GLOBAL HEALTH CONSULTING

METHOD PAPER

Defining Use Cases for Vaccines, Treatments for Neglected Tropical Diseases and Diagnostics

Foreword

Over the last several years, MMGH Consulting has worked to better define use cases for vaccines and drugs in multiple settings. This includes use cases for existing (influenza) and new vaccines (schistosomiasis, leishmaniasis), vaccines on microarray patches (MAPs) against measles-rubella (MR), measles, mumps, rubella (MMR), and typhoid (TCV), drugs for Neglected Tropical Diseases (NTD) (onchocerciasis, lymphatic filariasis), and diagnostics for cholera.

This work led to many interactions and insightful discussions with colleagues at the World Health Organization (WHO), Gavi, the Vaccine Alliance (Gavi), the Coalition for Epidemic Preparedness and Innovation (CEPI), UNICEF, the Wellcome Trust, the Bill & Melinda Gates Foundation (BMGF), the Drugs for Neglected Diseases Initiative (DnDI), as well as with experts in academic institutions (University of York, Imperial College, Erasmus Medical Centre, Oxford University).

These interactions highlighted the need to clarify how different medical products are used and to put the users' perspective at the centre of each project. The various deliberations mandated renewed clarification of the role of use cases in informing product development and design, policy, investment, and programme design decisions.

Leveraging the growing body of inputs and information, it has become pertinent to formalise the approach to defining use cases for medical products.

The MMGH team developed this method paper, providing clarity on the definitions used and the steps in defining and applying use cases in the immunization and NTD fields. Vaccines have been used as a reference to describe the process. Nonetheless, the same approach can be used for other medical products.

We hope that this approach will stimulate further discussion and ultimately assist in increasing the focus on the user in immunization and NTD work. With this perspective in mind, we encourage anyone interested to adopt it and contribute to its further refinement.

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1 Definitions

Designing vaccine programmes with the user in mind transforms health outcomes by delving into the needs and behaviours of everyone from vaccinators to policymakers.

Applying a design approach to informing product development and design, to the definition of vaccine policies, and to vaccine programme design requires a fundamental shift: putting the users at the centre. This involves the development of an in-depth understanding of all factors influencing vaccine use - one that draws insights firstly from the relevant users - vaccinees and vaccinators - and that also expands its reach to include caregivers, policymakers (at local, regional and global levels), and other relevant stakeholders (e.g., governments official, donors, etc.). Charting these factors influencing vaccine use requires developing a granular understanding of different elements and considering the involved "personae".

Four concepts from the design approach play a critical role in the MMGH approach to user research:

Use Case[1] - the original definition has evolved in software development since 1987. It has become an integral part of the Unified Modelling Language, the standard way to visualise the design of a system. This definition indicates *"all the ways of using a system to achieve a particular goal for a particular user"*. MMGH has adapted this concept to capture the interaction between a user and a health product or service and to identify *"a specific situation where a health product or a service is, or can be, used to achieve a defined health goal"*. Given people use the same product/service for different reasons, use cases can vary depending on specific circumstances. With a specific reference to vaccines, use cases focus the attention on who administers the vaccine (the vaccinator) and who receives it (the vaccinee).

Personae - the term was developed by Swiss psychoanalyst Carl Jung and derived from the Latin word 'persona', which referred to the masks worn by the Etruscan mimes. This concept has been adopted in fields like market research and user experience to define fictional characters created based on research that represent the different user types that might use a service or a product. Creating personae helps better understand users' needs, experiences, behaviours and goals.

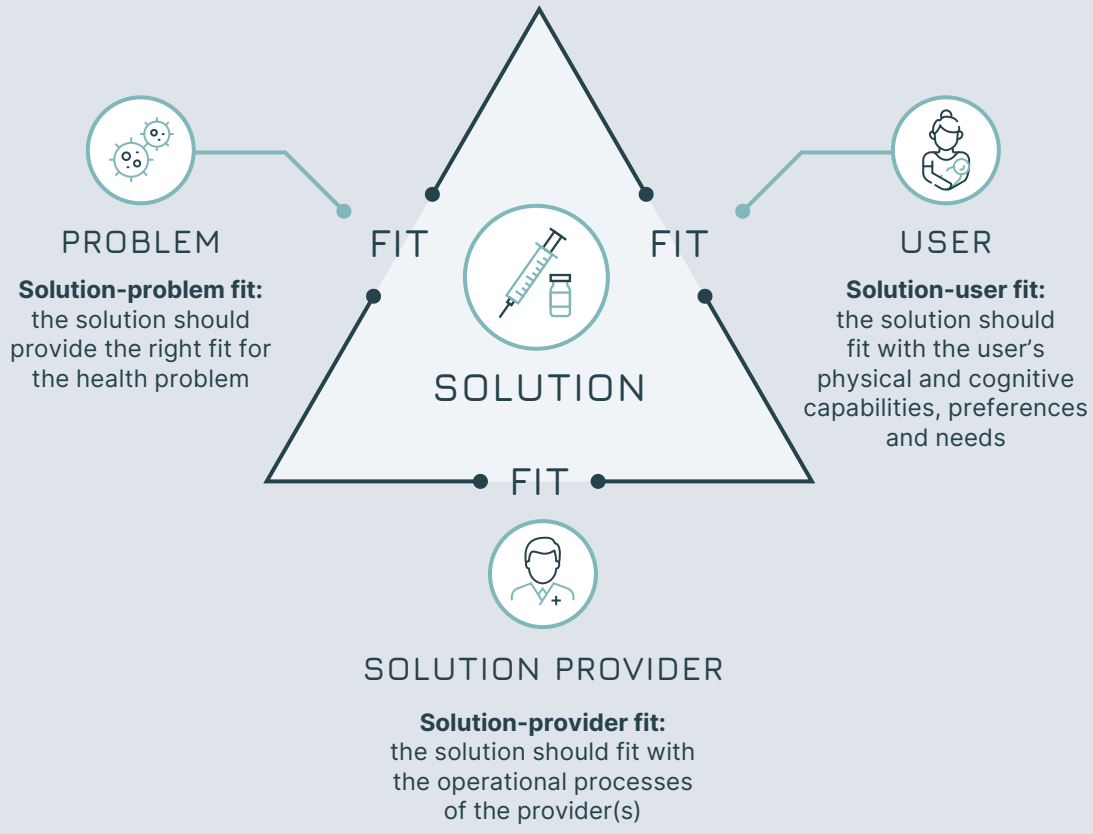
Beyond technical solutions, achieving a fit in vaccines involves aligning with user needs, health problems, and provider processes.

