NUVA – Unified Nomenclature of Vaccines

What is so special about vaccines ?

Specificities of vaccines

- They train the immunity system against antigens
- They are administered to healthy people
- They are generally not substitutable
- Their administration protocols are variable with the local context
- Most of them have a lifelong effect

Vaccines are made of antigens

- Antigens mimic some characteristics of the infectious agent to train the immunity system.
- An antigen is specific to an infectious agent (a disease)
- To reduce the number of vaccine administrations, many vaccines address several target diseases by carrying different antigens.

It is important to know the combination of antigens within each vaccine.

The notion of dose number should apply to antigens, not vaccines.

Vaccines are administered to healthy people

- The benefit/risk balance is even more critical than for therapies
- To enhance it:
  - The protocols are more and more targeted to populations at risk
  - Unnecessary vaccinations must be avoided

Assessing correctly the vaccination status is critical to avoid over and under vaccinations

The decision rules are complex, local and continuously evolving

Most vaccines are not substitutable

- There are no generic vaccines
- The combined use of different vaccines against a same disease is deliberate (heterologous vaccination) and protocolized.

To keep track of these :

- Full product information is the best
- Degraded information is better than no information at all

Vaccination protocols are variable

Each country defines its own vaccination protocol according to:

- Its epidemiologic context
- Its healthcare resources
- The availability of vaccines
- The preexisting organization of routine health checks

You cannot take for granted that any person has followed the vaccination protocols currently applicable in your country.

Vaccination history must be comprehensive and factual: such vaccine was administered on that date.

Most vaccines have a lifelong effect

Unlike other medications, you need to know of vaccines administered:

- Anytime over the patient's lifetime
- Anywhere in the world

The legacy records are mostly on paper, with various written forms.

This written information can be degraded:

- Conventional abbreviations (*Infanrix6* instead of *Infanrix Hexa*)
- Antigens (*Tdap*) instead of product identification
- Target disease (*Vaccinated against influenza*)

Even for contemporary vaccines, their names can be different (*Covishield* as an alternative name to *Vaxzevria*)

How was this addressed up to now ?

Data collection

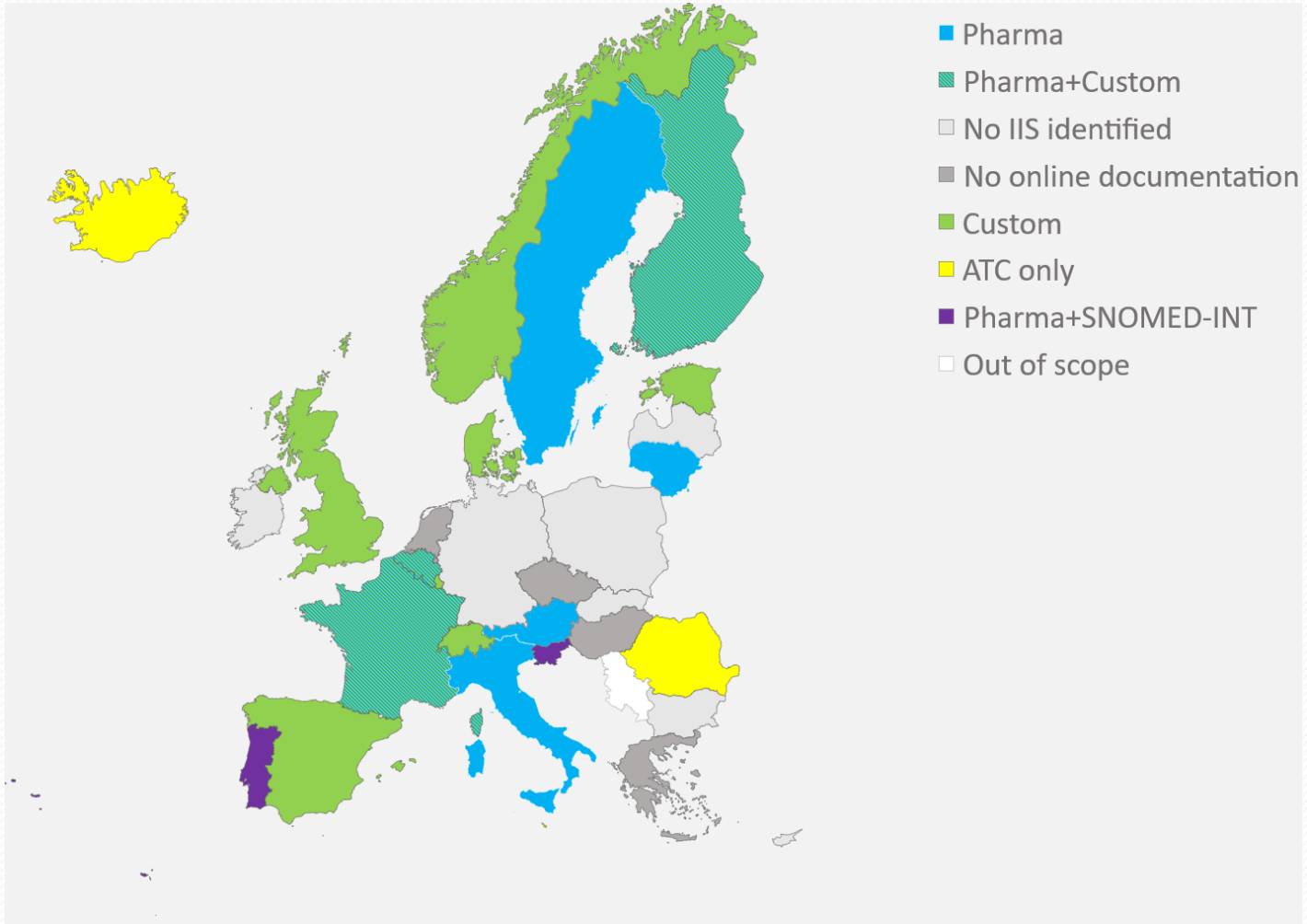
On behalf of the EC, we studied the representation used by Immunization Information Systems in Austria, Belgium, Croatia, Denmark, Finland, France, Italy, Lithuania, Malta, Spain (Andalusia), Portugal, Slovenia, Sweden, Norway, Iceland Switzerland, UK, USA, Canada, Australia.

