The “Buildable” Blueprint Toolkit

Introducing a World Bank ***facilitation*** aid for developing a national-scale digital health infrastructure investment plan.

Derek Ritz, P.Eng., CPHIMS-CA

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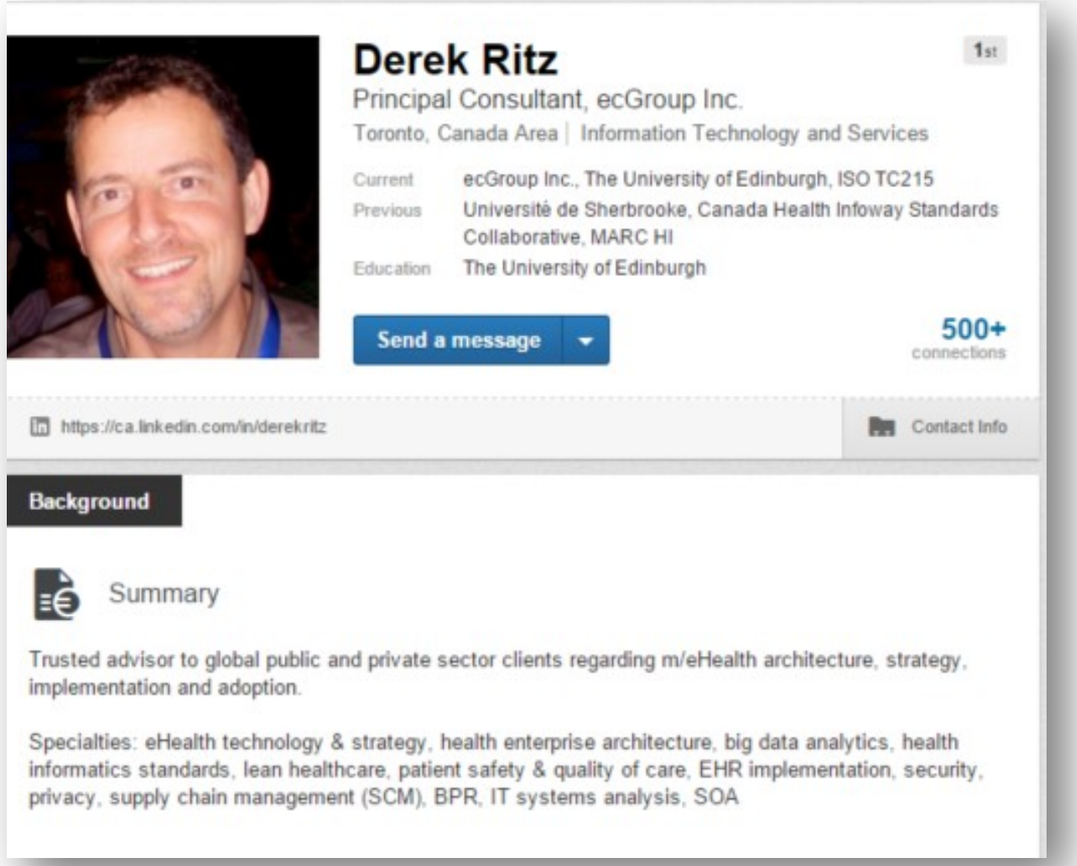
Mandatory apologies…

Story arc…

- *Super-brief* ***introduction***
- ***Why*** do “we” need the Toolkit… and ***what*** exactly does the Toolkit ***do***?
- ***How*** does the ***Investment Case*** work?
- Q&A

LinkedIn



OpenHIE

World Health Organization · unicef · UNOPS

Joint Learning Network For Universal Health Coverage · The World Bank · ADB

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ISO · HL7 · IHE · HL7 FHIR Foundation Founder

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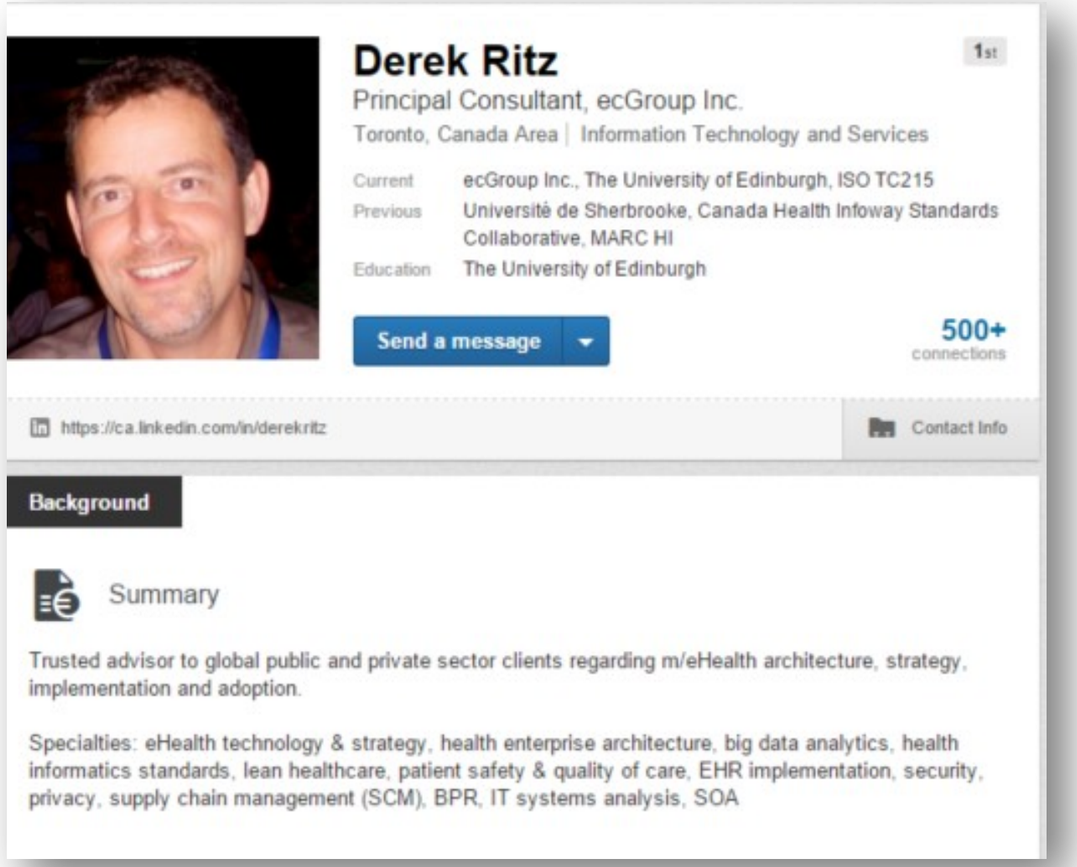

Derek Ritz

1st

Principal Consultant, ecGroup Inc.

Toronto, Canada Area | Information Technology and Services

Current ecGroup Inc., The University of Edinburgh, ISO TC215

Previous Université de Sherbrooke, Canada Health Infoway Standards Collaborative, MARC HI

Education The University of Edinburgh

Send a message

500+ connections

https://ca.linkedin.com/in/derekritz

Contact Info

Background

Summary

Trusted advisor to global public and private sector clients regarding m/eHealth architecture, strategy, implementation and adoption.

Specialties: eHealth technology & strategy, health enterprise architecture, big data analytics, health informatics standards, lean healthcare, patient safety & quality of care, EHR implementation, security, privacy, supply chain management (SCM), BPR, IT systems analysis, SOA

OpenHIE

World Health Organization

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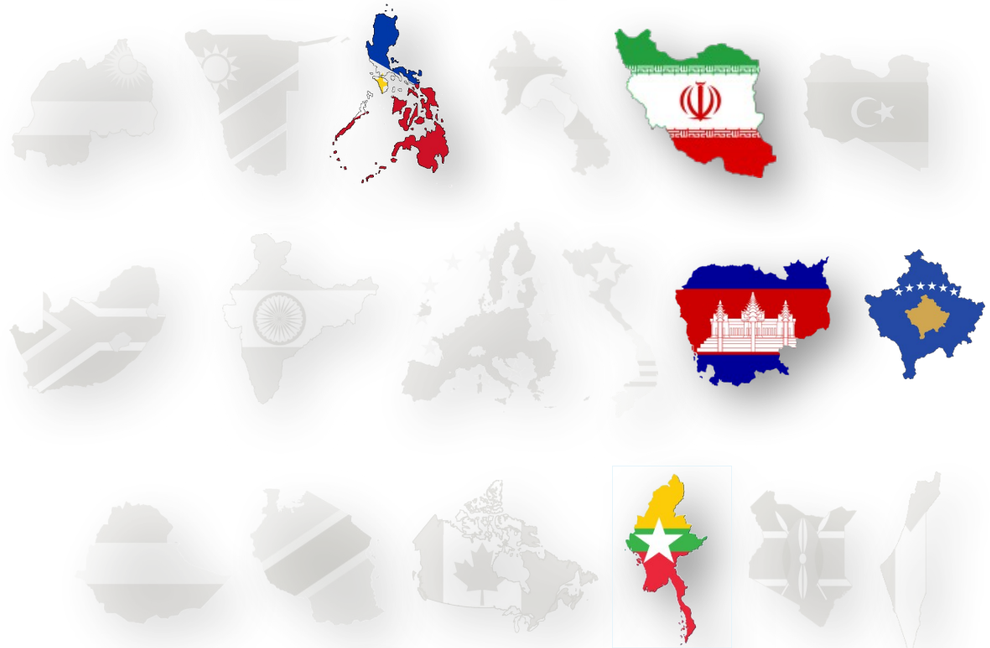
THE WORLD BANK

ADB



Canada Health Infoway

Inforoute Santé du Canada

ISO

HL7

IHE

HL7 FHIR FOUNDATION Founder

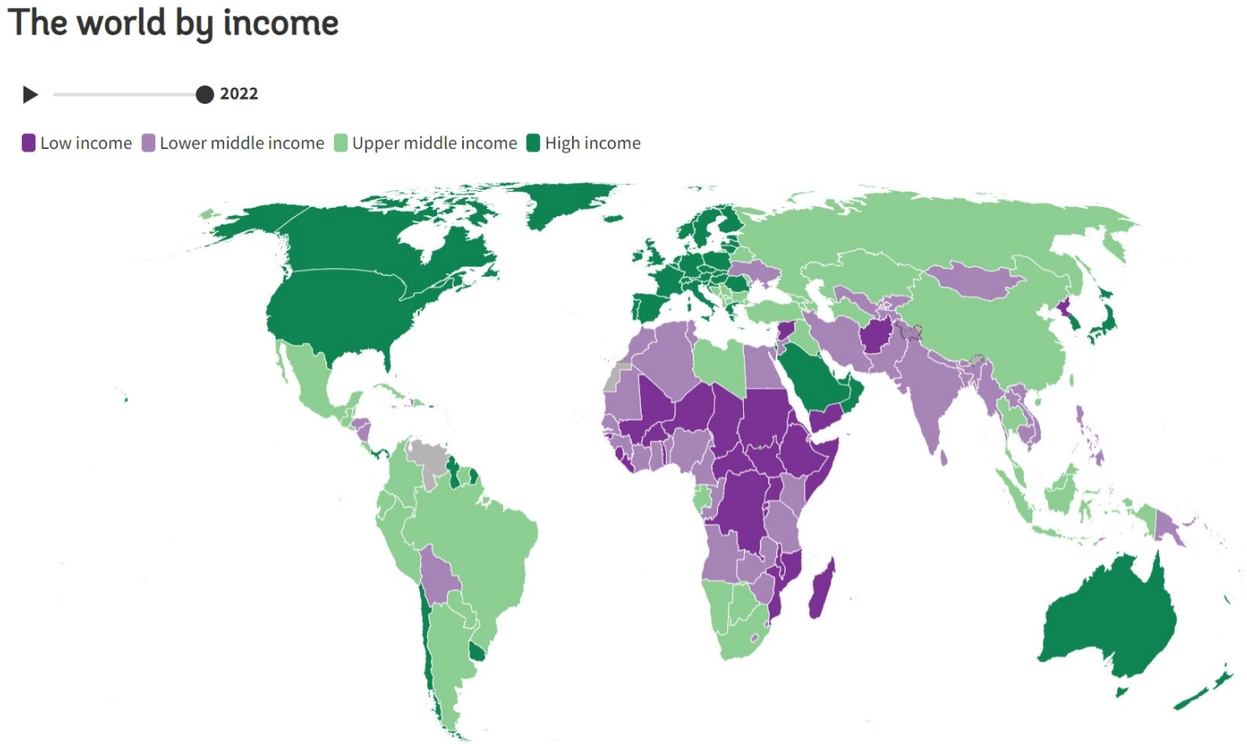
What ***is*** this Toolkit?

https://www.youtube.com/watch?v=uLX1pyam7IU

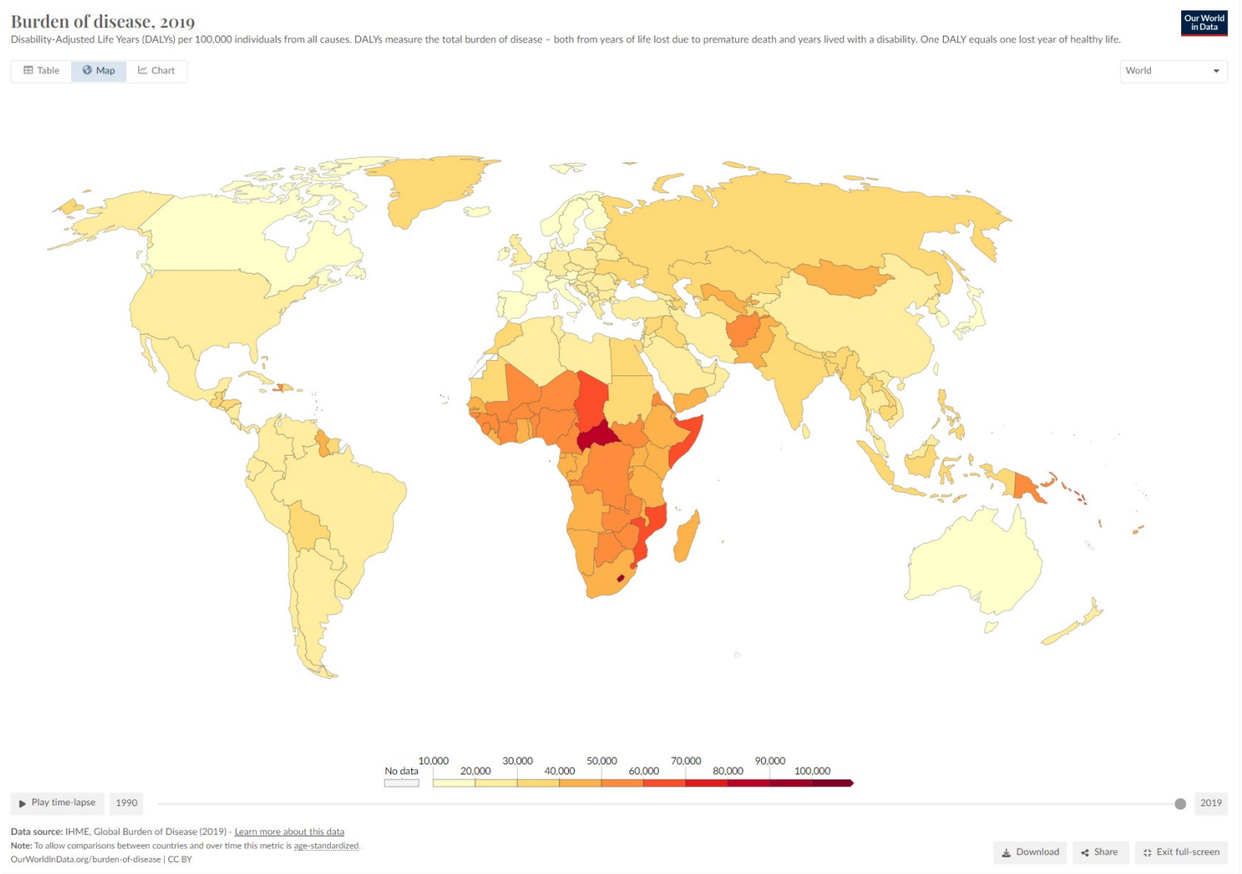
The **Toolkit** is a set of pre-built PPT decks, Google Forms, and WORD documents along with accompanying “how-to” guides regarding their use. These are **templates**. They are designed to be leveraged by a **facilitator** who is supporting a technical working group (**TWG**) tasked with developing and publishing a ***buildable*** digital health blueprint based on the **HL7 FHIR** standard.