Fit - is about improving products and services, in this case, better vaccines and immunization services. It is about moving from the current state ("as is") to achieve the goal of a desired future improved state ("to be"). Adopting a design approach that focuses on the users is ultimately about generating a fit across several different elements[2] and not being limited to the "technical" aspects of the health problem but rather focusing on the broader achievement of:

- Solution-problem fit: the vaccine (the solution) should provide the right fit for the health problem.
- Solution-user fit: the vaccine (the solution) should fit with the vaccinee's and caregiver's (the users) physical and cognitive capabilities, preferences and needs.
- Solution-provider fit: the vaccine (the solution) should fit with the operational processes of the health worker(s) (the provider).

Archetypes - are used to allow for the description of clusters or patterns of contextual factors. In the specific context of immunization, the concept of archetypes proves especially useful when referring to geographical contexts, for example, a *"group of countries sharing common characteristics concerning the use of a specific vaccine / in the design of a specific health programme"*.

Figure 1 **The three Fits**



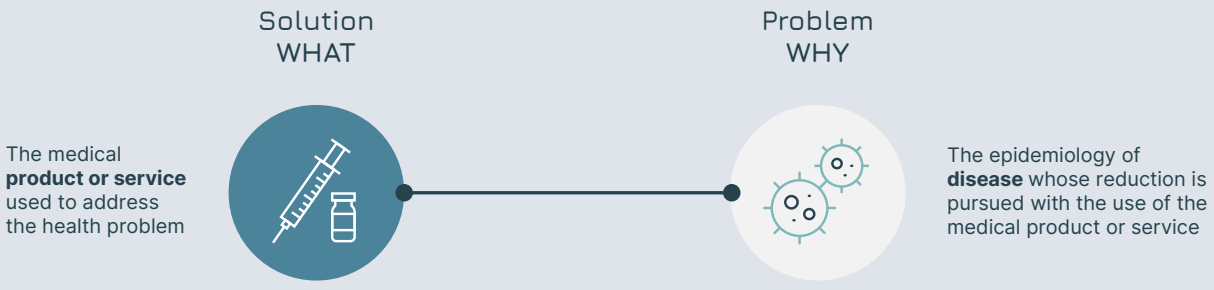
2 Method

2.1 Step 1 - The exploration of the problem-solution fit

The first step in the process of defining use cases is the exploration of the problem–solution fit. This entails analysing and achieving clarity on two components:

- The **problem** (the "WHY") - the public health problem, driven by the epidemiology of disease, whose reduction is pursued by the use of the vaccine.
- The **solution** (the "WHAT") - the vaccine used to address the health problem. The vaccine characteristics (e.g., formulation, indication, temperature stability) influence who can administer the vaccine (e.g., only trained health workers can administer intramuscular injections while community health workers can administer oral liquid vaccines), who can receive them (based on the indication), and where the vaccine can be administered (e.g., if a cold chain is required). If the vaccine already exists or is in a late stage of clinical development, the Target Product Profiles (TPP*)[3] can be used as a reference for the vaccine characteristics. If the vaccine is in earlier development stages, generally phase I or early phase II, the Preferred Product Characteristics (PPC**)[4] or other documents capturing the requirements of policymakers and procurement agencies can serve the same need. If none of those documents exist, a product profile must be created.

Figure 2 **The problem-solution fit**



* The Target Product Profiles (TPPs) define product attributes such as indication, target population, dosing regimen, duration of protection, route of administration, safety and efficacy. In the case of TPPs developed by WHO, particular focus is devoted to requirements to be fulfilled by products seeking WHO policy recommendation and prequalification (PQ). Other organisations besides WHO also develop TPPs, such as CEPI or the Center for Biologics Evaluation and Research (CBER), albeit with more targeted and focused goals. ** The Preferred Product Characteristics (PPCs), published by the WHO for all critical vaccines in the early stages of clinical development, define the attributes that optimise vaccine use and contribute to meeting global public health needs.