Codification	#IIS	Comment
Pharma. code	12	Specific to each country
Vaccine specific	13	Standalone or complement to pharmaceutical code Local extensions to SNOMED-CT are counted here.
ATC	10	Almost always a complement
SNOMED-CT	2	International version only

Code systems diversity

Custom or pharmaceutical codes (blue and green) are not compatible across countries.

EMA SPOR will unify pharmaceutical codes across the EU, but only for today's products.



The usual trajectory

Most countries :

- Start with pharmaceutical code
- Once in production, realize that it is not enough and complement with custom codes

Some anticipated and created fully dedicated code systems.

The most mature ones (i.e., Denmark, Canada) have built complete ontologies to bind vaccines codes, pharmaceutical codes, batch numbers, target diseases, etc. Yet they still address only domestic use.

How we addressed it

Where we come from

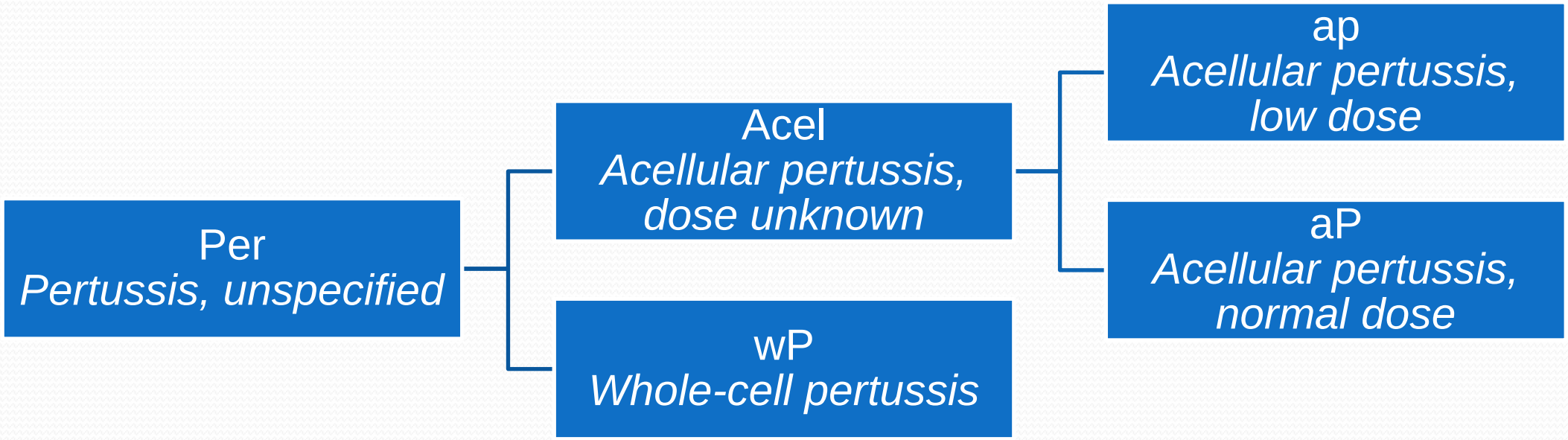
- We build and operate decision support systems for vaccination
- We needed a description of administered vaccines that was precise, comprehensive and inclusive of all existing vaccination trails.
- We used it for 10 years in France with a public facing vaccination information system, collecting vaccination trails for 1.4 million citizens.
- Incidentally, only 40% of the records would have been codifiable using the pharmaceutical codes.
- While working for the EC on recommendations for an EU citizen's vaccination card we realized that we had created a unique asset.