Why is this toolkit important?

For the World Bank, low- and middle-income countries (**LMIC**) represent a ***health equity***-addressing opportunity.

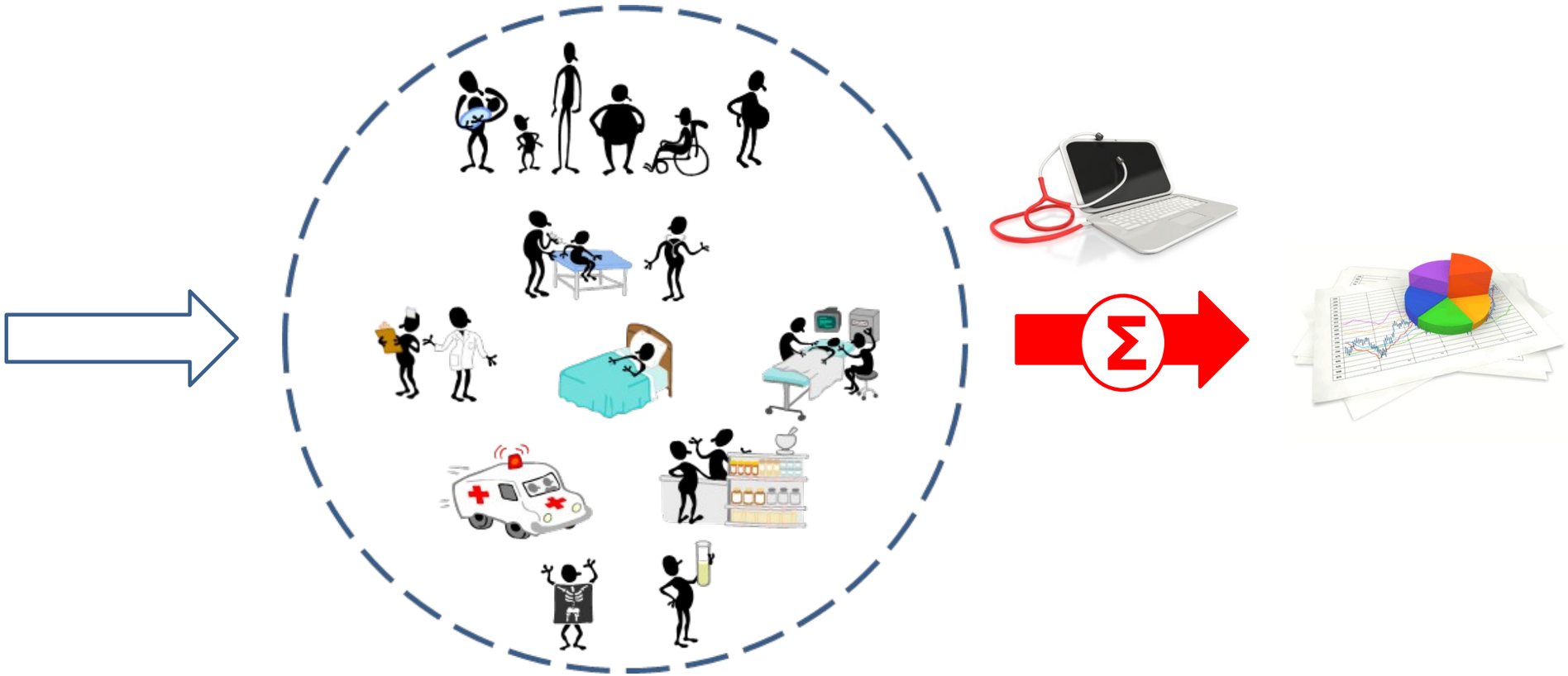


https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html



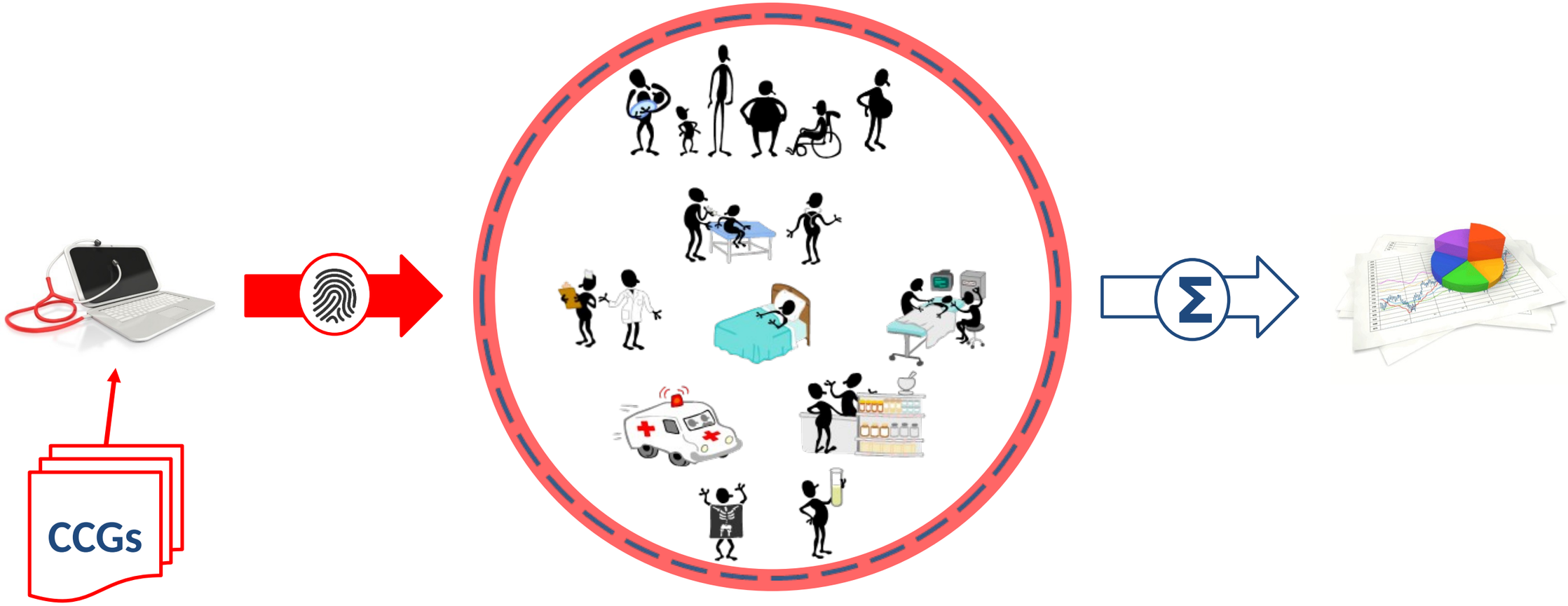
https://ourworldindata.org/health-meta

Over the last decade, digital health investments in LMICs have often focused on measuring ***aggregate indicators*** (outputs).

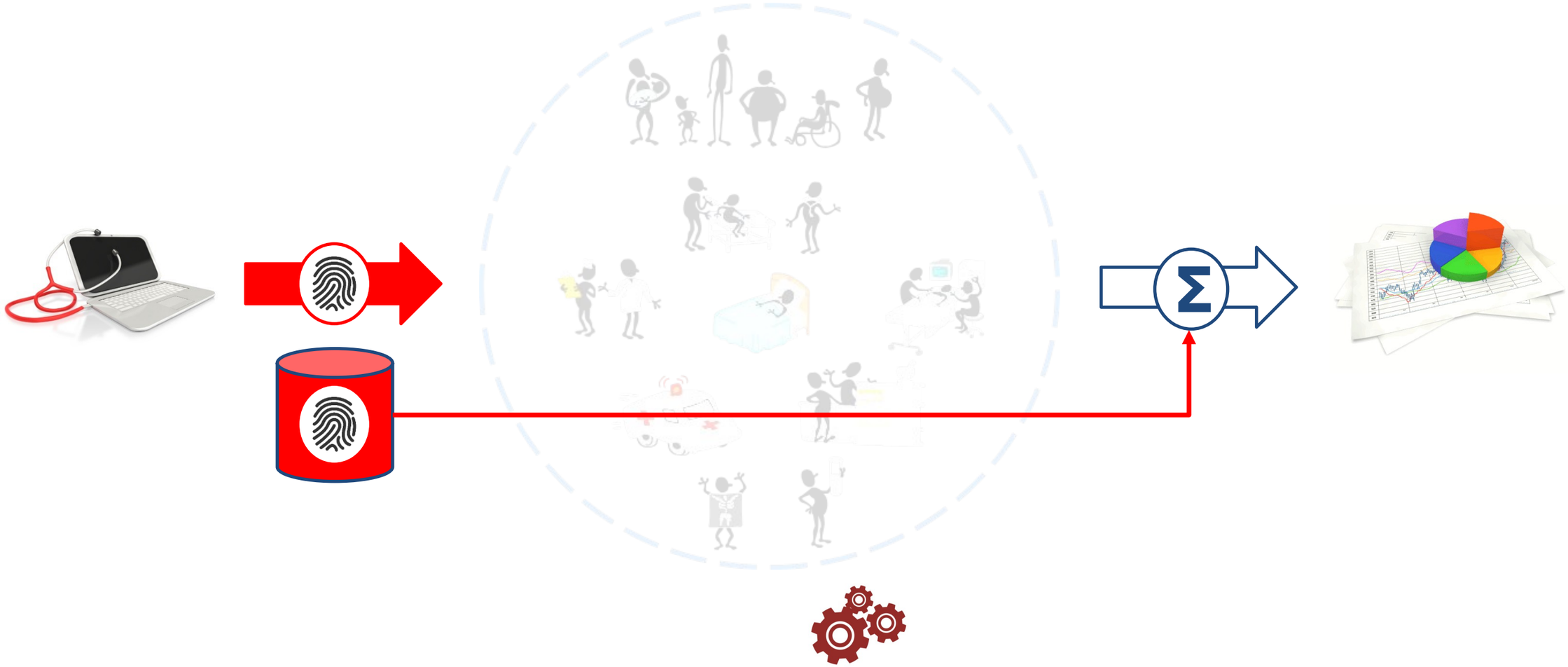


But to improve population health ***outcomes***, we want to leverage digital health to improve our person-centric care delivery ***activities*** (inputs).

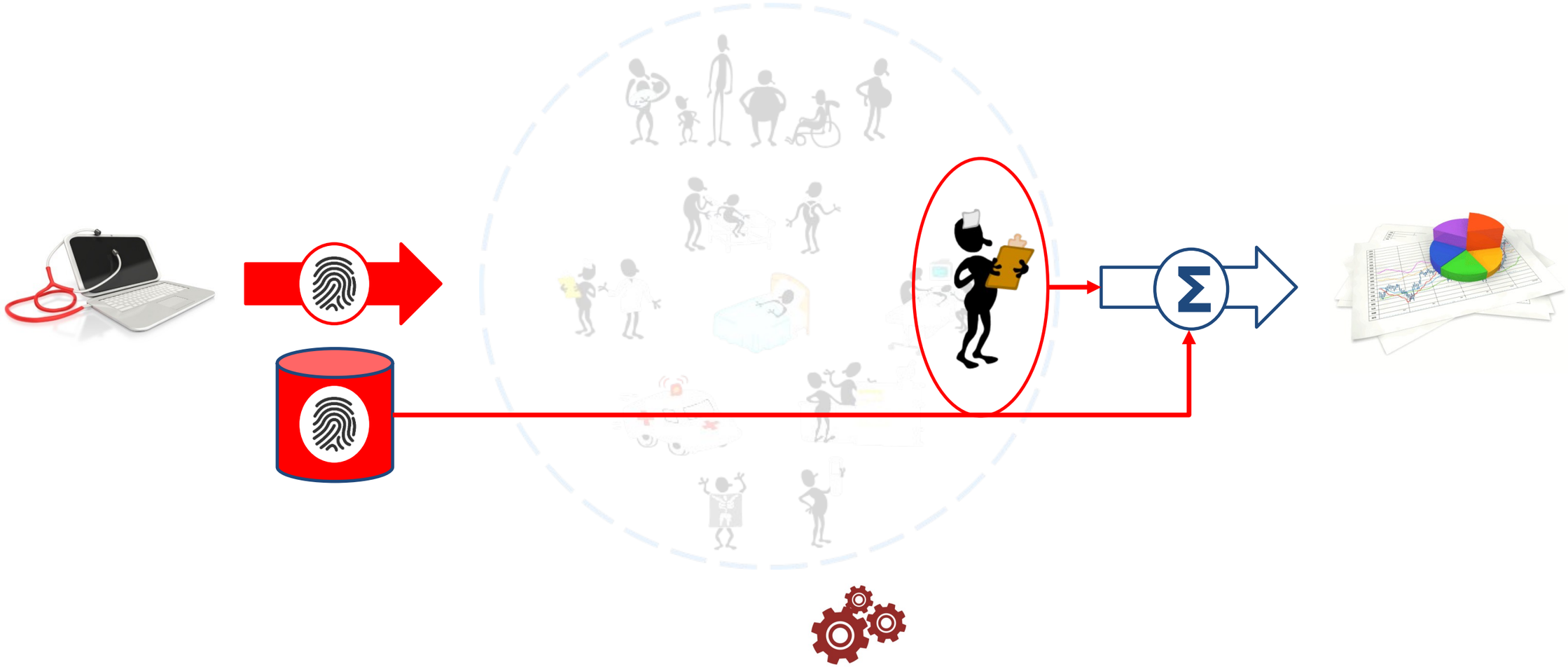
Leveraging Computable Care Guidelines (CCGs, such as WHO's ***SMART Guidelines***), care-focused digital health solutions can support broad adoption of ***evidence-based best practices*** across the whole care delivery network.



