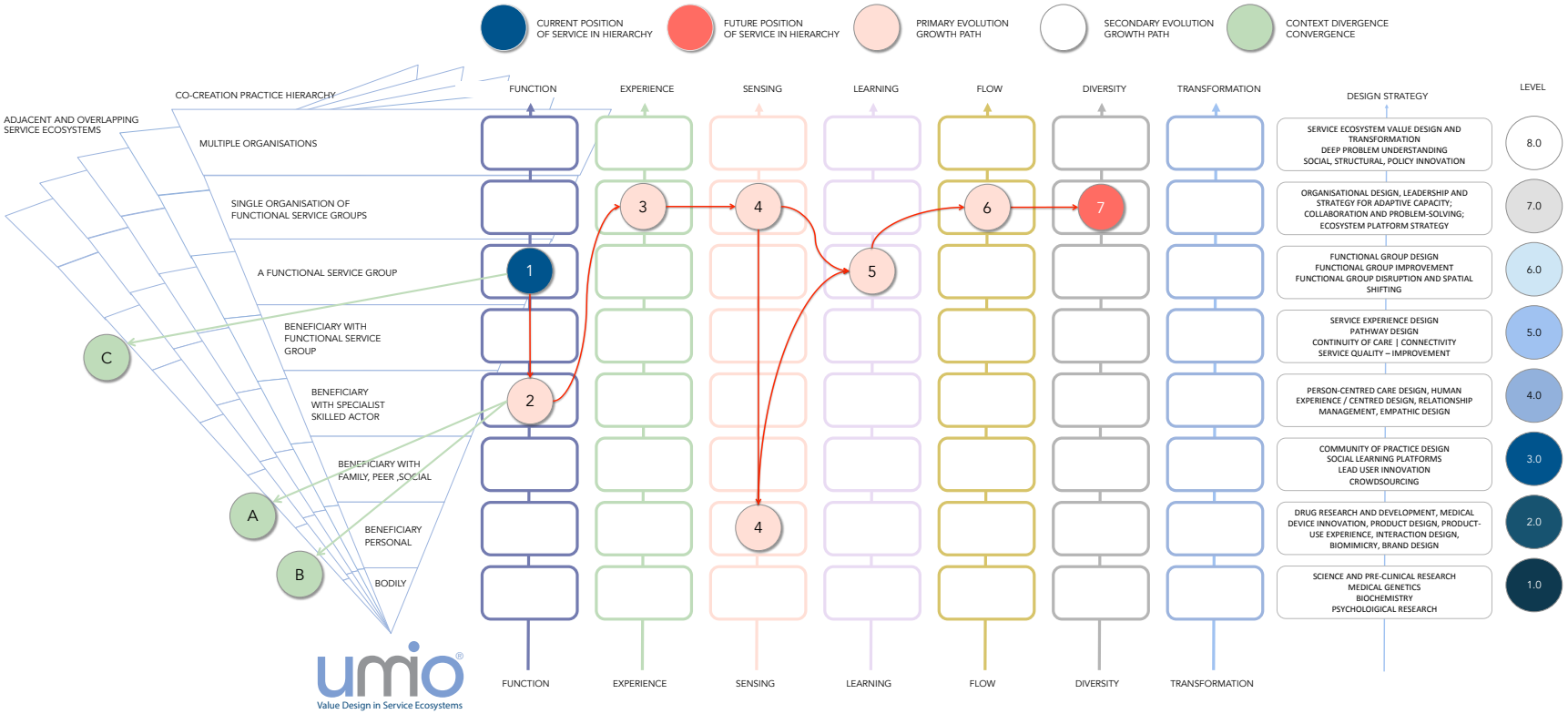
How might we provide value-added services to augment and differentiate our me-too clinical drug value proposition?



1	Starting at Level 1.0 in the hierarchy – a drug treatment intervention.	4	Develop a patient group and social learning platform to aid collective sense-making and crowdsourcing of solutions and innovative ideas to problems
A-D	Use Umio units of analysis to explore patient resources, interactions, services, outcomes and values in core and adjacent ecosystems, e.g., environment, work, travel, communications, food-nutrition (A-D) – any ecosystem context that has a bearing on patient outcomes	5	Support knowledge sharing and learning with professional functional service groups to allow them to develop more whole patient understanding
		6	Design flow / connectivity services to link patient with functional service groups, and specialist-skilled actors to build collaborative learning, patient experience and ecosystem adaptive capacity, thereby extending the sustainability of the treatment and value services
2	Design new services to improve patient experience to support adjacent context outcomes improvement within and beyond the clinical treatment domain, e.g., when travelling, when socialising, food, exercise etc.	7	Expand reach of service to a more diverse patient group and extend adaptive capacity, providing the means to continue to innovate and differentiate the service offering
3	Support patient and family / caregivers to sense problems, risks, positive changes and share experiences with peers	EXAMPLE CONTEXTS Obesity, addiction, cardiovascular disease, T2 diabetes, multiple sclerosis, osteoarthritis, etc.	