The concept of valence

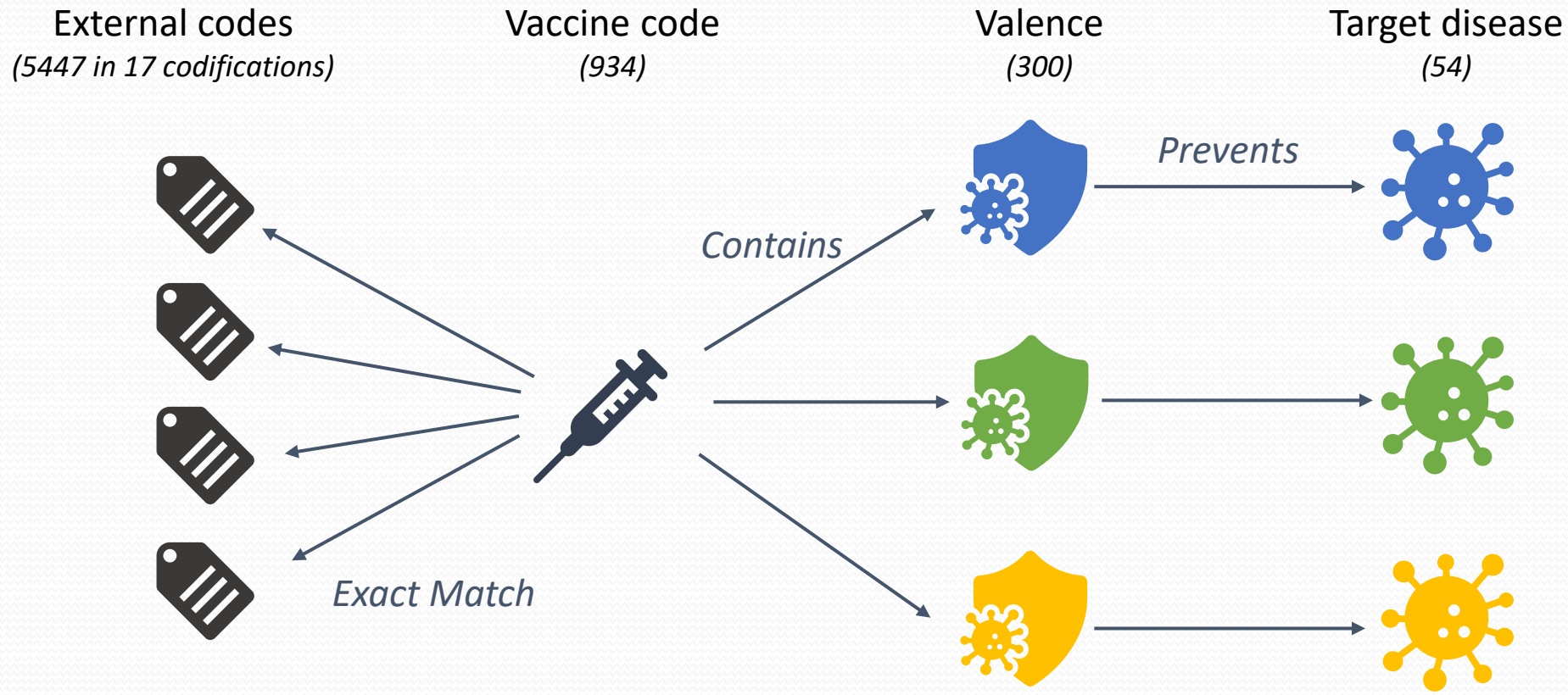
- The valence is the smallest functional unit of a vaccine, knowledge of which is necessary and sufficient to assess the immunization status of an individual against a specific infectious agent (or subspecies of that agent) and to plan the next dose of vaccine, if appropriate.
- A valence represents an antigen or a relevant group of antigens specific of a given target infectious agent or subspecies (such as serotypes or common proteins).