When we use digital solutions to support ***improved care***, *we* will generate ***person-centric*** health data in a ***computable*** format. From these data, we can ***automatically*** develop aggregate indicators.

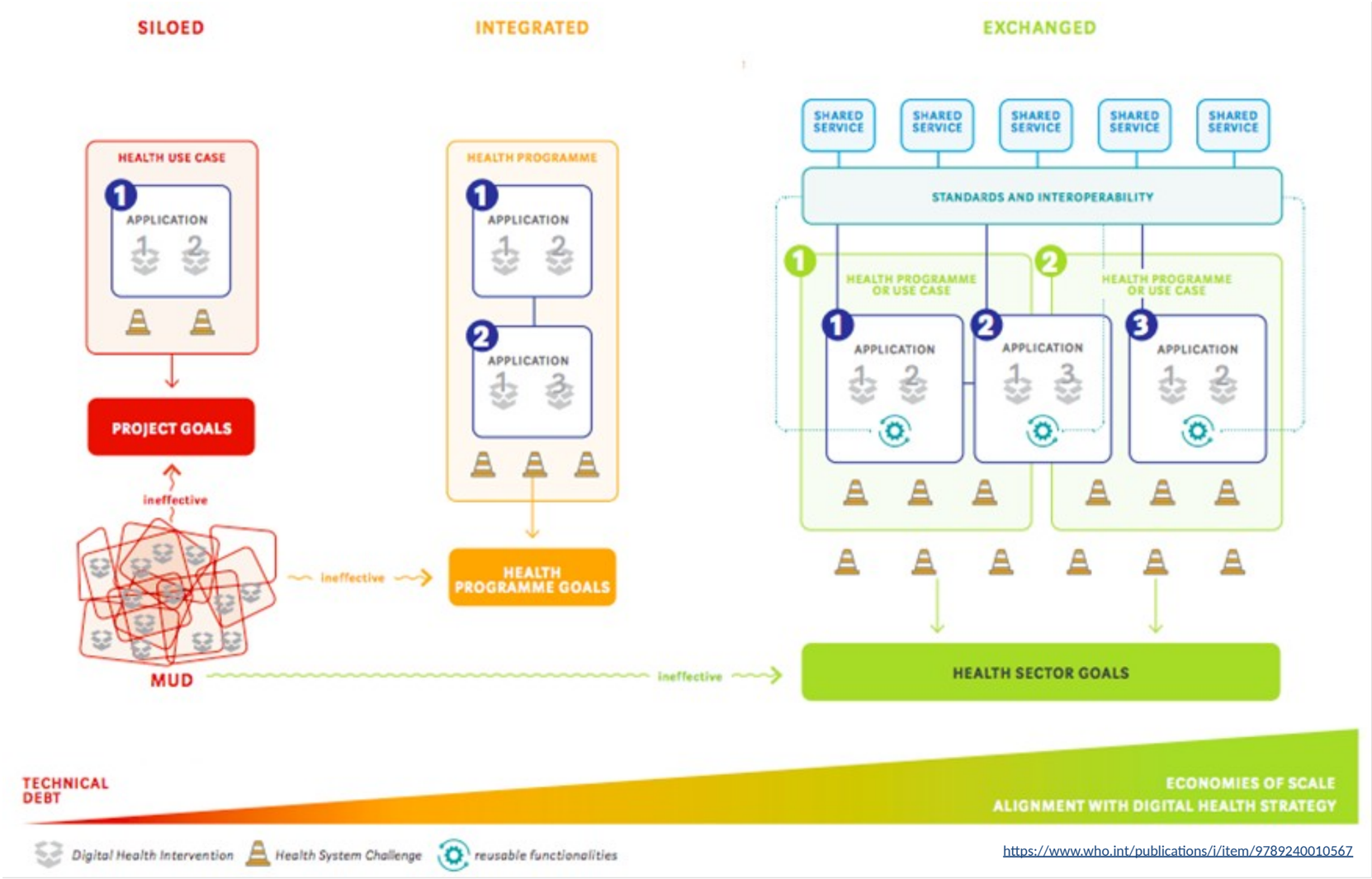


This reduces health workers' ***burden*** of manual indicator data entry.
Reducing this burden ***creates capacity*** in the health workforce.



The role of the Toolkit is to support the ***re-engineering*** of care delivery operations to make best use of ***digital health infrastructure***. Important ***implementation*** and ***investment*** plans will result from using the Toolkit.

As noted by the *WHO's DIIG framework*, the "platform" aspect of the digital health investments is a key to its ability to add *systemic value*.



https://www.who.int/publications/i/item/9789240010567

- We can adopt digital health as a means of ***improving person-centric care*** workflows which will, in turn, ***improve population health*** outcomes.
- Person-centric data may be leveraged to ***automatically generate reportable indicators*** and metrics. This can ***reduce health workers' burden*** of indicator data entry.
- The role of the Toolkit is to help ***create the implementation and investment plans*** needed to support ***re-engineering*** of the care delivery network to make the best use of digital health.

What is the ***process*** the Toolkit follows?

The Toolkit is leveraged to ***facilitate*** the efforts of a technical working group (***TWG***). Over a **short-duration project**, the TWG will generate ***actionable construction artefacts*** including an ***investment case***.

Form a TWG.
Launch the toolkit-facilitated process.

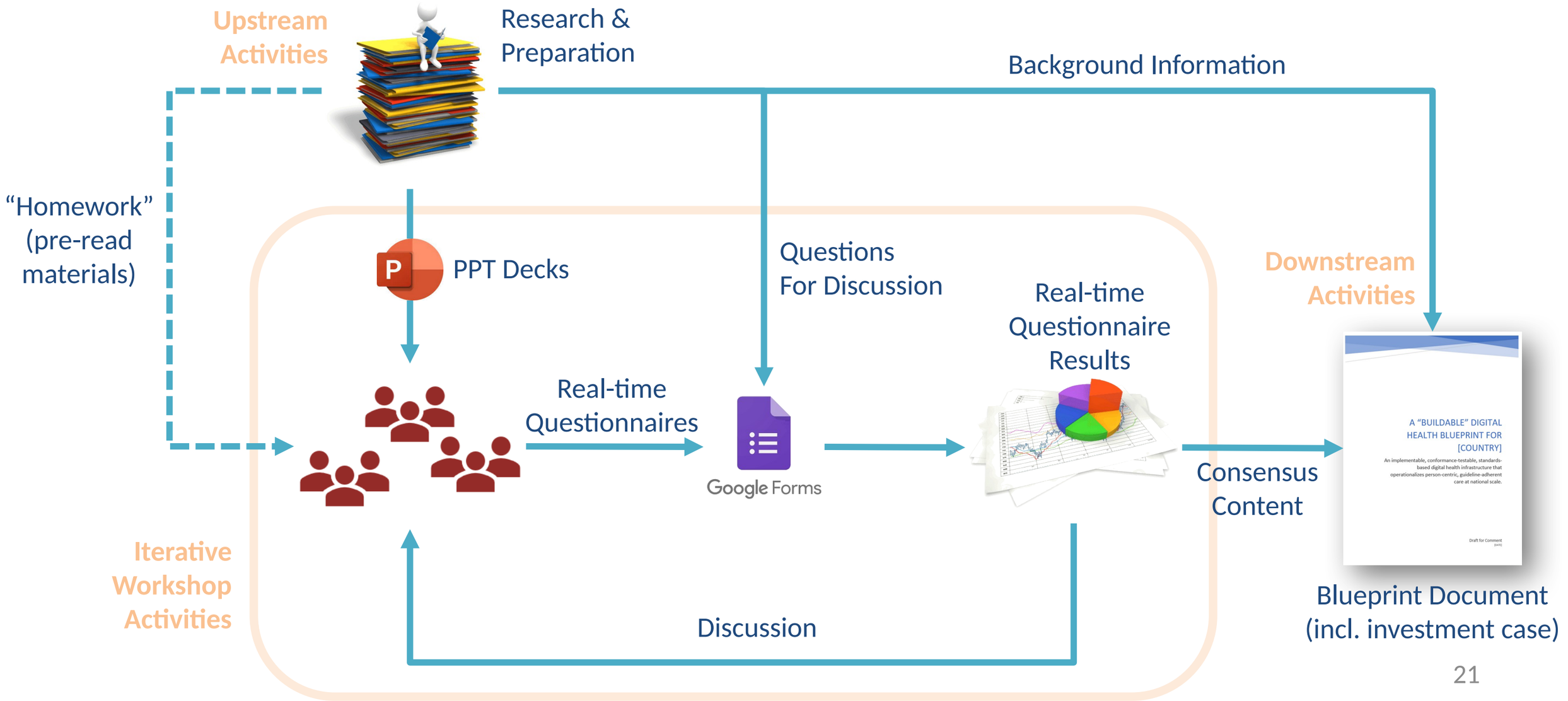
Deliver a ***buildable*** digital health blueprint.
Provide the investment case needed to launch a national-scale ***implementation*** project.

The TWG should include representatives from the ***MOH***, from ***development partners / donors***, from active ***NGOs***, from ***care provider*** organizations, and from relevant ***partner ministries*** of the government.

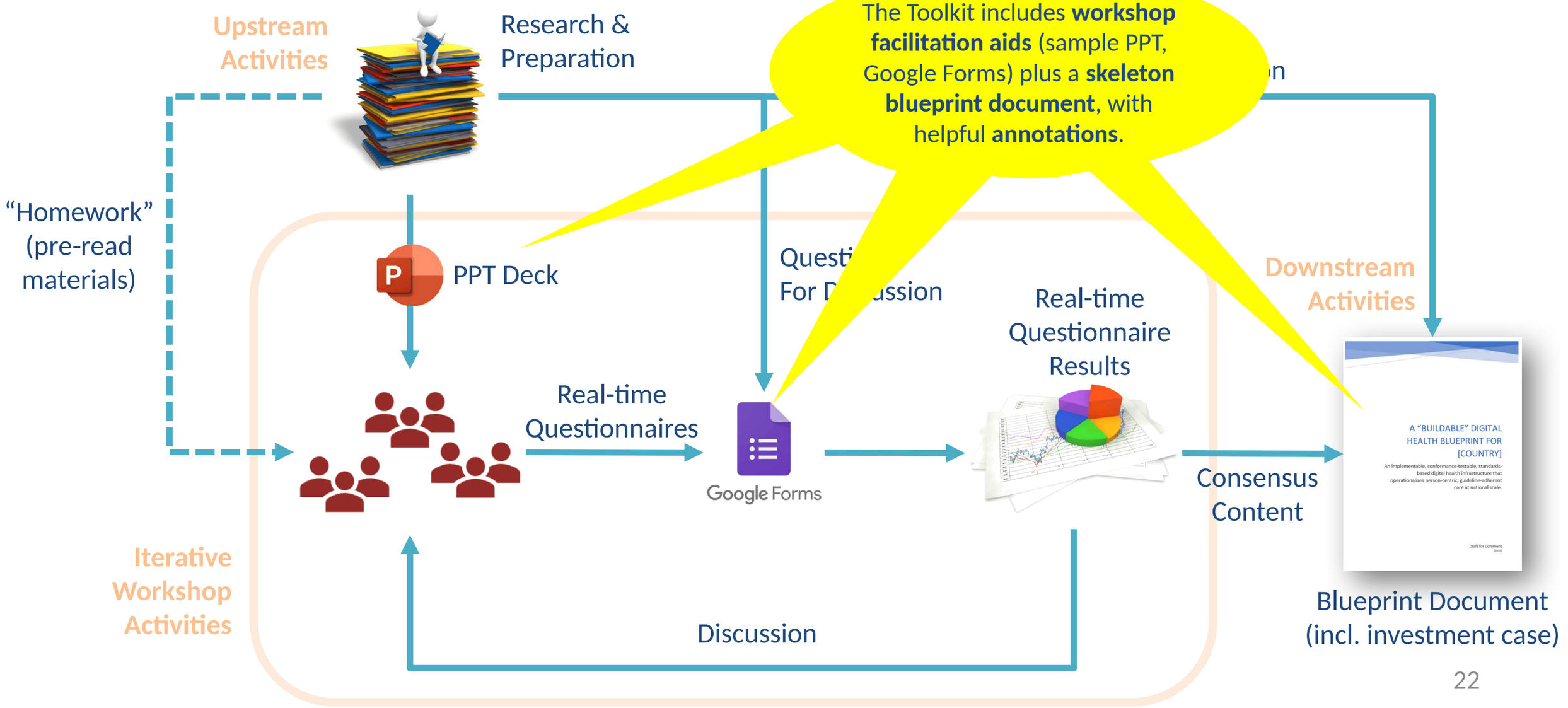
The Toolkit-supported ***process*** will work to ***align digital health tactics*** to the ***digital health strategy*** and to the MOH's overall ***health strategy***.

- What is the country's ***burden of disease***?
- What is the current ***health system strategy***? (check for alignment to the *burden of disease*)
- What is the current ***digital health strategy***? (check for alignment to the *burden of disease* and the *health strategy*)
- How can digital health make an ***impact***, and what conformance-testable ***infrastructure elements*** are needed?
- Where are we now (***current state***) and what should be done to progress from the current state to the ***future state***?
- How will implementation activities drive ***costs*** and deliver ***benefits***, and what is the ***investment case*** for the proposed plan?

Multiple *facilitated workshops* with the TWG will be leveraged to *generate relevant content* documented in the buildable blueprint.