2.2 Step 2 - The programmatic and policy analysis (the definition of the implementation strategies)

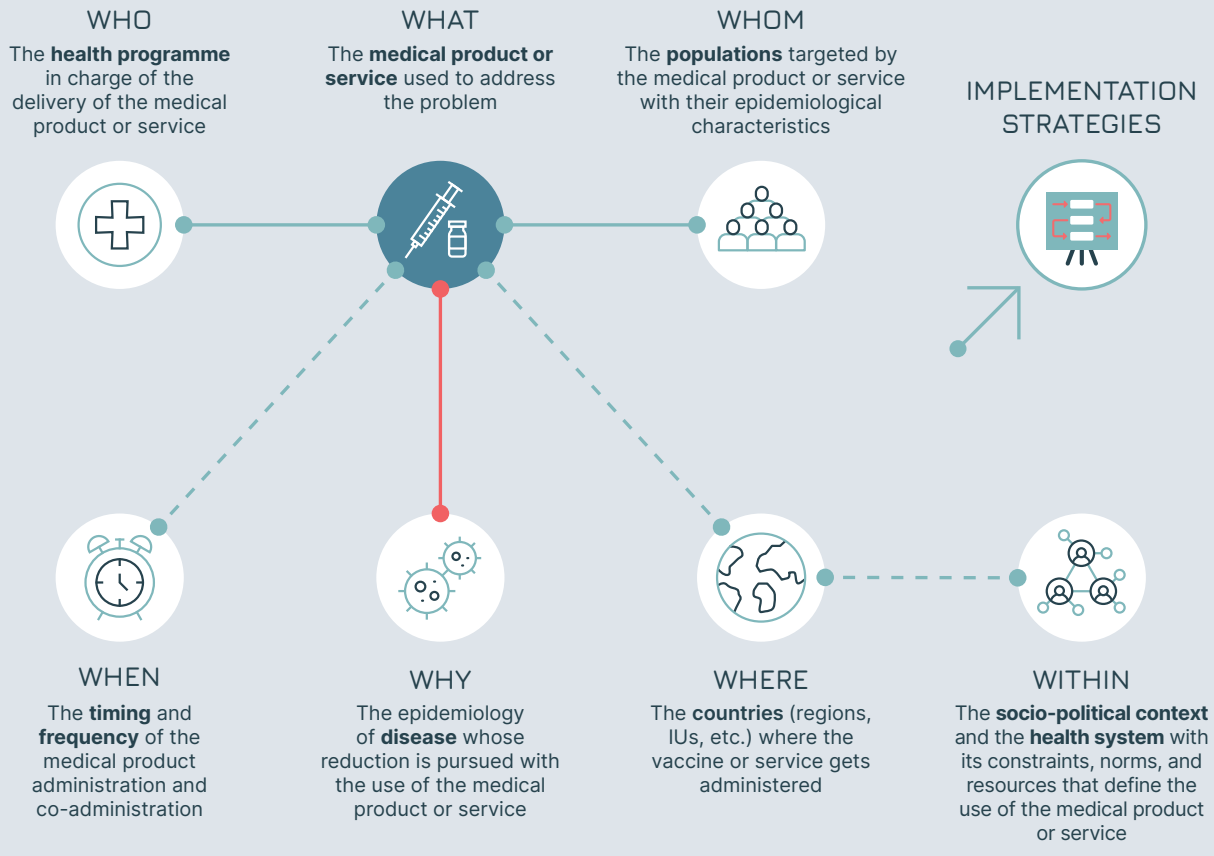
With the solution-problem axis clarified, the next step is performing an in-depth policy and programmatic analysis. This process starts by looking at two critical interlinked factors:

- The **geographical settings** (regional, country or subnational context) where, based on their epidemiological characteristics, the vaccine is meant to provide a solution (the "WHERE"). The epidemiological characteristics include areas of endemicity as well as non-endemic areas with different degrees of risk of infection.
- The **"health systems"** of relevant geographies, with their norms, resources and constraints, that define the context of vaccine use as part of the broader health services delivered to the population (the "WITHIN").

Once these higher-level contextual factors have been clarified, the analysis will concentrate on:

- The **population** or populations targeted (the "WHOM").
- The **health programme** that delivers the vaccine in a country and its relationship with other programmes in or outside of the healthcare system whose contribution may be required or desirable (the "WHO").
- The **timing and frequency** of the vaccine delivery and any linked co-administration (the "WHEN")

Figure 3 **The seven elements of the policy and programmatic analysis**



Analysing these seven "W" factors - two on the problem-solution axis and five specific to the programme and policy context – will allow the definition of the vaccine's **implementation strategies** thereby maximising the fit on the solution-user and solution-provider axes. An implementation strategy is defined as *"the methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical programme or practice"*.[5] In this context, we refer to a vaccination programme. It includes the combination of policies, personnel, resources (financial and technical), operational approaches, and behavioural aspects. The perspective should be forward-looking, focused on the "to-be", and capable of capturing the full potential of the vaccine based on its characteristics.

Decoding the seven "Ws" for vaccine strategies unveils tailored approaches that align with user and provider needs, ensuring a future where the full potential of vaccines is realised.

Example **Defining the "WHOM" for a vaccine against pulmonary TB at the policy-programmatic level: the population**

A generic new TB vaccine can target different population groups depending on their characteristics and indications:

- *Age groups*
- *Persons with varying TB infection status*
- *Persons with varying HIV status*

Specific conditions of the vaccinee can be important since they may allow access to particular delivery channels:

- *Pregnancy*
- *Co-morbidities*
- *Nutritional status: undernourishment, obesity, type 2 diabetes*
- *Substance use disorders: alcohol, drugs, etc.*
- *Special populations in high-congregate settings, including students in schools and other educational institutions, miners, prison inmates, migrants in camps, and internally displaced persons.*