Hierarchical representation of valences

Allows to include vaccines that are not fully identified.
Illustrated here with the case of pertussis valences



All NUVA concepts



Counted on August 9th, 2022

What valences bring ?

- They solve the usual issue of classification of multivalent vaccines (in ATC, J07AE = Cholera, J07AP = Typhoid,
  but J07AE51 = Cholera + Typhoid)
- They structure the reasoning for the decision support system
- They allow to navigate between different levels of abstraction:
  - Finding all vaccines that can be represented byJ07CA01
  - Finding possible SNOMED-CT representations for REPEVAX
  - A demonstrator is available at https://nuva.mesvaccins.net/mapping

Capturing vaccination records

- From paper-based vaccination cards:
  - Translations are included for language dependent labels
    - Pertussis (en) = Coqueluche (fr) = Čierny kaše (sk)
    - Tdap (en) = dTca (fr)
  - Abbreviations are included as hidden labels
- From digital records
  - Each external code is mapped to exactly one NUVA code, with the exact same level of precision

NUVA representations

Available:

- As an OWL/RDF graph at https://smt.esante.gouv.fr/terminologie-nuva/
  A SPARQL query interface is included.
- Through an exploration tool at https://nuva.mesvaccins.net
- A FHIR representation is also possible

Comparison with some alternatives

Comparison metrics

- Exhaustiveness – Against an estimated target of 1200 codes
- Ambiguousness – Average number of real vaccines per code
- Informativeness – 3 steps scale for the represented knowledge
- Inclusivity of paper trails – 3 steps scale according to flexibility
- Inclusivity of digital trails – Against a target of 50 code systems
- Translatability to external codes – 3 steps scale according to flexibility

Further aggregated into two synthetic metrics:

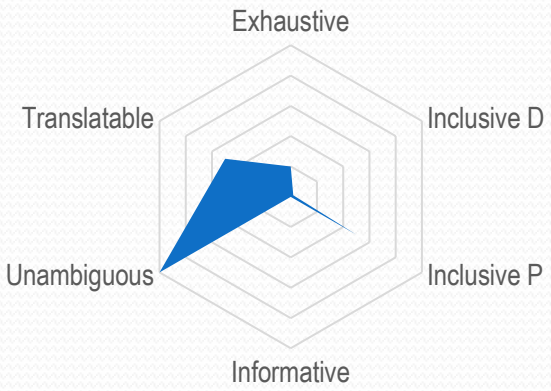
- Ability to capture (exhaustive, inclusive)
- Ability to process (unambiguous, informative, translatable)

Considered alternatives

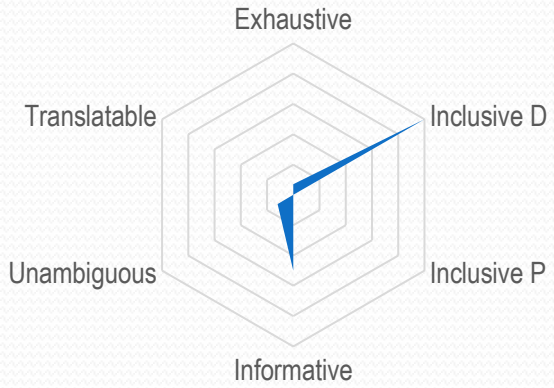
- Pharmaceutical codes (using the French CIS as reference)
- ATC (WHO)
- SNOMED-CT International Version
- CVX (US codification)
- Canadian Vaccine Catalogue (CVC)

Indicators per code system

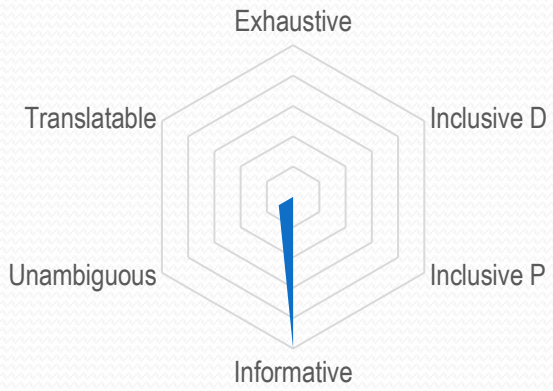
Pharmaceutical code (CIS)