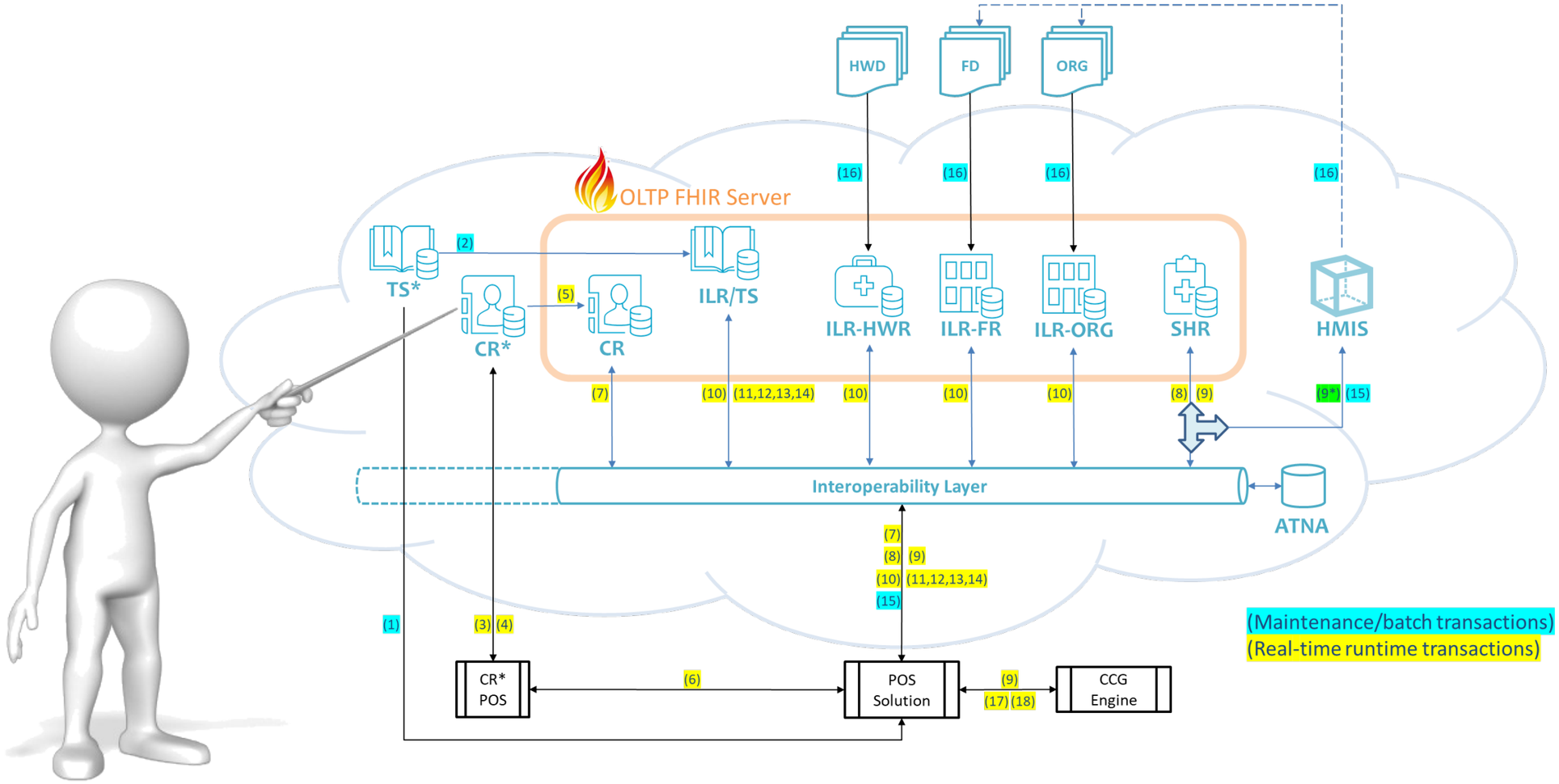


Multiple *facilitated workshops* with the TWG will be leveraged to *generate relevant content* documented in the buildable blueprint.

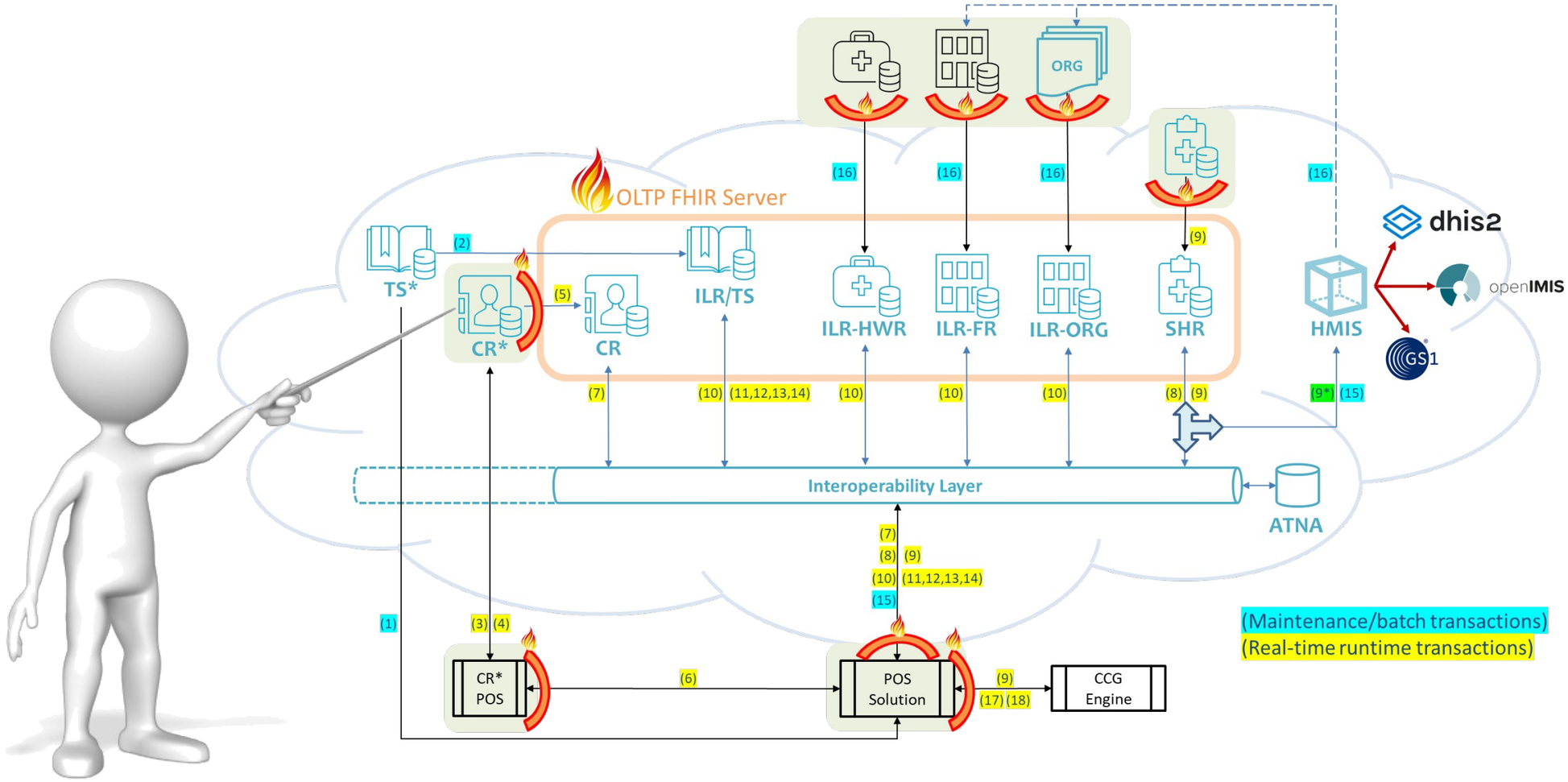


To *mitigate risk*, the toolkit leverages accepted international *norms*, *standards*, and *conformance-testable* architectural patterns. Data-informed decisions are based on *credible* global sources.

The Toolkit leverages a *generic infrastructure design* based on a small set of system *"actors"* executing standards-based, conformance-testable *transactions* with each other.

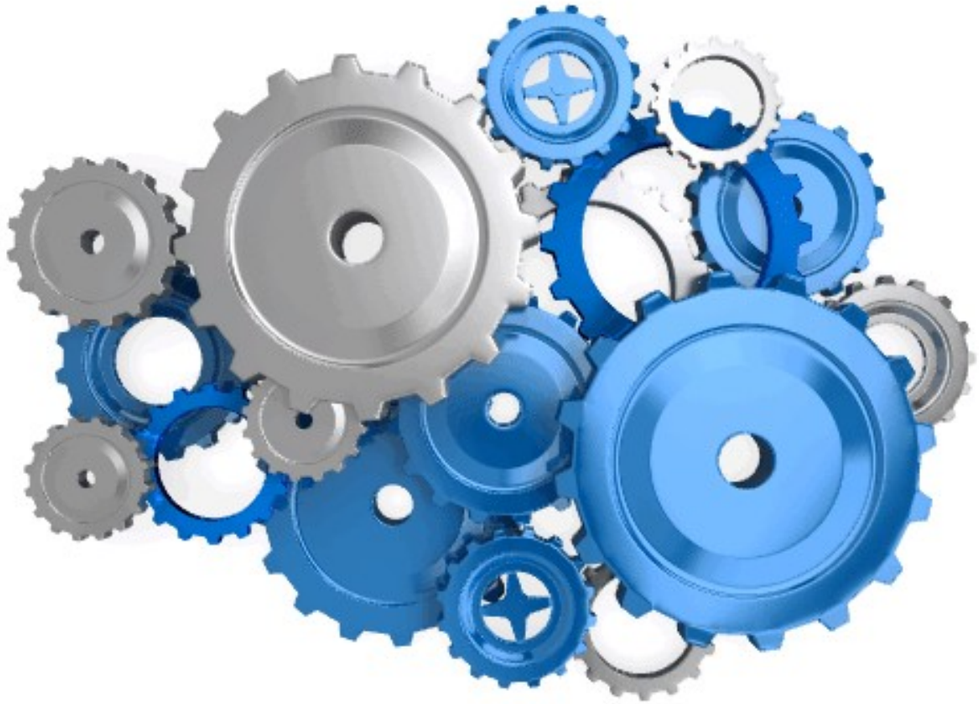


Where *existing solutions* have been widely deployed, we can leverage a *standards-based façade* to connect these into the infrastructure and give the project a *"running start"*.



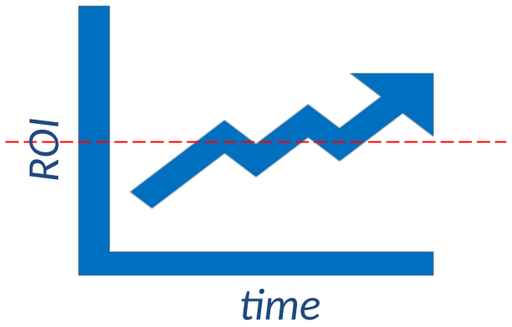
The investment case leverages an ***activity-based budgeting*** approach. Cost-utility analyses (CUA) are used to develop a ***DALYs-per-Dollar*** forecast over a ***10-year*** implementation planning horizon.

$

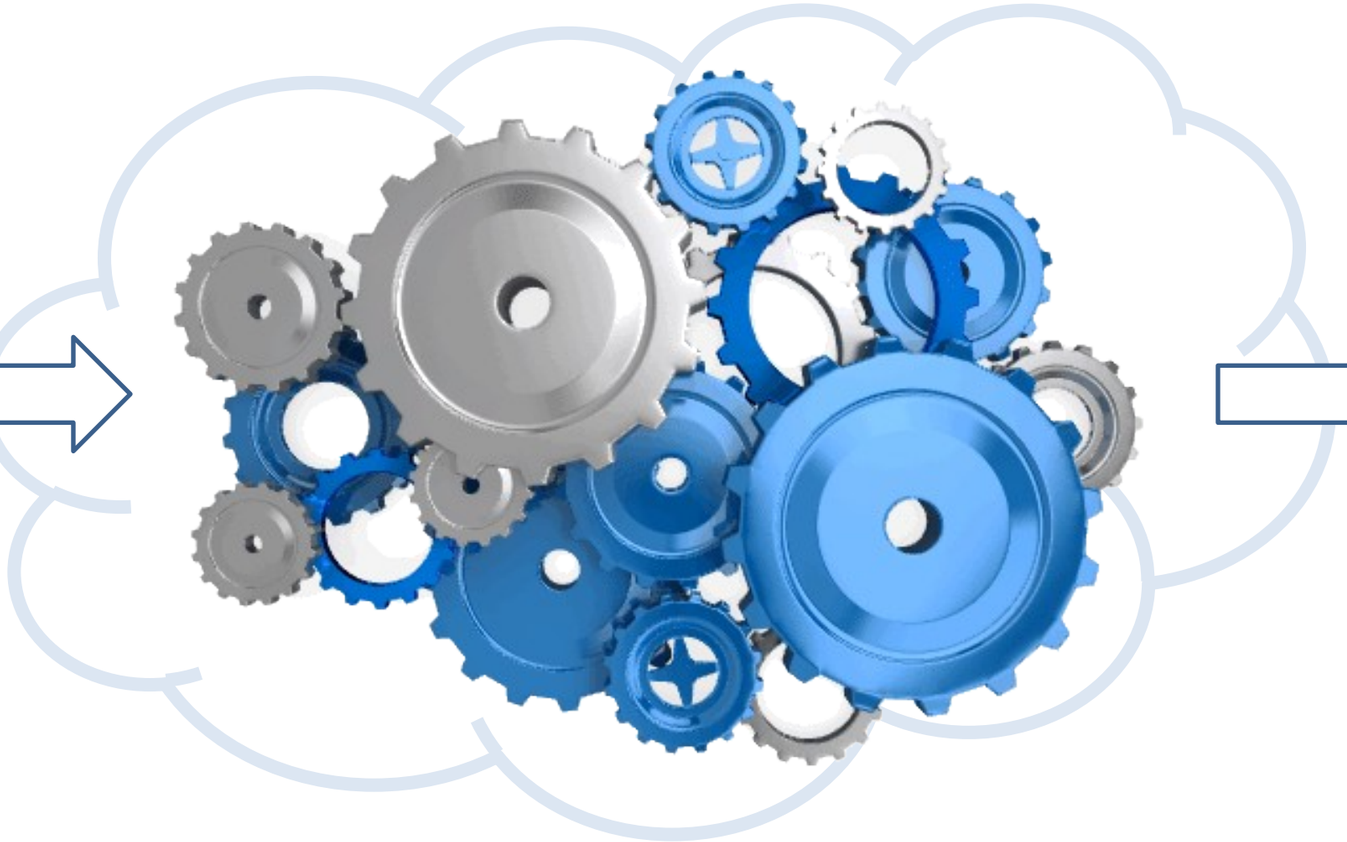


Money IN

Health OUT



Importantly, the investment case is predicated on ***whole-population*** impacts. This means the Toolkit has a ***whole-health-system scope*** including both ***private and public sector*** care delivery.



Money IN

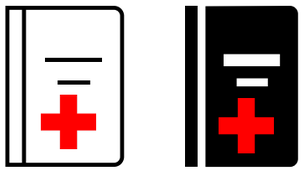
Health OUT

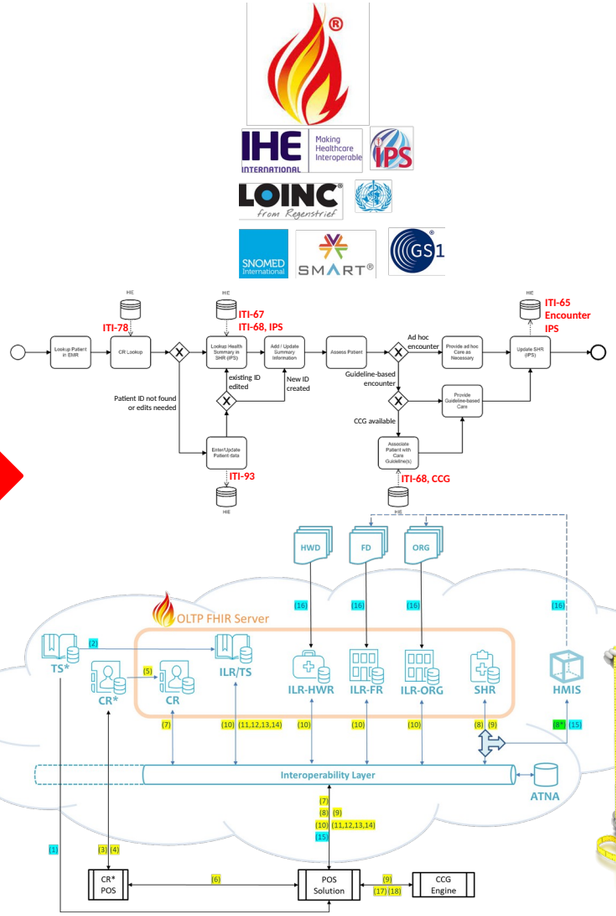
All care providers will connect to the national digital health data sharing infrastructure. A patient's data will follow them ***whenever*** and ***wherever*** they receive care.