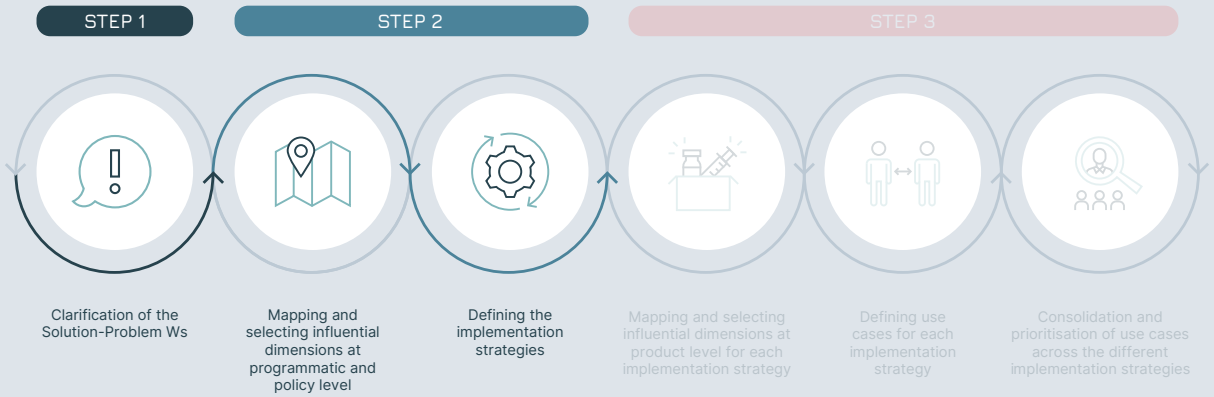
By combining the seven "Ws", we obtain a narrative description of the different potential "implementation strategies" that define the use of the vaccine, as presented in the following example:

*A measles-rubella combination vaccine indicated from 9 months of age (the **WHAT**), is delivered during an outbreak response (the **WHEN**), by the EPI programme (the **WHO**), to a 9-months to 15 years of age population (the **WHOM**), in countries in Central Asia (the **WHERE**), with decentralised health systems and high vaccine hesitancy (the **WITHIN**), to achieve the goal of eliminating measles (the **WHY**).*

Once all potential implementation strategies are identified and described, a review of the contextual dimensions, as described in the WHERE and WITHIN, should be performed to clarify the relevance of each of them. Some implementation strategies may only be relevant in specific contexts, and some may be common across different geographies. This analysis can include the definition of country archetypes and, based on these, prioritisation of the implementation strategies that correspond to the most relevant archetypes (e.g., those representing the largest or the most relevant target populations or countries).

This multi-step analytical process uses a mixed methods approach that incorporates desk reviews, quantitative and qualitative analyses, and direct insight-gathering from users, decision-makers, and other stakeholders via a combination of interviews, surveys, and direct observations. Where applicable, focus groups and validation workshops are also considered.

Figure 4 **The first three steps of user research: the policy–programmatic analysis for defining the implementation strategies**



2.3 Step 3 - The product use analysis (the definition of the use cases)

Once the implementation strategies are defined, the focus should switch towards how vaccines (the "WHAT", the solution) are used within each strategy: the use cases. This implies looking again at the dimensions analysed at the policy-programme level with a more granular lens focusing on the understanding of the different solution-user and solution-provider fits.

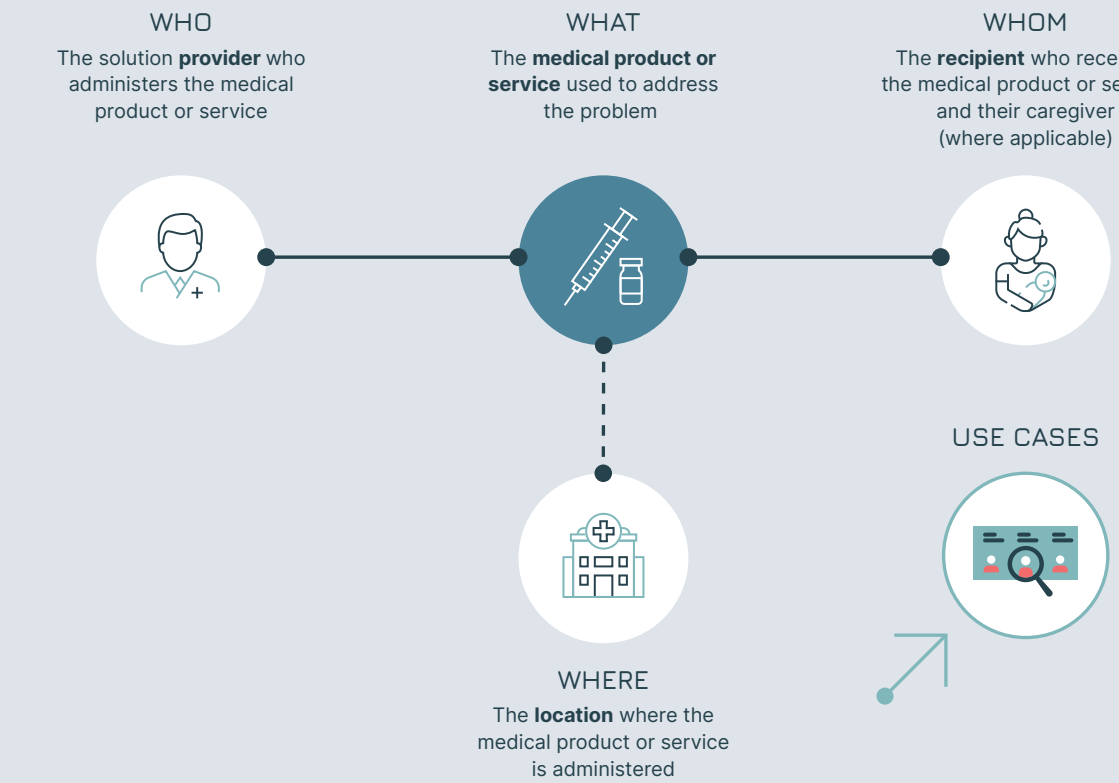
This requires a comprehensive mapping and description of the vaccine product (the "WHAT", the solution) and the relevant personae involved in the vaccine use (step 3a):

- The solution provider - the person that administers the vaccine, the vaccinator (the "WHO").
- The solution seeker – the person that receives the vaccine, the vaccinee, and, where necessary, the caregiver involved (the "WHOM").