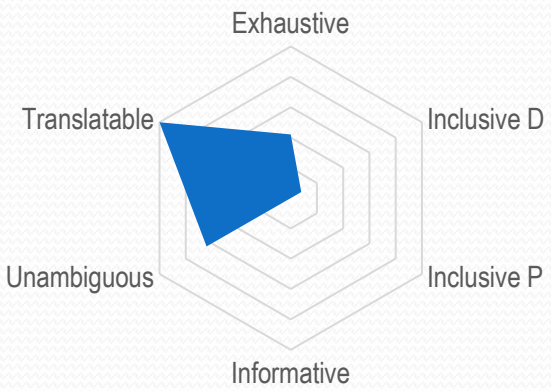
ATC



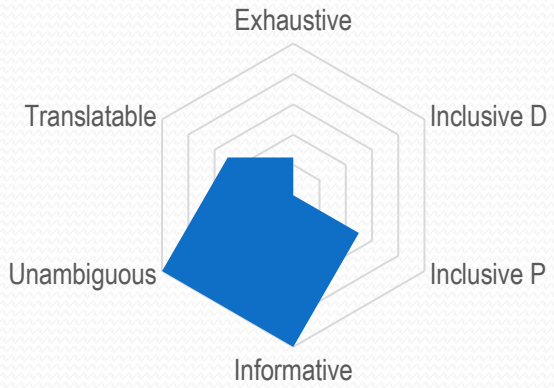
SNOMED-CT



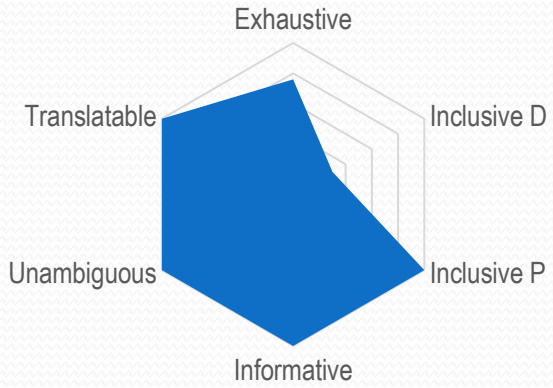
CVX



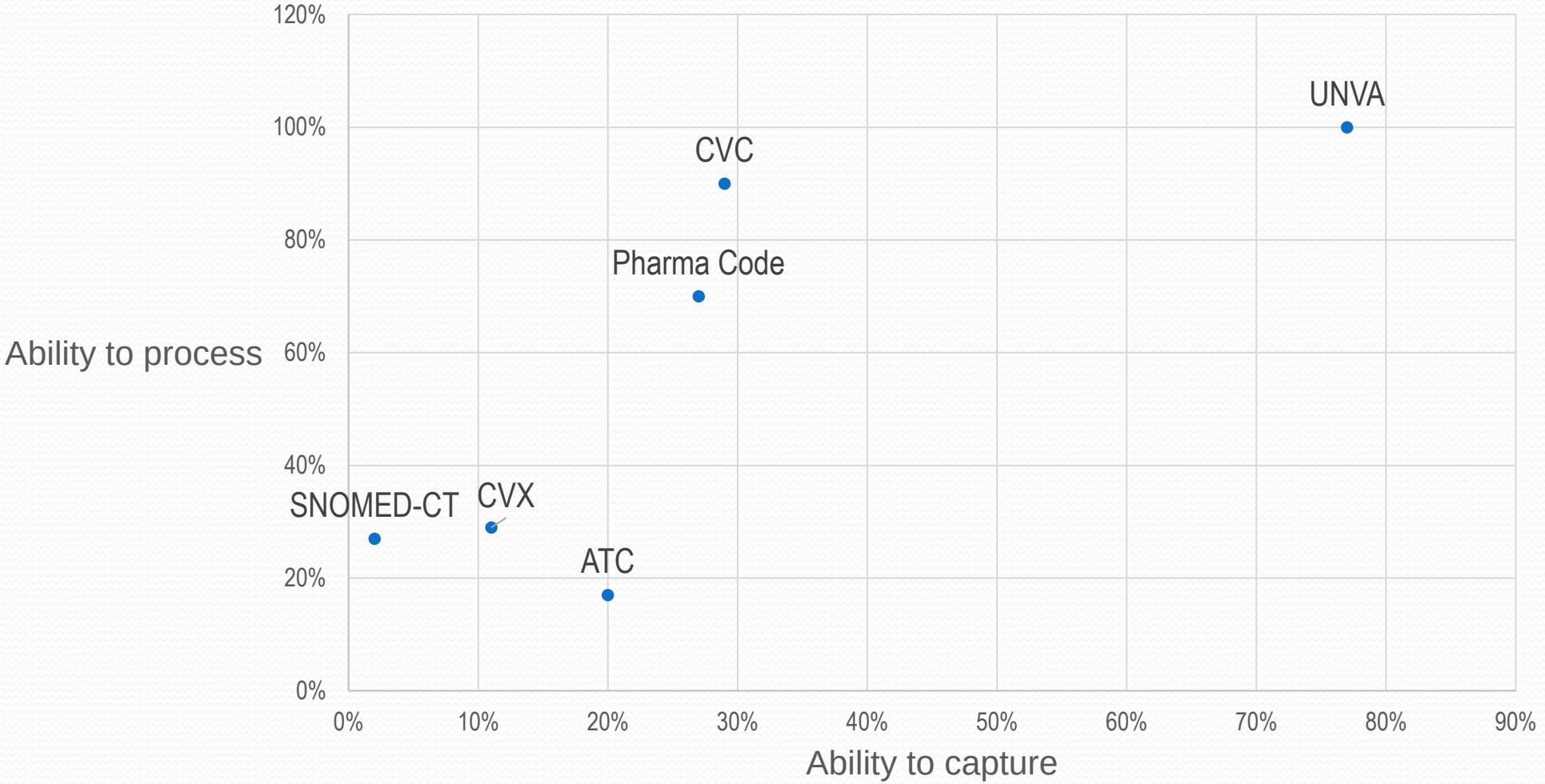
CVC



UNVA



Synthetic indicators



Our proposal for the future

NUVA as a common good

- We identified the need for a pivot terminology in our study for the EU citizen's vaccination card
- We propose to make it a common good, at least within the EU, since:
  - We consider it has a value for public health
  - It will anyhow create a favorable ground for decision support systems
- We intend to launch a pilot with several volunteer countries
- The appropriate governance structure is still to be defined; this should be part of the pilot project

Takeaway – One possibility among many

Reusing the technology of the Digital Covid Certificate, it is possible to create a NUVA encoded QR Code carrying a whole vaccination history (prototyped up to 100 events).

This could ultimately replace the yellow international vaccination certificate.

LE GOUVERNEMENT DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de la Santé

Carnet de Vaccination Electronique

Carnet de Vaccination Éléctronique au 30/09/2021

NOM:	Charles	SEXE:	Masculin
NOM DE NAISSANCE:		DATE DE NAISSANCE:	25/02/1984