Hospital inter-professional collaboration

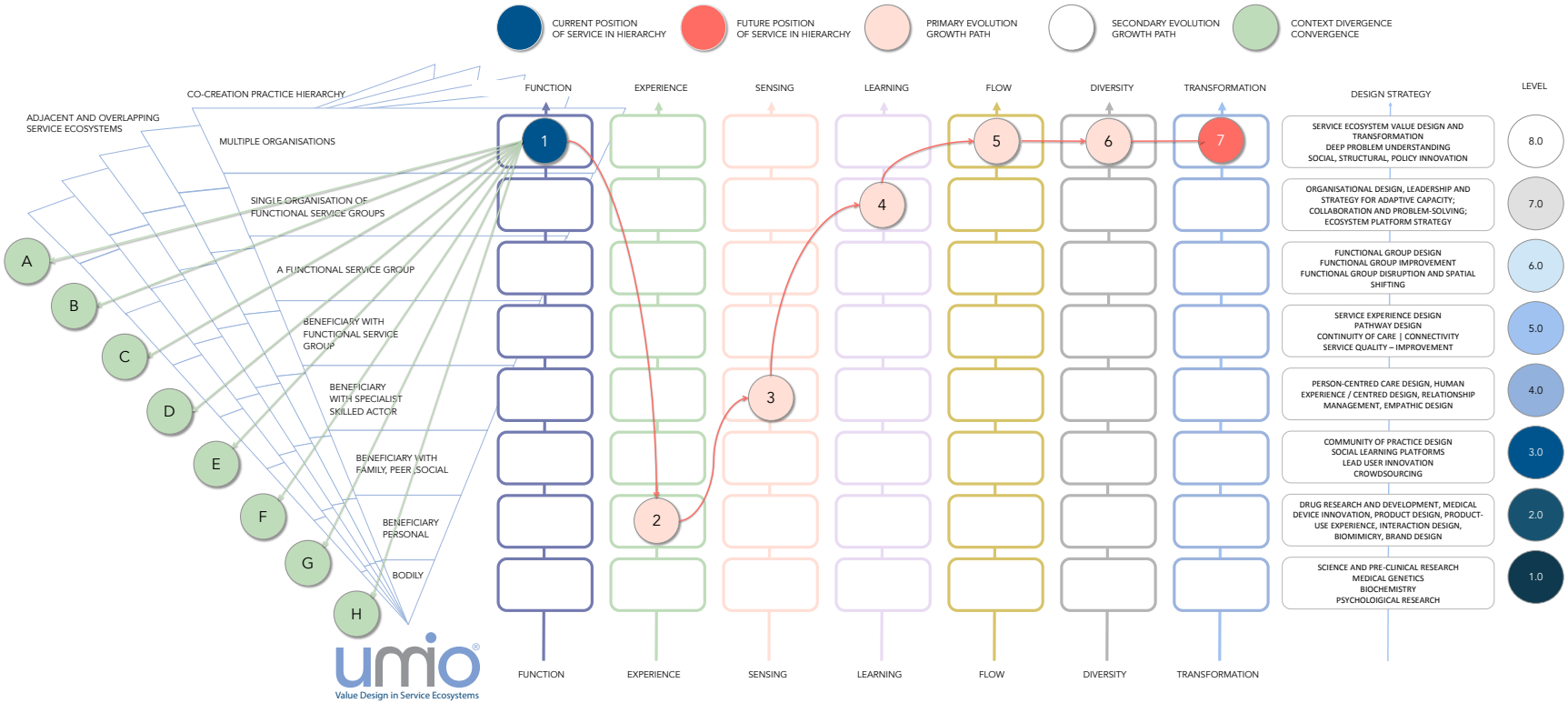
How might we go beyond functional inter-professional collaboration to achieve better patient, nurse and clinician co-ordination and outcomes in hospitals?