As well as the physical point of delivery of the solution:

- The location where the vaccine is administered with all its characteristics and constraints (the "WHERE").

Figure 5 **The four elements of the user-product analysis**



Example **Defining the "WHO" for MR-MAP vaccine[6] at the product level - the solution provider**

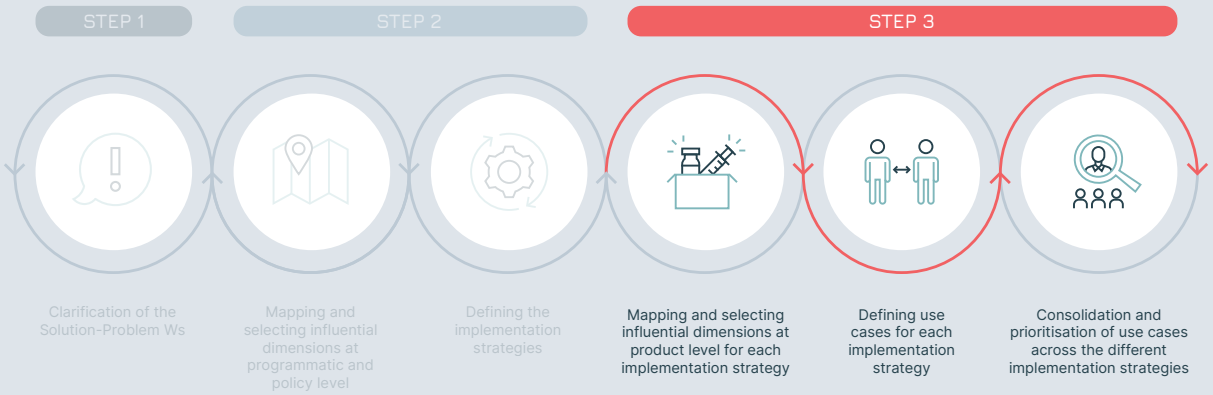
MAPs are needle-free delivery devices consisting of up to hundreds or thousands of tiny projections that deliver dry vaccines just below the skin surface. Some MAPs are applied manually, and others require an applicator for delivery. The vaccine is delivered into the skin within seconds to a few minutes of application. MR-MAPs are anticipated to deliver a single dose, without a need for reconstitution (as with the present lyophilised vaccine), and enhanced heat stability.

Considering the product characteristics and its modality of administration, different actors were viewed as being able to administer MR-MAPs as part of a supplementary immunization activity (SIA) (the implementation strategy in analysis):

- *fully trained health workers (e.g., doctors, nurses, registered pharmacists)*
- *community workers with basic standard training in the health field*
- *non-health personnel with no standard training in the health field (e.g., teachers, community leaders)*
- *caregivers administering the vaccine to their children*
- *persons self- administering the vaccine*

The goal of the analysis is to develop an in-depth understanding of the context in which the personae operate (e.g., family situation, financial situation, lifestyle, professional norms, and habits, etc.), their feelings and thoughts about vaccines and vaccination, their acceptance for injectable vaccines, and ultimately their needs that are to be satisfied by the vaccination programme, either as vaccine recipients or as the person administering it. Personae archetypes can be developed to facilitate the investigation and identification of relevant differences in personae behaviours and feelings that may influence their attitude towards vaccines and, ultimately, their use.

Figure 6 **Step 3 of the 7Ws approach to identifying use cases**



Once the mapping of these elements is completed at the product level, the next step is to **select the dimensions that most influence vaccine use (step 3a).** This step requires reflecting on each of the Ws and critically evaluating the relative weight of their impact. This can be done via expert interviews or through structured collaborative approaches (e.g., workshops, Delphi sessions).

Example **Prioritisation of the "Ws" for an MR-MAP vaccine[6] use case**

The first output of the landscape analysis was the mapping of the different dimensions that can impact how MR-MAP vaccines (the "WHAT") will be used and thus defining the MR-MAP use cases. The following dimensions were reviewed:

- *Delivery setting (the "WHERE") – vaccine use in a fixed post with complete health services (such as a hospital or a health centre) compared to use in a context with limited availability or total absence of health infrastructure (particularly cold chain or trained health workers). This depends on the setup of the immunisation systems and influences the most appropriate mix of delivery strategies (e.g., routine or campaign immunisation).*
- *Service providers (the "WHO") – the type of service providers involved in the immunisation activities – health workers (HWs), community health workers (CHWs), teachers, community leaders, caregivers or persons self-administering the vaccine– and their level of training and relevant knowledge can influence the acceptability and effectiveness of the MR-MAP delivery.*
- *Target population (the "WHOM") – the target age groups and their co-morbidities can trigger changes in how a vaccine can be used. In the case of MR vaccines, the focus on infants and young adults during campaigns reduces the "variety" of relevant use cases (e.g., the viability of self-administration or the ability to leverage specific professional or educational settings).*

The aspects above were discussed and agreed upon with an expert group supporting the project to select those dimensions that will most likely influence the use of MR-MAP vaccines. The delivery setting (the "WHERE", particularly concerning the availability of a cold chain, and the service provider (the "WHO"), with a specific focus on the skills level required for vaccine administration, were selected as the most critical dimensions, and subsequently used to define the MR-MAP use cases.