- It is expected that the Toolkit will be leveraged by a ***multi-stakeholder TWG*** over a ***short-duration*** project.
- The TWG will ***align tactics*** to existing digital health and health system ***strategies***. An ***implementable, conformance-testable*** digital health ***specification*** will be developed that is based on the current context.
- International ***best practices*** will be leveraged wherever possible to ***mitigate implementation risk***.
- The investment case will develop a ***DALYs-per-Dollar*** metric over a ***10-year*** planning horizon.

What are the ***outputs*** from the TWG meetings?

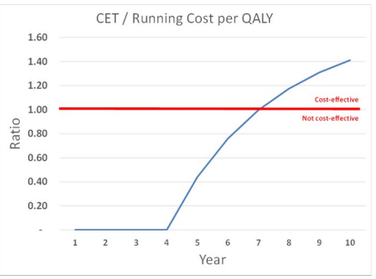
The key ***technical*** outputs will be a ***contextual analysis***, a conformance-testable, implementable, ***digital health infrastructure design specification***, and a 10-year ***investment case*** based on a notional implementation plan.





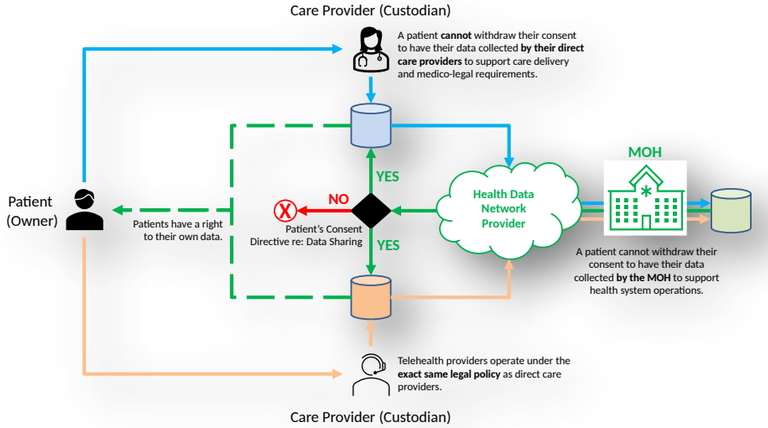
ID	Task Name	Predecessors	Duration
1	Start		0 days
2	a	1	4 days
3	b	1	5.33 days
4	c	2	5.17 days
5	d	2	6.33 days
6	e	3,4	5.17 days
7	f	5	4.5 days
8	g	6	5.17 days
9	Finish	7,8	0 days

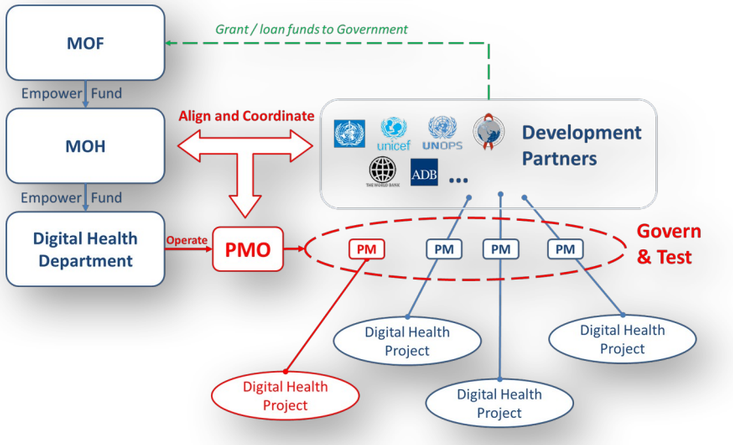
Year	1	2	3	4	5	6	7	8	9	10	10-yr Total
Governance	$ 165,000	$ 172,425	$ 180,184	$ 188,292	$ 530,671	$ 205,620	$ 214,873	$ 224,542	$ 234,647	$ 661,312	$ 2,777,566
Datacentre Infrastructure	$ 947,800	$ 258,951	$ 270,604	$ 282,781	$ 295,506	$ 308,804	$ 322,700	$ 337,222	$ 352,397	$ 368,254	$ 3,745,018
Client Registry	$ 1,337,536	$ 1,112,295	$ 1,167,522	$ 1,225,553	$ 1,056,200	$ 1,344,242	$ 1,411,075	$ 1,481,306	$ 1,555,113	$ 1,295,795	$ 12,946,637
Facility Registry	$ 26,945	$ 10,465	$ 11,013	$ 11,589	$ 12,196	$ 12,835	$ 13,507	$ 14,216	$ 14,961	$ 15,746	$ 143,473
Health Worker Registry	$ 280,000	$ 259,829	$ 274,436	$ 289,865	$ 306,162	$ 323,376	$ 341,559	$ 360,766	$ 381,054	$ 402,483	$ 3,219,530
Shared Health Record	$ 5,851,375	$ 7,144,432	$ 4,780,847	$ 5,509,078	$ 3,829,220	$ 4,041,082	$ 4,264,673	$ 4,500,639	$ 4,749,666	$ 5,012,478	$ 49,683,493
Terminology Services	$ 40,000	$ 41,800	$ 43,681	$ 45,647	$ 47,701	$ 49,847	$ 52,090	$ 54,434	$ 56,884	$ 59,444	$ 491,528
HMIS	$ 36,668	$ 20,727	$ 21,844	$ 23,021	$ 24,262	$ 25,569	$ 26,948	$ 28,402	$ 29,934	$ 31,549	$ 268,924
Total Annual Cost	**$ 8,685,324**	**$ 9,020,925**	**$ 6,750,130**	**$ 7,575,825**	**$ 6,061,917**	**$ 6,311,377**	**$ 6,647,426**	**$ 7,001,527**	**$ 7,374,655**	**$ 7,847,062**	**$ 73,276,168**
Running total cost	**$ 8,685,324**	**$ 17,706,249**	**$ 24,456,379**	**$ 32,032,205**	**$ 38,094,122**	**$ 44,405,499**	**$ 51,052,925**	**$ 58,054,452**	**$ 65,429,107**	**$ 73,276,168**	



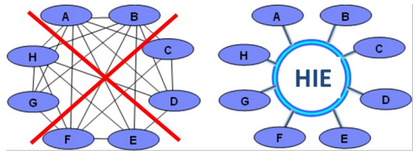
Based on the contextual analysis, recommendations related to *governance* and relevant *legal frameworks* (consent, privacy, etc.) will also be documented.

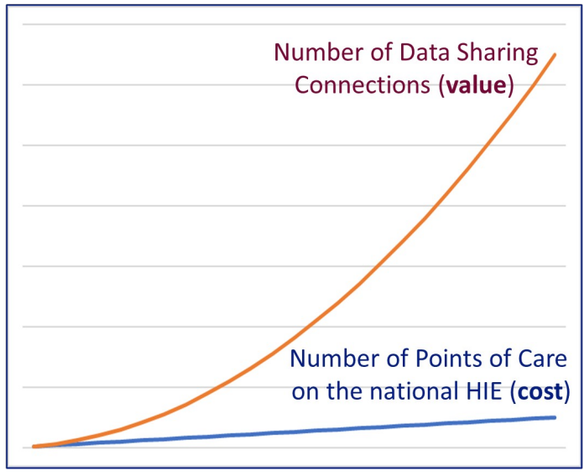
Health Data Owner It is a best practice that patients are the legal ***owners*** of health data about themselves.	**Health Data Custodian** Care providers, including independent clinicians, care provider organizations, or the MOH, will be ***custodians*** of personal health data.	**Health Data Network Provider** Network operators ***convey*** personal health data but do not become ***custodians*** of it.





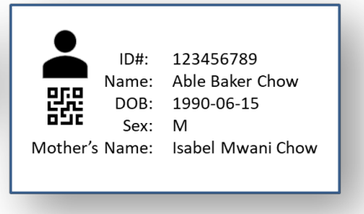
Best practices and techniques related to *implementation science* are recommended that can *reduce risk* and shorten *time-to-value*.





4-digit PIN

VS.



VS.

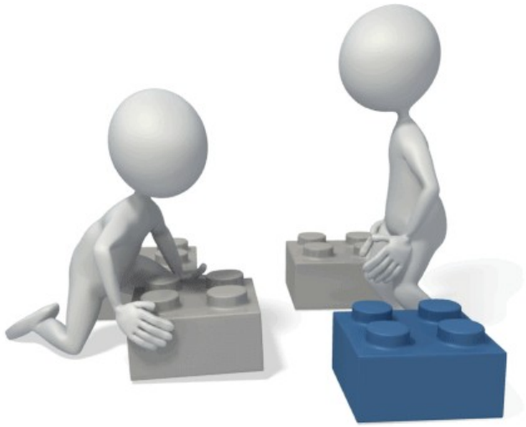
HIE Infrastructure-as-a-Service (IaaS)

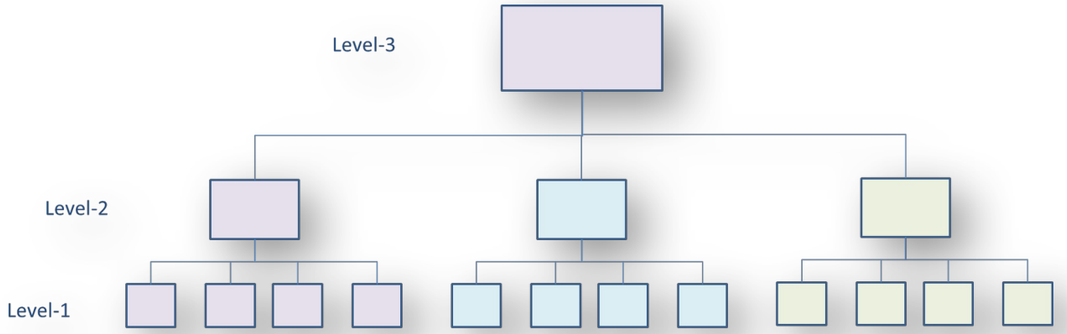
VS.

HIE "Private" Cloud

VS.

Stick-built HIE





The blueprint document resulting from the Toolkit-supported process will include chapters on each of these relevant sections, plus appendices. An ***example Table of Contents*** is shown below.

1. Introduction
2. Burden of Disease
3. Digital Health Readiness
4. National Health & Digital Health Strategies
5. Components of a “Buildable” Health Information Exchange
6. Digital Health Landscape and Quick-win Opportunities
7. HRH Capacity Building
8. Governing the National HIE
9. Appendix: Example Use Case
10. Appendix: 10-year Roadmap & Associated Investment Case

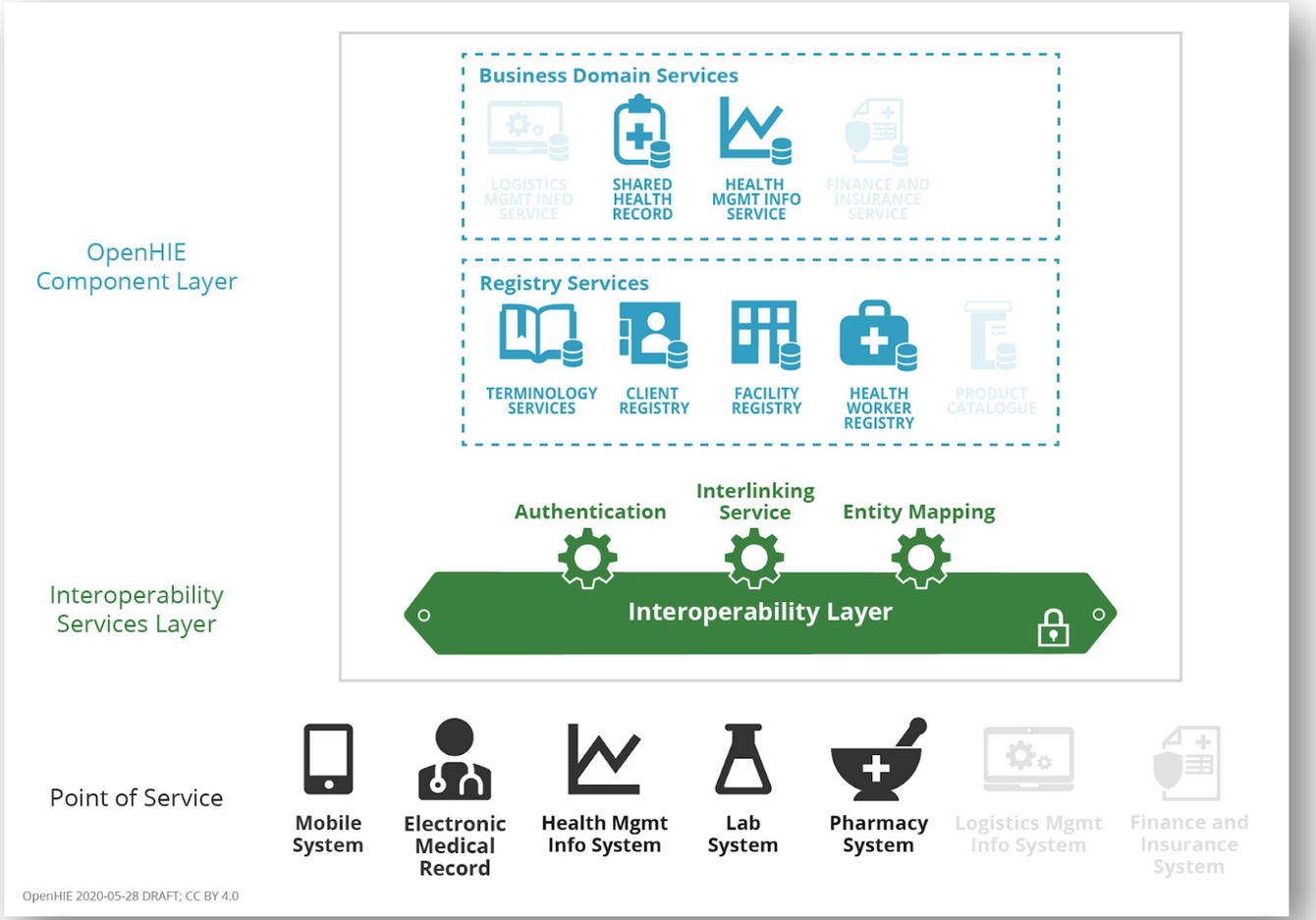
- The project outputs will be ***actionable*** artefacts.
- The ***contextual analysis*** will align digital health tactics and designs to current strategies, deployments, and (where applicable) global best practices.
- A buildable, conformance-testable, standards-based ***digital health infrastructure specification*** will address contextual requirements.
- The ***notional project plan*** will map a path from the current state to the desired future state.
- The ***investment case*** will document costs and benefits over a ***10-year*** horizon and support decision-making.
- Where appropriate, recommendations regarding ***governance*** and ***policy*** and ***implementation science*** will be documented.