1	Starting point – individual service groups such as ward teams, medical teams, engaged in functional, episodic interaction	4	Co-create formal and informal collaboration strategies and action plans (that sense and identify problems, risks and opportunities) with multiple functional service groups taking into account need for different interactions, activities and meanings. Put these into context of delivering an improved patient experience to create a unified, aligned sense of purpose
2	Identify functional activities and services provided to patients by functional service groups that require inter-professional collaboration, e.g., on a hospital ward		
3	Using Umio units of analysis, determine the "experience of interaction" between multiple functional groups" – purpose, resources used, types and values/meanings ascribed as well as the +/- outcomes that result	5	Capture data and analytics about the efficacy of the new strategies and establish these in collaborative learning routines and artefacts; link these together into a unified collaboration learning strategy at multi-group level
ABC	Examine adjacent contexts of patients that may influence the interactions needed, e.g., home context, co-morbidities, family, etc., and also those of professionals that influence interactions and values for individual functional service group, e.g. professional education, ongoing training, socialisation opportunities, peer networking – sourced values; as well as the context of hospital leadership	6	Improve connectivity of multiple functional groups by examining routinised collaboration that may be substituted with technology; build connectivity to further add efficiency and efficacy whilst improving the patient experience
		7	Build collaboration at scale across multiple deployments and functional groups to allow more diverse collaborative requirements; create a self-learning system

Complex health ecosystem problem collaboration

How might we collaborate with outside partners to deeply understand a complex health ecosystem problem, and come up with a portfolio of value proposition options?



1	Starting at Level 8.0 in the hierarchy – a multi-organisational, ecosystem wide complicated health problem, e.g., obesity, drug resistance, opioid addiction	4	Gather data on patterns, insight and learning from ecosystem actors to stimulate learning; set problem challenges based on knowledge of root causes and ecosystem deficiencies
A-H	Use Umio units of analysis to explore and reveal deep problem patterns in adjacent ecosystems, e.g., environment, work, travel, communications, food-nutrition (A-H) – any ecosystem context that has a bearing on the problem	5	Improve flow of insight, data and problem understanding across multiple actors at all levels
		6	Converge actors from outside the core ecosystem to widen perspective and stimulate diversity and problem-transformation potential; examine conflicts and constraints; ; attack the context and look for dominant logic and values
2	Understand impact of contexts and adjacencies on beneficiary actors – their resources, interactions, activities / services, contexts, values and outcomes	7	Define ecosystem transformation strategy, objectives and roadmap; design social and policy innovation, incentives and grants; conduct education programs etc.
3	Search for, and stimulate sense-making and problem interpretation in social learning platforms, communities of practice, social media	EXAMPLE CONTEXTS Reducing obesity, addiction, elderly loneliness, cardiac disease, medicine overprescribing	

Final word

The need for advanced (eco)systemic design thinking problem learning and solving capabilities has never been greater. As persistent complex health system problems continue to drain scarce resources and lead to worsening health and societal outcomes, there is a pressing need to reframe the current paradigm of problem approaches.

No longer can we rely on iteratively developing rapid solutions and technologies based on flawed and narrowly defined insight with a subset of ecosystem actors; rather, we need to go both deeper into the heart of complex problems, and wider to explore adjacent possibilities for transformation. In short, we need to rethink how we approach the understanding of complex health system problems in the first place.

In this paper, I have set out a design framework and approach for addressing complex health ecosystem problems. This framework:

- Defines individual and adjacent health service ecosystems to frame problem enquiry and analysis
- Embodies the dynamic functioning and universal components of health service ecosystems, allowing for their objective analysis, profiling, patterning and comparison
- Allows the identification and mapping of multiple actor types, interactions, activities and relationships
- Profiles the resources used by actors alone, or when interacting with others, when engaged in activities, allowing us to assess resource and practice costs, and predict the effect of changing the current resource mix or introducing a new resource into a practice
- Helps to avoid bias or making assumptions about the form or existence of practices or the solutions that actors should use
- Provides a methodological framework for understanding and measuring the nature and pattern of diversity within health ecosystems
- Delivers greater knowledge and foresight about complex health system problems, and gets us closer to their root causes
- Defines appropriate design and innovation approaches for making interventions in health ecosystems
- Reveals new possibilities for designing and transforming value in health
- And which ultimately, supports the co-creation of better solutions and interventions

We do this at Umio

At Umio, we believe that deploying a deeper and more appropriately applied natural ecosystem perspective helps us to better address complex, persistent health system problems. There are many novel possibilities for doing so.

We are excited and ready to help you find, shape and realise these possibilities. I hope this paper has demonstrated this clearly and you share in our excitement too.

About Umio

Umio helps pharmaceutical, medical device, IT, care provider, social innovation and government organisations to design value and transform outcomes in their therapeutic area, health market or social context.