The subsequent step consists of mapping **the attributes of the selected dimensions that influence the different uses of the vaccine (Step 3b).** The prior analysis at the policy and programmatic level provides the foundation for this step. The attributes of the identified dimensions are discussed and their relevance for influencing vaccine use validated. This step requires a forward-looking perspective that focuses on the "to be" and goes beyond an "as is" view. Focusing on the "to-be" allows capturing use cases that do not exist today but may become viable in the future if new vaccines or improved versions of existing vaccines become available. This may allow new uses that are not yet possible today (for example, self-administration with needle-free, thermostable presentations, such as MAPs).

Example **Attributes of selected dimensions for typhoid conjugate vaccine (TCV) use cases[7]**

*The **delivery location dimension** ("WHERE") was selected given the assumed product characteristics of the MAP presentation. This is an essential dimension of planning the use of MAPs: given its ease of administration, lighter weight and volume, and potential controlled temperature chain characteristics, it can be more impactful to use a MAP presentation in outreach or mobile settings. In this context, the following locations emerged as relevant:*

- *Public health facility (hospital, health centre, health post) - Delivery strategy: fixed site with full cold chain.*
- *Private health facility (hospital, health centre, health post, private practice) - Delivery strategy: fixed site with full cold chain.*
- *Private accredited pharmacy - Delivery strategy: fixed site with full or reduced cold chain.*
- *Public setting with some basic health services (e.g., school, military barracks) - Delivery strategy: outreach with reduced cold chain.*
- *Private setting with some basic health services (e.g., workplace, school, home) -Delivery strategy: outreach with reduced cold chain.*
- *Public or private setting without any health services (e.g., school, workplace, religious institution, other locations) - Delivery strategy: mobile with cold boxes.*

*The **target population dimension** ("WHOM") was selected due to the heterogeneous disease burden of typhoid and the specific WHO recommendations for using TCV. WHO recommends the introduction of TCV into the routine system at nine months of age or in the 2nd year of life with a catch-up campaign of up to 15 years of age while considering the country-specific epidemiology. The WHO position paper also identifies potential special populations that could require typhoid vaccination, such as food handlers, laboratory workers, and travellers from non-endemic to endemic countries. Military personnel were also included as part of the draft use cases, given the potential interest in exploring the size of this target population. Further, the historical use of typhoid vaccines did not show clear trends in how countries use typhoid vaccination, confirming the choice of target population as a dimension that can lead to different uses of the vaccines. The following stratification of the target population was adopted:*

- *Children aged 6-24 months as per WHO recommendation*
- *Children aged 2- to 15-years*
- *Adolescents and adults (15- to 45-years)*
- *Food handlers*
- *Military personnel*
- *Travellers*
- *Health workers*

As a subsequent step, **draft use cases are identified by looking at all potential combinations of the attributes along the selected dimensions (Step 3b).** It is to be noted that in the case of vaccination, the definition of use cases implies "uses" of a vaccine in the context of the immunization programme's efforts to achieve a disease control or elimination goal. It is hereby assumed that all upstream constraints (e.g., manufacturing, financial, policy, regulatory, procurement and supply chain) have been resolved to allow focus solely on the act of delivering the vaccine to its target population.

Example **Seasonal influenza vaccine use cases**

A key implementation strategy was identified for seasonal influenza vaccination: an annual, seasonal, time-limited campaign.

Target population ("WHOM") and delivery location ("WHERE") were selected as the most relevant dimensions influencing the use of seasonal influenza vaccines. Five different target populations were identified based on WHO recommendations: pregnant women, health workers, children (6 to 59 months of age), people with chronic conditions, and the elderly.

Three distinct delivery locations emerged as relevant when considering the countries using the vaccine: health facilities (hospital, health centre, health post, private practice), accredited pharmacies (public or private), settings with some or no health services (e.g., school, military barracks, workplaces, schools, religious institution, other locations). Combining those dimensions and their attributes led to the definition of up to 15 use cases.

	Pregnant women	Health workers	Children (6-59mo)	Individuals w/ underlying conditions	Older adults (>65yo)
Health facility (hospital, health centre, health post) *Delivery strategy: Fixed site with cold chain*	Pregnant woman is vaccinated in a health facility with full cold chain by a HW	Health worker is vaccinated in a health facility with full cold chain by a HW	Child, accompanied by caregiver, is vaccinated in a health facility with full cold chain by a HW	Individual w/ underlying conditions is vaccinated in a health facility with full cold chain by a HW	Older adult is vaccinated in a health facility with full cold chain by a HW
Pharmacy (public or private accredited) *Fixed site or outreach with cold chain*	Pregnant woman is vaccinated in a pharmacy with full cold chain by a HW or pharmacist	Health worker is vaccinated in a pharmacy with full cold chain by a HW or pharmacist	Child, accompanied by caregiver, is vaccinated in a pharmacy with full cold chain by a HW or pharmacist	Individual w/ underlying conditions is vaccinated in a pharmacy with full cold chain by a HW or pharmacist	Older adult is vaccinated in a pharmacy with full cold chain by a HW or pharmacist
Setting with limited or no health service (e.g., school, workplace, religious institution, nursing home, other locations) *Outreach/mobile or fixed site without cold chain*	Pregnant woman is vaccinated in the community with no cold chain by a HW in a mobile session	Health worker is vaccinated in the community with no cold chain by a HW in a mobile session	Child, accompanied by caregiver, is vaccinated in the community with no cold chain by a HW in a mobile session	Individual w/ underlying conditions is vaccinated in the community with no cold chain by a HW in a mobile session	Older adult is vaccinated in the community with no cold chain by a HW in a mobile session

As a last step, **all potential combinations of attributes across the selected dimensions are assessed to capture commonalities in the use of the vaccine, thereby indicating a common use case (Step 3c).** A simplification of the use case framework occurs at this stage. This can be done by combining use cases whose practical differences in the use of the vaccine are minimal (e.g., because different target populations are receiving the vaccine in a similar way or because different locations share similar modes of delivery). The population attributable to each use case can also be measured to **assess the use case size.** Such sizing allows for prioritising the most relevant use cases (e.g., use cases for very small populations may be consolidated with others). It is critical to maintain a forward-looking perspective that accounts for future epidemiological, demographic, or other dynamics that could result in population-level changes.