Q
&
A

What is the ***technical foundation*** for the Toolkit's HIE design?

OpenHIE

Over ***60 LMICs*** have adopted **OpenHIE** as the basis of their ***health*** **enterprise architecture**. OpenHIE defines a set of infrastructure and service specifications that, together, operationalizes a health data sharing network.



What are the data that “***drive***” the investment case? And ***where*** do these data come from?

The investment case content comes from the **country context** and the **workshop activities**. The overall **organizing framework** for the content is the **OpenHIE blueprint**.

What is the top-10 ***burden of disease***?

What is the present ***readiness*** (e.g. health strategy, DH strategy, etc.)

How many ***health workers***? How digital-ready?

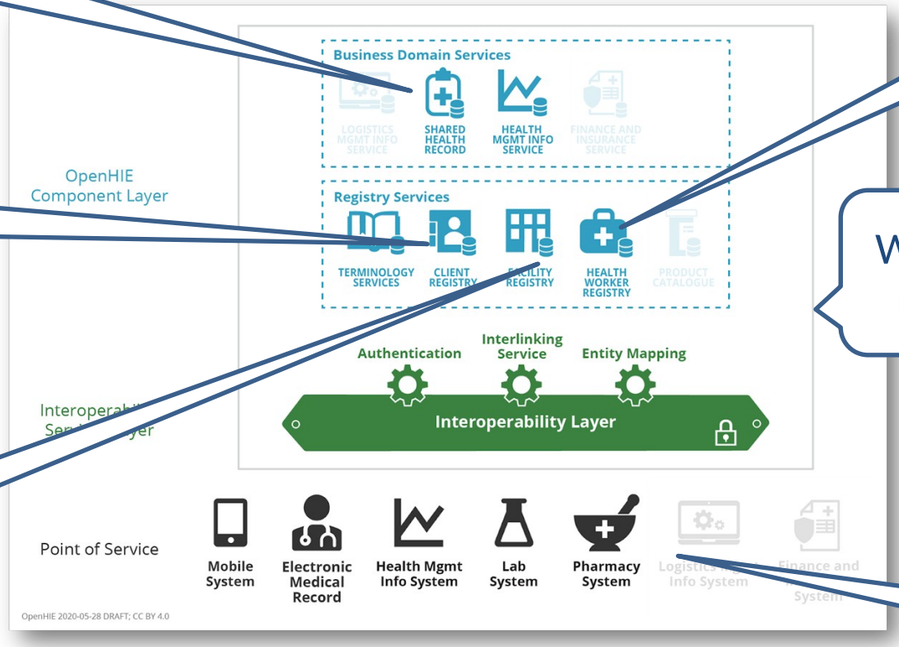
How many ***people***? What kind of health IDs?

What ***kind*** of HIE architecture? How ***quickly*** will we deploy?

How many ***facilities***? What types? How digital-ready?

What is the ***demographic*** and ***economic*** situation (pop. growth rate, inflation, GDP, THE, etc.)?

How many ***point-of-service solutions***? What types?



Workshop-1 of the toolkit process surfaces contextual information. This comes from MOH, World Bank, IHME, country surveys, etc.

What is the top-10 ***burden of disease***?

What is the present ***readiness*** (e.g. health strategy, DH strategy, etc.)

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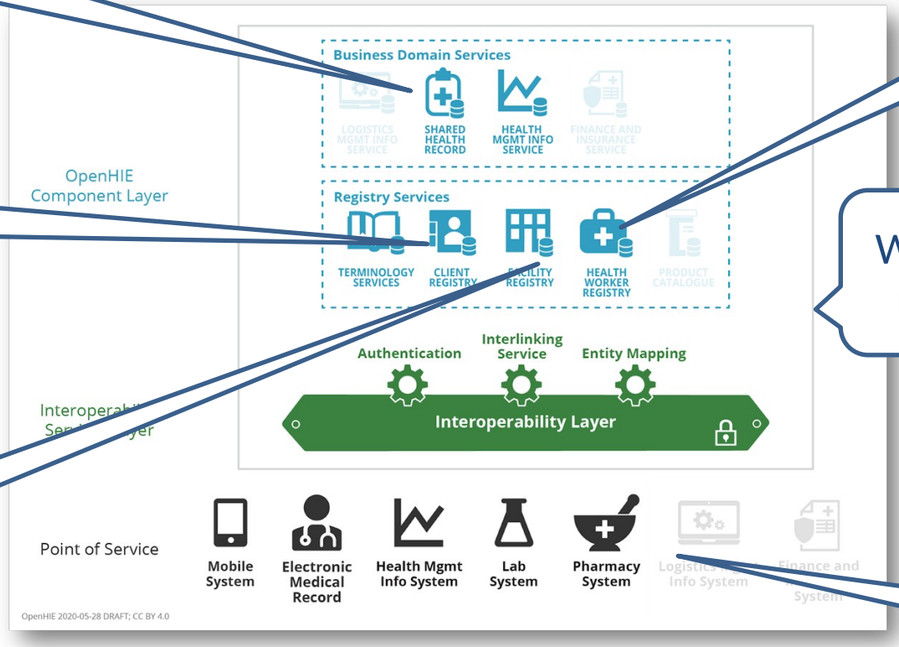


Workshop-2 is focused on ***digital health infrastructure***, on how we can deploy it, and on how we can leverage it to address the country's burden of disease.

What is the top-10 ***burden of disease***?

What is the present ***readiness*** (e.g. health strategy, DH strategy, etc.)

How many ***health workers***? How digital-ready?

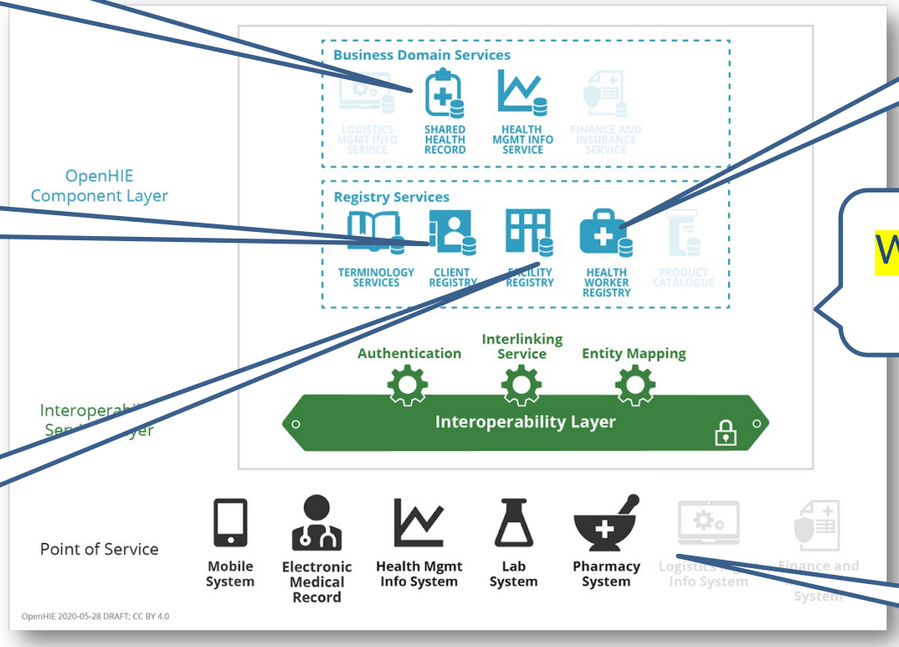
How many ***people***? What kind of health IDs?

What ***kind*** of HIE architecture? How ***quickly*** will we deploy?

How many ***facilities***? What types? How digital-ready?

How many ***point-of-service solutions***? What types?

What is the ***demographic*** and ***economic*** situation (pop. growth rate, inflation, GDP, THE, etc.)?



Workshop-3 focuses on the ***current digital health landscape*** and how these solutions can be leveraged in the national blueprint.

What is the top-10 ***burden of disease***?

What is the present ***readiness*** (e.g. health strategy, DH strategy, etc.)

How many ***health workers***? How digital-ready?

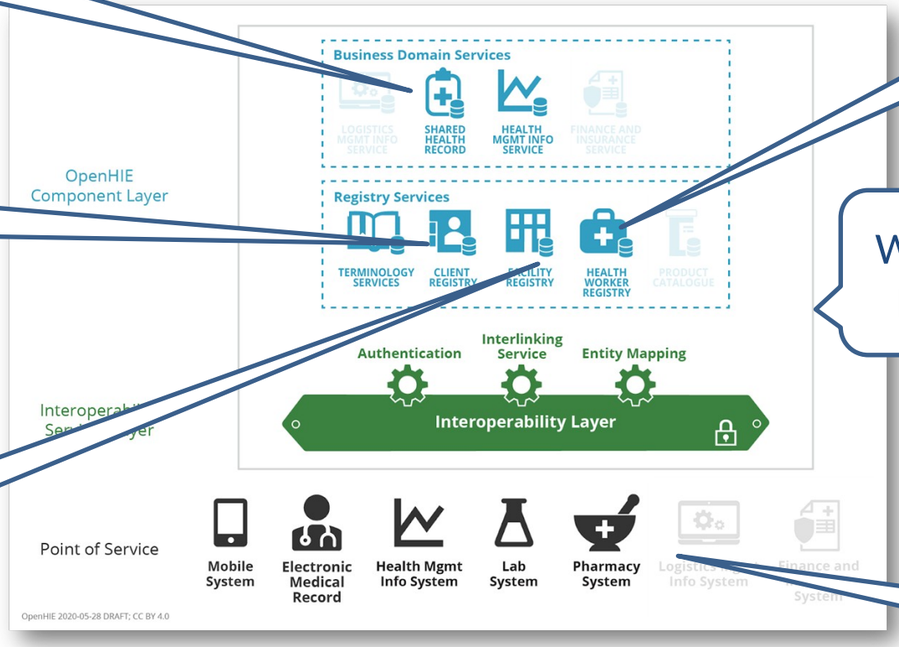
How many ***people***? What kind of health IDs?

What ***kind*** of HIE architecture? How ***quickly*** will we deploy?

How many ***facilities***? What types? How digital-ready?

What is the ***demographic*** and ***economic*** situation (pop. growth rate, inflation, GDP, THE, etc.)?

How many ***point-of-service solutions***? What types?



Workshop-4 is focused on ***implementation science***. Tactical decisions are made that will drive the pace and cost of the roll-out and the time-to-benefit.

What is the top-10 ***burden of disease***?

What is the present ***readiness*** (e.g. health strategy, DH strategy, etc.)

How many ***health workers***? How digital-ready?

How many ***people***? What kind of health IDs?

What ***kind*** of HIE architecture? How ***quickly*** will we deploy?

How many ***facilities***? What types? How digital-ready?

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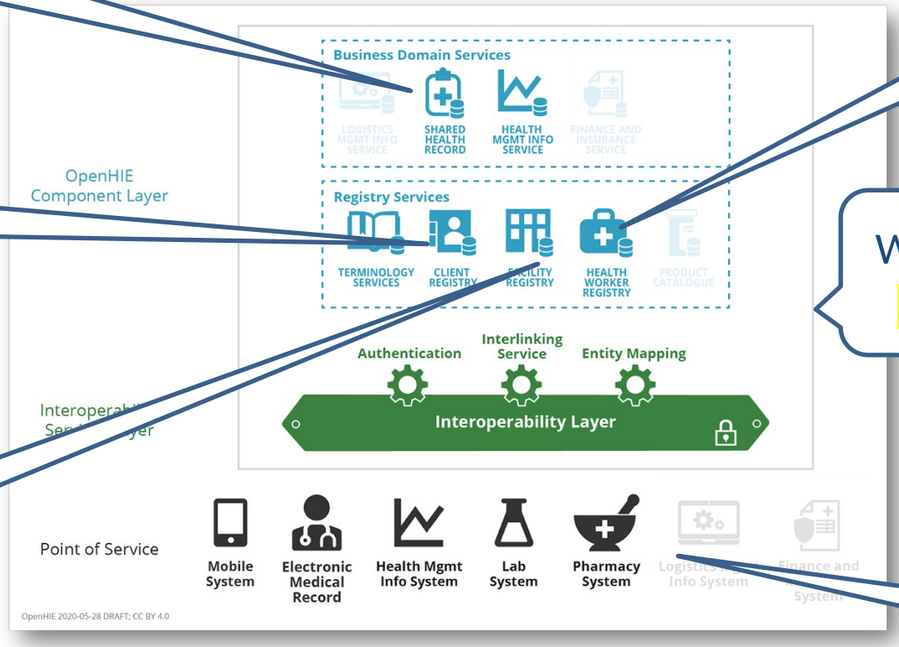
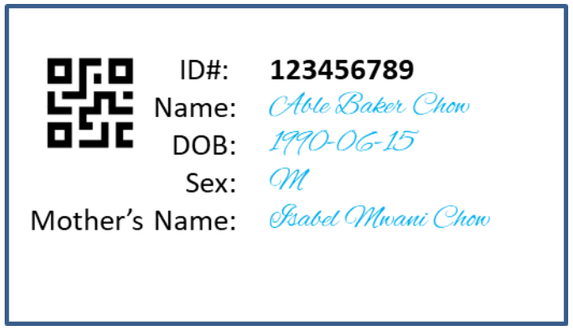


How does the ***investment case spreadsheet tool*** create its cost profiles and its benefit profiles?

All the model's cost estimates are developed using activity-based ***budgeting*** (**ABB**). This mature method leverages cost ***drivers*** and ***multipliers*** to calculate a forward-looking budget value.



X

=

$750 thousand

e.g. Preprinted QR code on simple ID card with content hand-entered.
Cost / each = $0.05

15 Million People

The key is to agree on values that are “close enough”. Over any 10-year period, it is impossible to be precise. ***Close enough is perfect!***

NOTE: our lecture included a **live** demo. The following slides are from previous presentations that included illustrative “screen captures” related to the Investment Case tool.

Top-level **demographic** and **economic** contextual data are captured. These provide both the starting point and inform the 10-year projections.