We do so through a unique blend of advanced, early-stage, upstream innovation process, original strategic ecosystem design thinking, and deep thought leadership.

Health Value Design® is Umio's innovation and strategy approach for the discovery, design and transformation of value in health ecosystems, contexts and settings. Health Value Design® takes an ecosystem view of complicated problem situations, tailoring each programme for specifying problems, engaging with multi-stakeholders, capturing the ideal future, finding hidden opportunity patterns and re-imagining valid, desirable and feasible possibilities for intervention and action.

Central to our philosophy is that understanding problems, identifying opportunity and defining potential interventions *independent of specific solutions* is a strategic design problem in itself.

Health Value Design® is an advanced framework for enquiring into health ecosystem problems and designing value, consisting of ten foundational principles organised into a loose process flow model (see Figure 15). It has been applied in different guises in multiple health service ecosystems for the past ten years, yet through ongoing adaptation has itself evolved into the system defined in this document. Example projects can be found on our website.

Contact us today to discover how Umio can solve your complex health ecosystem problem, and help you deliver breakthrough results.

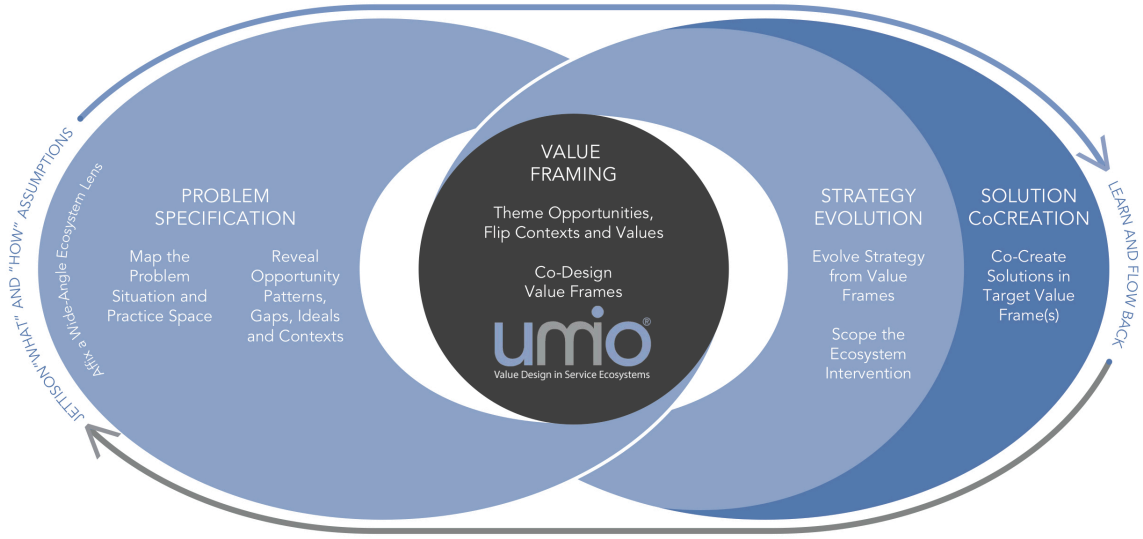


FIGURE 15 - The flow and foundations of Umio Health Value Design

About the Author

Chris Lawer is the CEO of UMIO.

For twenty years, he has specialized in advancing early-stage innovation and value design by synthesising deep problem analysis with strategic design thinking. Chris has advised companies in multiple industries and in most major geographical markets but has been primarily working in health contexts for the past 10 years.

His broad sector experience of how to find opportunities, and design winning value-propositions and strategy helps Umio's clients see and capture novel innovation and growth opportunities, beyond status quo thinking. He also supports them to build advanced early-stage innovation and "upstream" design thinking capabilities.

Through his work in health ecosystems, Chris has acquired particular specialism in wound care, infection prevention and control, the surgical ecosystem, diabetes, diabetic foot, ostomy care, incontinence and obesity. The Umio team covers many other therapeutic and disease areas.

Chris has a research degree from Cranfield School of Management, a Masters degree in economic development and a first degree in geography from Liverpool University. His research work at Cranfield concerned the development of customer-orientation at a global medical device company.

He is based in Oxford UK, is frequently in the US at Umio's Cambridge, MA office, and often works globally. Chris' thoughts on value design and strategy in service ecosystems can be found on his blog at www.chrislawer.com. He can be reached via email at chris.lawer@umio-health.com or on Twitter at @chrislawer.

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