Example **Seasonal influenza vaccine use case (continued)**

The use case sizing focused on quantifying the maximum potential population that would use any seasonal influenza vaccine in each of the identified use cases, independent of a time dimension and based on the current knowledge and data related to the delivery of seasonal influenza vaccines. It was assumed that seasonal influenza vaccines could be adopted contemporaneously by all countries and delivered to all priority target populations, irrespective of current seasonal influenza vaccine use and without any policy (i.e., current national recommendations for influenza vaccines), financial (ability or willingness to pay), programmatic (i.e., available cold chain or adult vaccination delivery approaches), or supply-related constraints. The analysis resulted in the following estimates:

	Pregnant women	Health workers	Children (6-59mo)	Individuals w/ underlying conditions	Older adults (>65yo)
Health facility (hospital, health centre, health post)	87%	99%	57%	83%	83%
Pharmacy (public or private accredited)	<1%	<1%	<1%	4%	6%
Setting with limited or no health service (e.g., school, workplace, religious institution, nursing home, other locations)	12%	<1%	42%	13%	11%

Example **Seasonal influenza vaccine use case** (continued)

This result, combined with an analysis of the delivery modality, led to the exclusion of four smaller and less significant use cases and to the combination of use cases with similar vaccine use as considered by the expert group informing the project. As a result, the following nine use cases were identified for seasonal influenza vaccines:

	Pregnant women	Health workers	Children (6-59mo)	Individuals w/ underlying conditions	Older adults (>65yo)
Health facility (hospital, health centre, health post) *Delivery strategy: Fixed site with cold chain*	Pregnant woman is vaccinated in a health facility with full cold chain by a HW	Health worker is vaccinated in a health facility with full cold chain by a HW	Child, accompanied by caregiver, is vaccinated in a health facility with full cold chain by a HW	Individual w/ underlying conditions is vaccinated in a health facility with full cold chain by a HW	Older adult is vaccinated in a health facility with full cold chain by a HW
Pharmacy (public or private accredited) *Fixed site or outreach with cold chain*				Individual w/underlying conditions and older adults are vaccinated in a pharmacy with full cold chain by a HW or pharmacist	
Setting with limited or no health service (e.g., school, workplace, religious institution, nursing home, other locations) *Outreach/mobile or fixed site without cold chain*	Pregnant woman is vaccinated in the community with no cold chain by a HW in a mobile session		Child, accompanied by caregiver, is vaccinated in the community with no cold chain by a HW in a mobile session	Individual w/underlying conditions and older adults are vaccinated in the community with no cold chain by a HW in a mobile session	

As mentioned in the programmatic and policy steps of the analysis, contextual factors influence implementation strategies and, consequently, the use cases and their relative importance. Reviewing the **country archetypes** identified in the programmatic and policy steps can help prioritise and refine the use cases.

Example **Use case refinement – country archetypes for a TCV MAP vaccine**[7]

Given the non-universal recommendations for TCV and the heterogeneous burden within and between countries, country archetypes were developed for TCV-MAPs.

A standard set of characteristics defined the country archetypes, which were also used in forecasting TCV-MAP demand. In determining the country archetypes for TCV-MAPs, eight potential parameters were reviewed:

- *Income level (high-income countries (HIC); upper-middle-income countries (UMIC); low-middle-income countries (LMIC); low-income countries (LIC)), with high data availability*
- *Regional market characteristics (public, mixed private and public, etc.), with medium data availability*
- *Typhoid incidence (high, medium, low), with high data availability*
- *Level of typhoid surveillance (yes, no), with medium data availability*
- *Level and type of typhoid antimicrobial resistance (AMR) severity (high, medium, low), with medium data availability.*
- *Level of access to water and sanitation (high, medium, low), with medium data availability*
- *Existence of policy on typhoid (yes, no), with low data availability*
- *Historical use of typhoid vaccines (yes, no), with medium data availability*

Four parameters were chosen to define the country archetypes based on the data reviewed. These parameters included income level, regional market characteristics, typhoid incidence, and level and type of typhoid antimicrobial resistance (AMR), and ultimately resulted in five identified country archetypes for TCV-MAPs categorised by disease and AMR burden:

- *A: HICs or UMICs with low incidence and in countries of the Pan American Health Organisation (PAHO)*
- *B: LMICs or LICs located in PAHO and in the WHO regions for Africa (AFR), Eastern Mediterranean (EMR), and Europe (EUR) with high typhoid incidence and AMR*
- *C: LMICs or LICs located in PAHO, AFR, EMR, and EUR with medium typhoid incidence and AMR*
- *D: LMICs or LICs located in PAHO, AFR, EMR, and EUR with low typhoid incidence and AMR*
- *E: LMICs or LICs with significant private market (located in WHO South-East Asia (SEAR) or Western Pacific (WPR) regions) with high or medium typhoid incidence and AMR*

The final result is a narrative description of the different "uses" of the vaccine. Those are the use cases for each implementation strategy, as presented in the following example:

*As part of an outbreak response (the **IMPLEMENTATION STRATEGY**), a lyophilised measles-rubella combination vaccine (the **WHAT**), is reconstituted and administered by a trained health worker (the **WHO**), to a 9-month-old infant accompanied by the mother (the **WHOM**), in a remote health post without cold chain or storage capacity (the **WHERE**)."*

3 The final output and its use

A use case matrix provides clarity on the way vaccines can be used.