PRÉNOM:	Charnby	MATRICULE:	1984022560043

Historique Vaccinal

DATE	NOM DU VACCIN	MALADIES
30/09/2021	Prepandemic influenza vaccine (H5N1) Novartis Vaccines and Diagnostic	Grippe aviaire
30/09/2021	FLUVIRINE (rappel)	Grippe saisonnière
30/09/2021	PENTAVALENTE (rappel)	Coqueluche, Diphtérie, Haemophilus influenzae b, Hépatite B, Hépatite B, Hépatite B, Hépatite B, Tétanos
30/09/2021	MENCEVAX A (rappel)	Méningocoque A
30/09/2021	MENPOVAX 4 (rappel)	Méningocoques ACWY
30/09/2021	A.D.T. (rappel)	Diphtérie, Tétanos
30/09/2021	D.T. POLIO MERIEUX (rappel)	Diphtérie, Poliomyélite, Tétanos
30/09/2021	DTVax	Diphtérie, Tétanos
30/09/2021	PRIORIX-TETRA (rappel)	Oreillons, Rougeole, Rubéole, Varicelle
30/09/2021	VICPS (TYPHIM VI)	Typhoïde

Statut Vaccinal

EN RETARD

MALADIE	DEPUIS LE
Test 1	18/07/2015
Test 2	28/03/2018
Test 3	03/11/2020

À FAIRE

MALADIE	À PARTIR DU	AVANT LE
Test 4		18/01/2022
Test 5	10/02/2022	
Test 6	05/01/2022	

CAS PARTICULIERS

MALADIE	INFORMATIONS COMPLÉMENTAIRES
Pneumocoque	La vaccination n'est recommandée que s'il existe des facteurs de risque.
Papillomavirus	Pas d'indication chez l'homme après 26 ans.

À JOUR

Covid 19, Fièvre jaune, Hépatite B, Tétanos

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