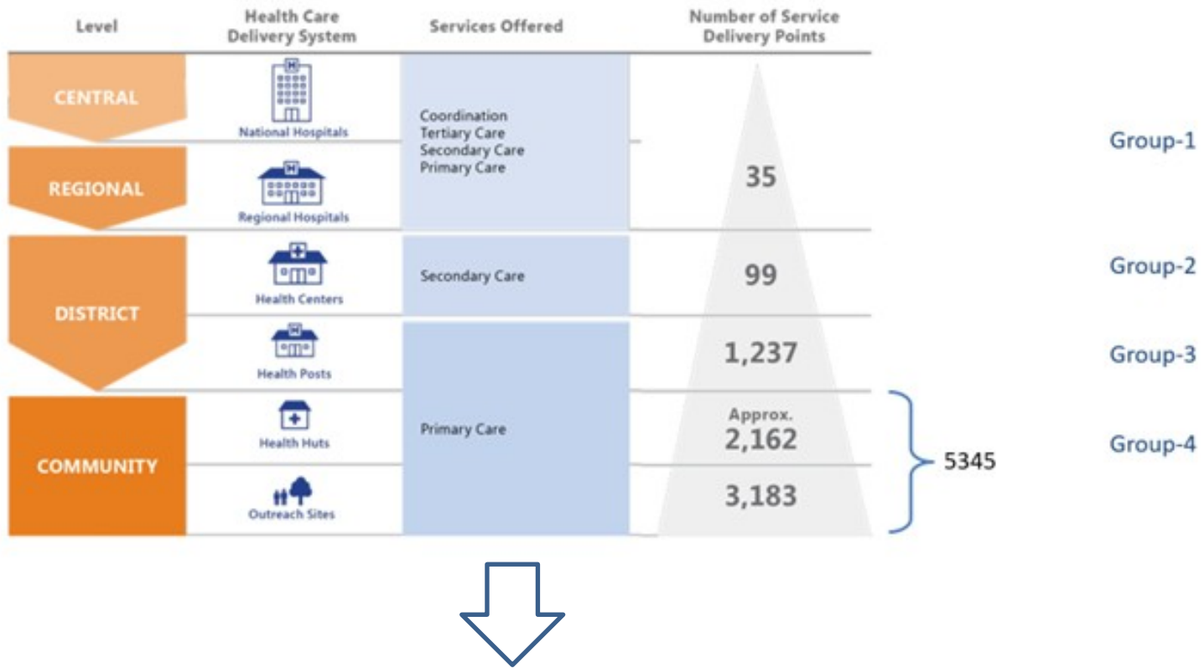
Year-over-year cost escalation (%)	9%
Annual facility growth rate	1.0%
# Regions	14
# Districts	78
Population size	15,100,000
Annual population growth rate	2.6%
ID penetration rate (%/yr)	25%
# Health Workers	6155
HW population growth rate	2.6%

The inflation rate and the growth rates are used to appropriately calculate year-over-year changes to the overall model.

The ID “penetration” rate is a top-level choice about how quickly the population will be issued unique identifiers (e.g. 25% per year implies a 4-year programme of assigning IDs).

As a visual cue, values in the spreadsheet tool that are to be edited or entered are shown in **GREEN**.

Information about the number and types of ***facilities*** is entered. The "type" infers the ***costs*** related to deploying a digital health POS solution, *not* the care type.



	TYPE 1	TYPE 2	TYPE 3	TYPE 4
	0.5%	1.5%	18.4%	79.6%
6716	35	99	1237	5345

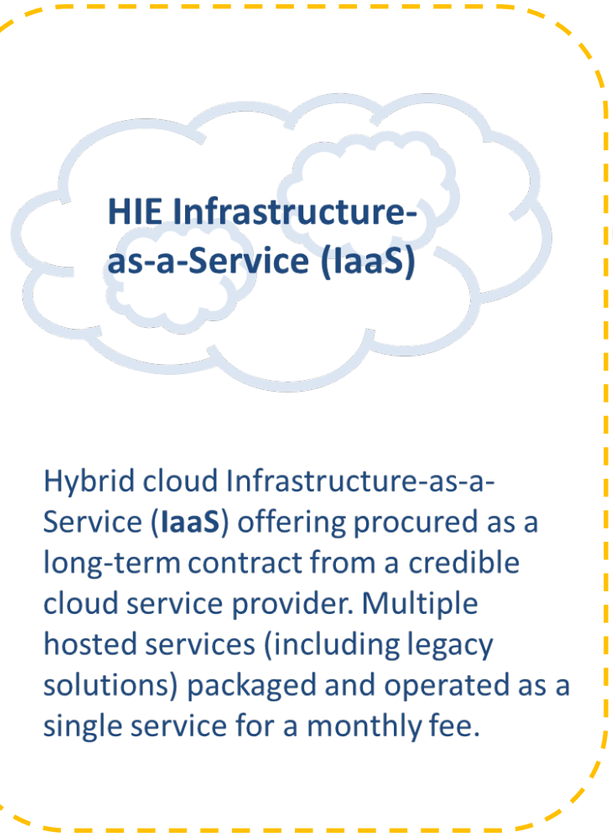
1. **Large-scale digital health implementations** with a one-time cost of $50,000 and digital system operating costs of $1000 per month (e.g. implement a cloud hosted solution; provide hardware and training for dozens of digital solution users; sustain hardware maintenance, network access, and local help desk support). For the model, it is assumed National, provincial, and referral hospitals are in this cost category. (est. 35 facilities)
2. **Medium-scale implementations** with a one-time cost of $10,000 and operating costs of $100 per month (e.g. implement a cloud hosted solution; provide hardware and training for ~10 users; sustain hardware maintenance, network access, and remote help desk support). (est. 99 facilities)
3. **Small-scale implementations** with a one-time cost of $2000 and monthly operating costs of $100 (e.g. implement a cloud hosted solution; provide hardware and training for ~5 users; sustain hardware maintenance, network access, and remote help desk support). Health centres are assumed to be in this category. (est. 1237 facilities)
4. **Remote implementations** with a one-time cost of $1000 and monthly operating costs of $25. The 5345 Health Huts and Outreach Sites are in this category.

Based on the present ***readiness***, and on the "***refresh plan***", costs for the strategy and governance efforts are estimated.

	#	Units	Cost per Unit	Extended Cost	Pre-Launch	YEAR 1	2	3	4	5	6	7	8	9	10
Digital Health Strategy	Put a "1" for the years when this activity is to be done				1					1					1
External advisors	40	days	$ 1,000	$ 40,000											
Workshops	1	each	$ 10,000	$ 10,000											
Regional meetings	4	each	$ 10,000	$ 40,000											
Subtotal				$ 90,000	$ 90,000	$ -	$ -	$ -	$ -	$ 127,042	$ -	$ -	$ -	$ -	$ 195,470
Digital Health Blueprint	Put a "1" for the years when this activity is to be done				1					1					1
External advisors	40	days	$ 1,000	$ 40,000											
Workshops	2	each	$ 10,000	$ 20,000											
Regional meetings	0	each	$ 10,000	$ -											
Subtotal				$ 60,000	$ 60,000	$ -	$ -	$ -	$ -	$ 84,695	$ -	$ -	$ -	$ -	$ 130,314
eHealth Norms and Standards	Put a "1" for the years when this activity is to be done				1					1					1
External advisors	20	days	$ 1,000	$ 20,000											
Workshops	1	each	$ 10,000	$ 10,000											
Regional meetings	4	each	$ 10,000	$ 40,000											
Subtotal				$ 70,000	$ 70,000	$ -	$ -	$ -	$ -	$ 98,811	$ -	$ -	$ -	$ -	$ 152,033
Health Data Sharing Policy	Put a "1" for the years when this activity is to be done				1					1					1
External advisors	10	days	$ 1,000	$ 10,000											
Workshops	1	each	$ 10,000	$ 10,000											
Regional meetings	4	each	$ 10,000	$ 40,000											
Subtotal				$ 60,000	$ 60,000	$ -	$ -	$ -	$ -	$ 84,695	$ -	$ -	$ -	$ -	$ 130,314
Digital Health Governance			**Annual cost/unit**	**Annual costs**	1	1	1	1	1	1	1	1	1	1	1
Committees	1	department	$ 100,000	$ 100,000											
Regular meetings	50	meetings	$ 100	$ 5,000											
National meetings	4	meetings	$ 15,000	$ 60,000											
Subtotal				$ 165,000	$ 165,000	$ 165,000	$ 179,850	$ 196,037	$ 213,680	$ 232,911	$ 253,873	$ 276,722	$ 301,626	$ 328,773	$ 358,362

The HIE operates as a national digital infrastructure. ***Datacentre operating costs*** reflect the country's deployment choice (from Workshop-4).

As an assumption for **today's** example, the all-in Infrastructure-as-a-Service option was chosen. All of the options can be modeled using the spreadsheet tool.

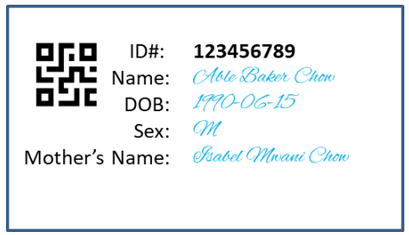


"All in" one-time setup cost	$ 500,000
"All in" infrastructure monthly operating cost	$ 20,000

For the **unique health IDs**, a simple and inexpensive option is favoured for today's example.

ID provisioning cost ($/ea)	$	0.05
ID renewal period (yrs)		5
ID churn rate (%/yr)		1.00%
ID issuing facilities (#)		1371
ID establishment setup cost ($)	$	200
ID establishment operating cost ($/mo.)	$	50

For this example, simple assumptions were made related to the cost per ID card (e.g. a simple paper or cardboard card that can be printed at a facility in real time). It was also assumed that these would have a **5-year validity period** and that **1% of cards will need to be reprinted each year** because they are lost or damaged. Every facility in category 1, 2 and 3 is assumed to be able to issue cards. The setup cost for each facility (e.g. printer, laminator) is expected to be $200 and a $50 monthly budget is set for consumables and maintenance.



For the **interlinked Facility Registry** costs, the main driver is the ***integration*** and the multiplier is the number of underlying ***facility databases***.

Facility databases (#)		2
Cost per database application interface ($)	$	10,000
API maintenance cost per year (%)		15%
MOH interactions per facility per year (#)		2
Cost per interaction ($)	$	5.00

The costs for the ILR-FR are driven by the number of underlying data sources, the cost to connect each data source to the ILR (and to maintain this interface) and by the number of interactions the MOH will need to have with **each facility, each year** in order to ensure the data is kept current and correct. The cost per interaction will vary depending on whether it is an in-person visit or a phone call. An average cost of $5 per “check” is assumed.

For the **interlinked Health Worker Registry** costs, the main driver is the ***integration*** and the multiplier is the number of underlying ***HW databases***.

Health Worker Cadre databases (#)		4
Cost per database application interface ($)	$	10,000
API maintenance cost per year (%)		15%
MOH interactions per HW per year (#)		12
Cost per interaction ($)	$	1.00

The cost drivers for the ILR-HWR are identical to the ones for the ILR-FR, with the exception that **MOH interactions to ensure data correctness** involve data checks with health workers vs with facility operators. The idea is that a text message or automated phone message solution could be employed to confirm details with each health worker at least once per month. The estimated cost reflects connecting 4 underlying databases (e.g. from Colleges or Professional Associations, MOH HR systems, etc.) plus the use of simple SMS message exchanges.

Modeling the costs for the **Shared Health Record** repository is done in two parts. The first cost is driven by the number of **unique POS solutions**.

Unique health ICT applications (#)		10
Cost per application interface ($)	$	25,000
API maintenance cost per year (%)		15%

The cost drivers for the SHR are not as much related to the central server as they are related to the point of service (POS) applications that must be implemented at facilities and connected to the HIE. Here, the assumptions (denoted in the previous section) for implementation costs for each of the 4 different facility types drive the model. Also, it is assumed that each different POS application will need to be interfaced to the SHR and the costs of these interfaces will need to be maintained.

The second **SHR-related** cost represents the **single largest budget item**. It is where **national-scale** POS deployment and maintenance is estimated.

Facilities (from Summary sheet) (#)	6,716	TYPE 1	TYPE 2	TYPE 3	TYPE 4
Facilities of this TYPE (%)		0.5%	1.5%	18.4%	79.6%
Facilities of this TYPE (#)		35	99	1,237	5,345
1-time ICT implementation cost for TYPE ($)		$ 50,000	$ 10,000	$ 2,000	$ 1,000
Annual ICT operating cost for TYPE ($)		$ 12,000	$ 1,200	$ 1,200	$ 300
Current ICT adoption by this TYPE (%)		0%	0%	0%	0%
Current ICT-capable by this TYPE (#)		-	-	-	-
ICT adoption increase per year (%)		50%	25%	25%	25%
MOH interactions per year (#)		1	1	1	4
MOH cost per interaction ($)		$ 200	$ 100	$ 50	$ 5

For the deployments to facilities, an estimate is made of the implementation cost plus the annual operating costs. To model the timing, an estimate is made of the number of facilities that already ***have*** solutions implemented, plus the adoption rate per year (e.g. 50% per year assumes a 2 year implementation period; 25% a 4-year period). There is an expected requirement that MOH interact with each facility to audit conformance or to refresh software or other tasks – and these costs are estimated by annual number of interactions and cost per interaction.

To be conservative, it is assumed **zero** facilities are HIE-ready, today.

The **Terminology Service** costs are modeled based on one-time setup fees plus ongoing maintenance and adoption costs.

Total cost of codelist databases ($)	$ 250,000.00
Codelist maintenance cost per year (%)	15%
Year-over-year cost escalation (%)	9.0%
# of software applications (from SHR sheet)	10
MOH interactions per app per year (#)	4
Cost per interaction ($)	$ 1,000.00

The costs for the terminology service are driven by the cost of the terminologies set up in the server plus the annual maintenance fees per year for keeping the server updated. For Amalgaland, it is expected that open standards will be leveraged. That said, it is estimated it will cost **$250k to instantiate the terminology service** and that a 15% annual maintenance cost will be incurred to keep it up to date. The other cost driver is the number of times the code lists must be refreshed by the POS applications and the cost of each refresh.