Once all three steps of the process are completed, the prioritised use cases are defined for each implementation strategy. The use cases can be visualised in a matrix that provides a comprehensive overview and helps capture all relevant factors.

These maps can facilitate discussions and inform decisions across the entire life cycle of a vaccine. During the product development phase, vaccine implementation strategies and use-related insights can inform policy recommendations and guidance on the potential use of a vaccine to achieve stated public health goals. These insights can also guide the design of clinical trials and the prioritisation of product-specific characteristics that could be especially valuable for the users. After vaccines have been introduced in national immunization programmes, the use cases can help highlight potential areas for improvement of second-generation products or where to target interventions for increased use and coverage.

Figure 7 **Complete steps of the 7Ws approach to identifying use cases**

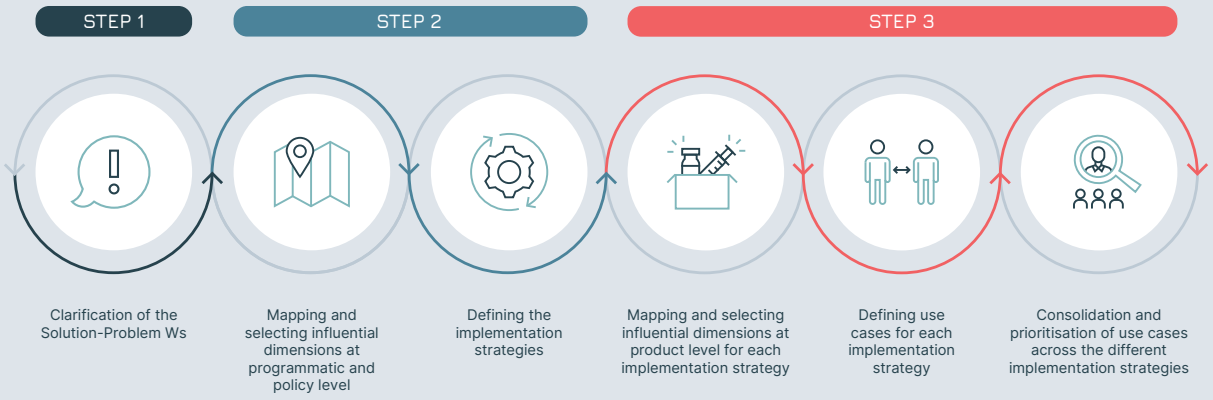


Figure 8 **Use cases for a TCV vaccine with MAPs[7]**

	Fixed Health Facility (e.g., hospital, health centre, health post)	Setting with limited health services (e.g., schools)	Setting with no health services (e.g., home, workplace)
Delivery strategy:	Fixed site with full cold chain capacity	Outreach/campaigns in areas with reduced cold chain	Outreach or campaigns with limited cold chain and/or cold boxes
 <2 year old	1 Delivery by HW or CHW in Fixed Health Post Infant, accompanied by a caregiver, is vaccinated in a health post with full cold chain	2 Delivery by HW or CHW in settings with limited health services Infant, accompanied by a caregiver, is vaccinated in a community setting with reduced cold chain	3 Delivery by HW or CHW in setting with no health service Infant is vaccinated in the community with no cold chain by a HW/non-HW during a mobile session
 2- to 15-year-old 24 months-15 years	4 Delivery by HW or CHW in Fixed Health Post or a setting with limited/no health services Pre and school-age child is vaccinated as part of supplemental immunization activity at a health post with full cold chain or in a school with reduced cold chain, or as part of a campaign in the community with no cold chain by HW/non-HW		
 Adolescents & adults >15 to 45 years, including special populations*	*No use case - deprioritised due to low likelihood*		
 Military	5 Delivery by HW in Fixed Health Post Military personnel is vaccinated at military health facility with full cold chain by a HW		
 Travellers	6 Delivery by HW or CHW in Fixed Health Post or a setting with limited health services Adult traveller to an endemic typhoid area is vaccinated at a travel clinic or pharmacy with full or reduced cold chain by a HW or CHW		

* Special populations include food handlers and laboratory workers

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5 References

1. Ivar Jacobson International. (2011). USE-CASE 2.0 - The Guide to Succeeding with Use Cases https://www.ivarjacobson.com/sites/default/files/field_iji_file/article/use-case_2_0_jan11.pdf

2. Leurs B., & Roberts I. (2017). What do we mean by design? Retrieved May 20 from https://www.nesta.org.uk/blog/what-do-we-mean-by-design/

3. World Health Organization (2015). Target Product Profile

4. World Health Organization (2019). Preferred Product Characteristcs

5. Curran G.M., Bauer M., Mittman B., Pyne J.M., Stetler C. (2012). Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care.* 2012; 8:217–226. doi: 10.1097/MLR.0b013e3182408812

6. Malvolti S., Malhane M., Ko M., Menozzi-Arnaud M., Mantel M., Jarrahian C., Amorij J.P., Giersing B., Hasso-Agopsowicz M. (2023). Exploring potential applications of measles and rubella microarray patches (MR-MAPs): use case idenification, *Front. Public Health* 11:1165110., doi: 10.3389/fpubh.2023.1165110

7. Soble A. et al. (2024). A review of potential use cases for measles-rubella, measles-mumps-rubella, and typhoid-conjugate vaccines presented on microarray patches, *Vaccine* 42. 1230–1246

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