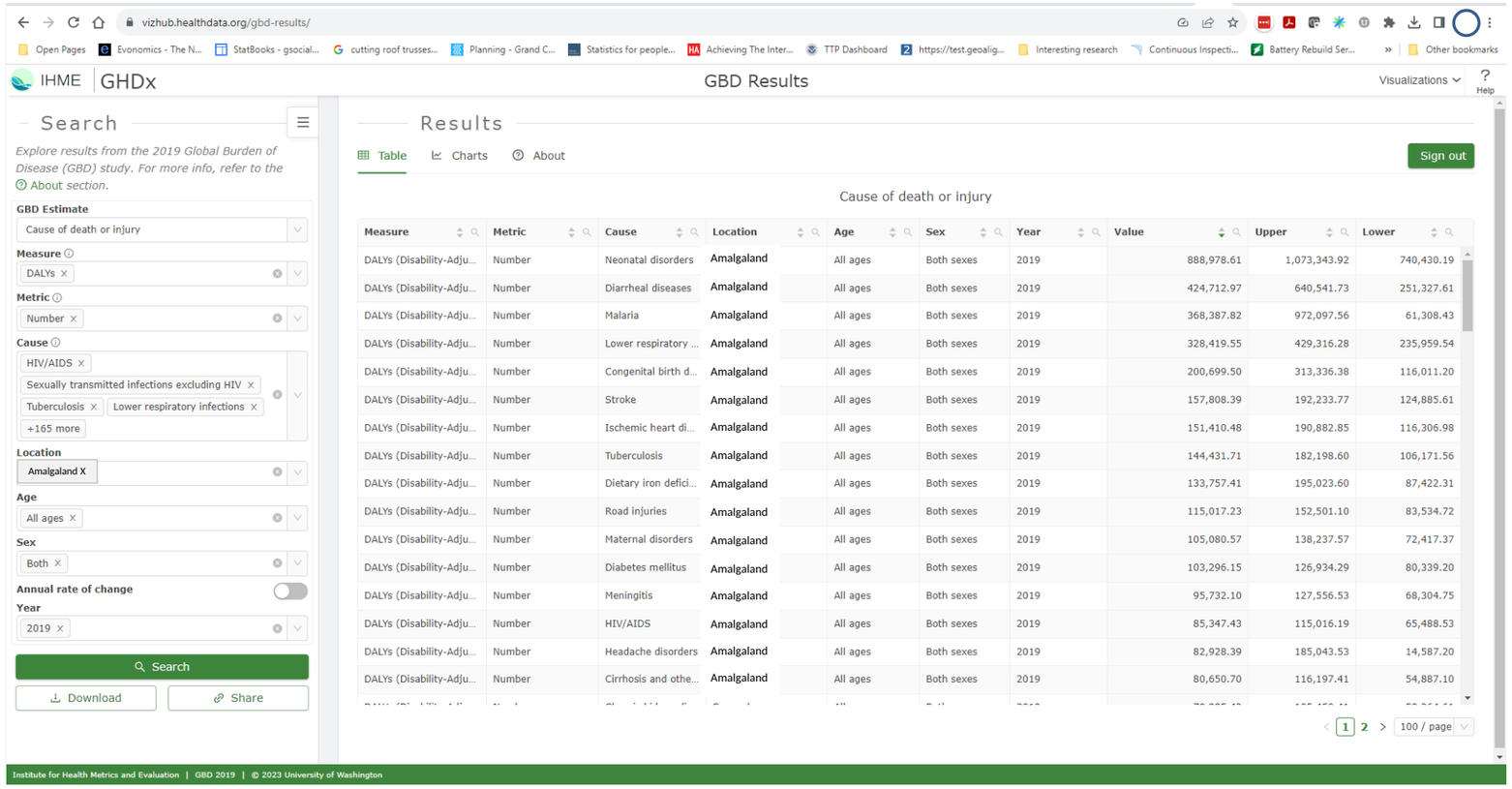
HMIS costs were modeled based on the number of ***analytics servers*** and on the costs to connect these to the **SHR**. Regular facility reporting was also modeled.

HMIS databases (#)		2
Cost per SHR-HMIS interface ($)	$	25,000
API maintenance cost per year (%)		15%
HMIS data collections per facility per year (#)		12
Cost per interaction ($)	$	10.00

The HMIS costs are driven by the number of **data warehouses**, the cost for an **SHR-HMIS data interface**, and the annual maintenance costs for each interface. Operational costs are also driven by the **number of data collections per year** from each reporting facility and by the cost of each of these data reporting workflows.

What about the ***benefits***?

The heart of the benefits will come from **ameliorating the DALYs lost** to the country's burdens of disease.



The disability-adjusted life-years (**DALYs**) associated with significant causes of death and disability are shown (from **IHME**). On a **theoretical** basis, it can be proposed that if 100% of the burden of disease could be alleviated by the application of digital health solutions for Neonatal disorders (#1 in the list), then 889 thousand "life-years" of lost health could be averted – or, conversely, 889 thousand **QALYs** could be gained.

To drive the benefits model, a **subset of target disease burdens** is selected, and estimates are made regarding the **amelioration impact**.

Interventions	Malaria	Ischemic Heart D.	Neonatal Disorders	Diarrheal Disease	L. Resp. Infect.
Potential Health Impact (QALYs)	368,388	151,410	888,979	424,713	328,420
Lead time (years before benefit)	4	4	4	4	4
Benefit realization (%)	1%	1%	1%	1%	1%

Target cost/QALY (CET)	$1600

The target diseases were selected as part of the facilitation of Workshop-1. Based on the country's GDP, a **cost-effectiveness threshold** (CET) is determined to be 1 annual GDP per capita (a "great buy", based on the simple WHO heuristic).

For each target, the total health impact is identified, expressed as QALYs (which for this analysis are assumed to be equal to averted DALYs). The time to benefit, in years, is indicated for each. This is noting that benefits may not be realized until, for example, a "critical mass" of health facilities have completed their digital health implementations. To support sensitivity analysis, a benefit realization value (expressed as a percent) is used to calculate how much of the total disease burden can be ameliorated through the digital health intervention.

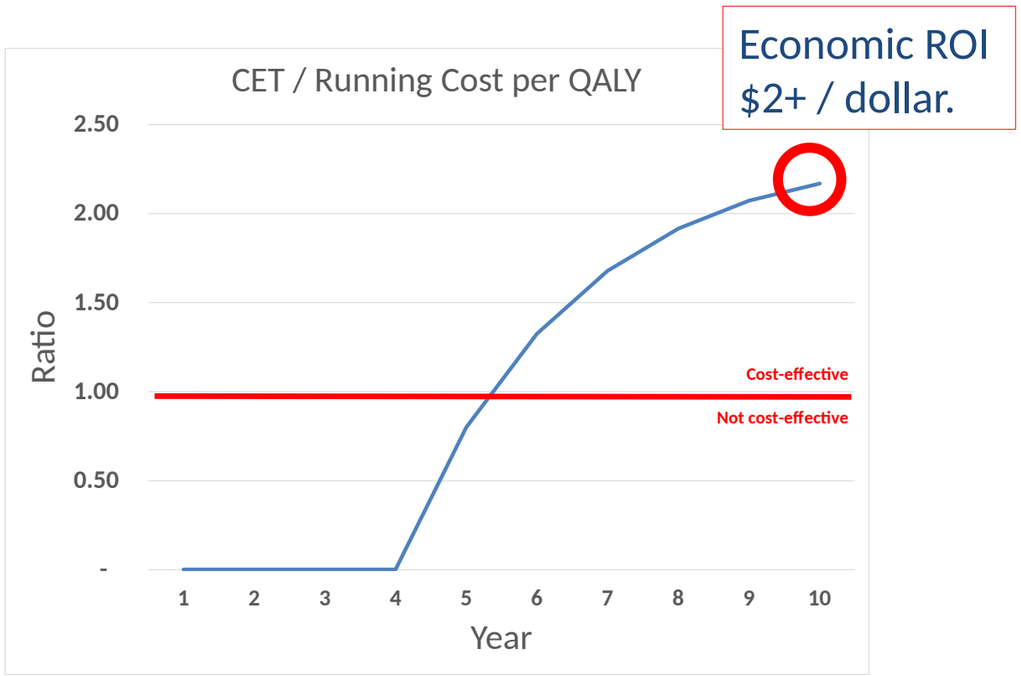
The ***cost-utility analysis*** (CUA) is now a matter of arithmetic. Over the 10-year horizon, what will be the costs and what will be the ***QALYs gained*** (-DALYs)?

Year	1	2	3	4	5	6	7	8	9	10	10-yr Total
Governance	$ 165,000	$ 179,850	$ 196,037	$ 213,680	$ 628,154	$ 253,873	$ 276,722	$ 301,626	$ 328,773	$ 966,493	**$ 3,510,206**
Datacentre infrastructure	$ 740,000	$ 261,600	$ 285,144	$ 310,807	$ 338,780	$ 369,270	$ 402,504	$ 438,729	$ 478,215	$ 521,254	**$ 4,146,303**
Client Registry	$ 1,312,024	$ 1,139,493	$ 1,251,353	$ 1,374,449	$ 1,203,989	$ 1,644,711	$ 1,806,809	$ 1,985,256	$ 2,181,743	$ 1,927,397	**$ 15,827,224**
Facility Registry	$ 87,160	$ 77,206	$ 84,961	$ 93,495	$ 102,886	$ 113,221	$ 124,595	$ 137,111	$ 150,886	$ 166,045	**$ 1,137,566**
Health Worker Registry	$ 287,260	$ 283,061	$ 316,373	$ 353,610	$ 395,236	$ 441,769	$ 493,786	$ 551,935	$ 616,941	$ 689,610	**$ 4,429,581**
Shared Health Record	$ 4,387,088	$ 5,795,712	$ 6,382,242	$ 8,184,060	$ 5,806,451	$ 6,391,745	$ 7,036,043	$ 7,745,294	$ 8,526,047	$ 9,385,511	**$ 69,640,191**
Terminology Services	$ 290,000	$ 84,475	$ 92,078	$ 100,365	$ 109,398	$ 119,243	$ 129,975	$ 141,673	$ 154,424	$ 168,322	**$ 1,389,952**
HMIS	$ 855,920	$ 895,412	$ 985,670	$ 1,085,027	$ 1,194,401	$ 1,314,800	$ 1,447,338	$ 1,593,237	$ 1,753,845	$ 1,930,646	**$ 13,056,297**
Total Annual Cost	**$ 8,124,452**	**$ 8,716,810**	**$ 9,593,856**	**$ 11,715,492**	**$ 9,779,294**	**$ 10,648,632**	**$ 11,717,771**	**$ 12,894,863**	**$ 14,190,874**	**$ 15,755,278**	**$ 113,137,321**
Running total cost	**$ 8,124,452**	**$ 16,841,261**	**$ 26,435,118**	**$ 38,150,610**	**$ 47,929,904**	**$ 58,578,536**	**$ 70,296,307**	**$ 83,191,170**	**$ 97,382,044**	**$ 113,137,321**	

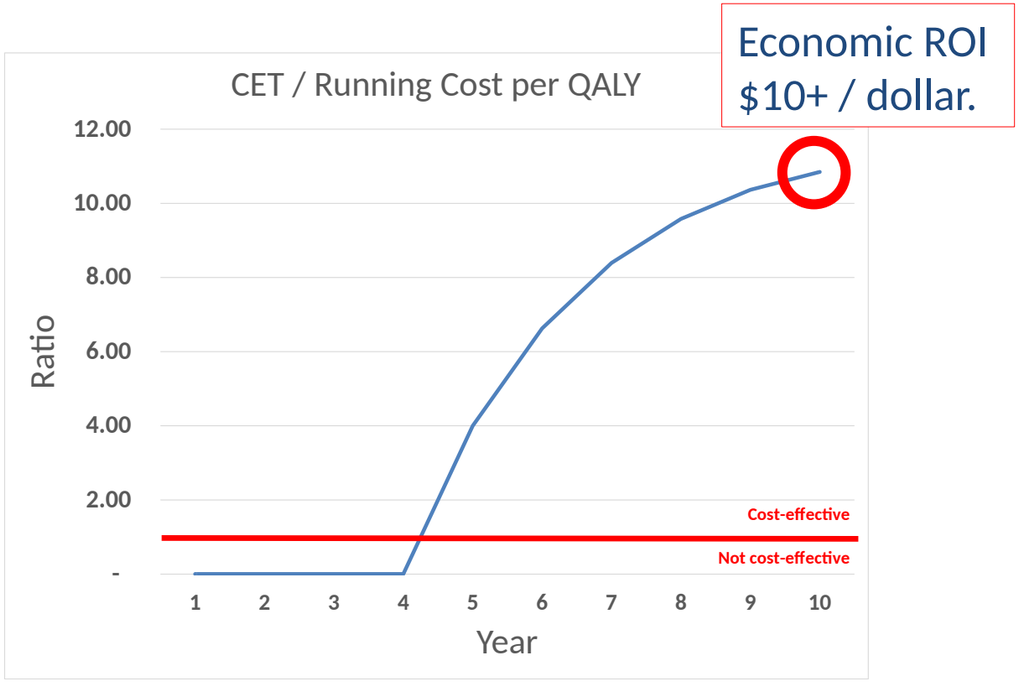
Year	1	2	3	4	5	6	7	8	9	10
Total QALYs	-	-	-	-	23,957	24,580	25,219	25,874	26,547	27,237
Running total QALYs	-	-	-	-	23,957	48,536	73,755	99,629	126,176	153,414
Total costs ($)	$ 8,124,452	$ 8,716,810	$ 9,593,856	$ 11,715,492	$ 9,779,294	$ 10,648,632	$ 11,717,771	$ 12,894,863	$ 14,190,874	$ 15,755,278
Running total costs ($)	$ 8,124,452	$ 16,841,261	$ 26,435,118	$ 38,150,610	$ 47,929,904	$ 58,578,536	$ 70,296,307	$ 83,191,170	$ 97,382,044	$ 113,137,321
Cost per QALY	**$ 8,124,452**	**$ 8,716,810**	**$ 9,593,856**	**$ 11,715,492**	**$ 408**	**$ 433**	**$ 465**	**$ 498**	**$ 535**	**$ 578**
Running cost per QALY	**$ 8,124,452**	**$ 16,841,261**	**$ 26,435,118**	**$ 38,150,610**	**$ 2,001**	**$ 1,207**	**$ 953**	**$ 835**	**$ 772**	**$ 737**
CET / Cost per QALY	0.00	0.00	0.00	0.00	3.92	3.69	3.44	3.21	2.99	2.77
Cost per QALY / CET	5,077.78	5,448.01	5,996.16	7,322.18	0.26	0.27	0.29	0.31	0.33	0.36
CET / Running Cost per QALY	0.00	0.00	0.00	0.00	0.80	1.33	1.68	1.92	2.07	2.17
Running Cost per QALY / CET	5,077.78	10,525.79	16,521.95	23,844.13	1.25	0.75	0.60	0.52	0.48	0.46

When the cost-per-QALY is above the CET, it is shown **RED**. When it is below, it is **GREEN**.

Graphically, we can display for a decision-maker a curve of the CET over the running cost-per-QALY. This is a useful ***economic ROI*** measure.



Based on 1% impact.



Based on 5% impact.

Because a 10-year budget has been developed, we can calculate the **percent of THE** (Total Health Expenditure) that this budget represents.

Annual health expenditure (per capita)	$	71.00
10-yr avg annual ICT cost per capita	$	0.75
ICT as a % of health expenditure		**0.69%**

This provides a useful “reasonableness” check for MOH decision-makers. In OECD economies, percent of THE spent on digital health ranges from 2-5%.

- The Investment Case tool is used to develop an ***activity-based budget*** based on a notional implementation plan.
- The activities and the costs are informed by the country ***context*** and by consensus-based implementation decisions documented during the TWG ***workshops***.
- The country's top-5 burden of disease is leveraged to establish a target for "***avertable DALYs***". We can test the sensitivity of the business case by iterating the ***degree of amelioration*** attributable to the digital health investments.
- Leveraging a cost-effectiveness threshold (***CET***) based on 1 GDP per capita, we can establish the ***economic return*** of the digital health investments over a 10-year horizon.
- Once the model is defined, the spreadsheet tool can be leveraged to run ***what-if scenarios***.


Q
&
A

Derek's career advice: devote yourself to navigating to the centre of this graphic.