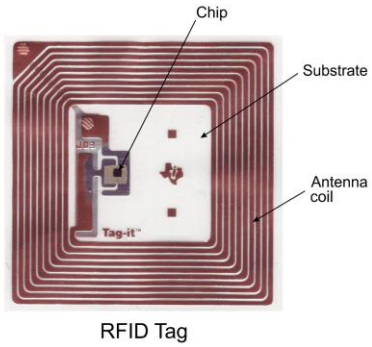
Radio Frequency Identification (RFID)

Comparator: Use without innovation (i.e. no RFID)

Section 1: Summary of innovation

1.1 Example images:

RFID tags		RFID readers	
RFID tag  RFID Tag Image source: [a]	RFID tags used for hospital medication trays  Image source: [b] RFID tag attached to drug  Image source: [c]	Handheld RFID readers & scanners  Image source: [d]	Android App to scan RFID  Image source: [e]

[a] http://endtimestruth.com/wp-content/uploads/2014/01/RFID-chip-and-antenna-3.png
[b] http://ww1.prweb.com/prfiles/2014/10/05/12223944/HCL%20-%20Seal%20Tags%20Kit%20Check.jpg
[c] http://www.radiofrequency-tags.com/photo/pl13237005-programming_printable_rfid_tags_for_identifying_medicine_bottles_to_track_prescription_drugs.jpg
[d] https://www.abr.com/products/rfid-products/
[e] https://dribbble.com/shots/1142633-Android-App-RFID-Scan

1.2. Description of innovation:

- Radio-frequency identification (RFID) is used in many different industries – pharmaceuticals, healthcare, food and agricultural.
- RFID tags can store a wide range of information useful for inventory control, equipment tracking, patient monitoring and providing data for electronic medical record systems. This innovation focuses on RFID tags that are incorporated into a primary vaccine container to enable tracking of vaccines at the vial-level.
- An RFID system consists of three components, namely the (i) tag, (ii) reader and (iii) the middleware. RFID middleware refers to the computer hardware and software, which connects the reader to computer systems and data repositories, by converting data captured from tags into tracking or identification information. The RFID tag is affixed to the item/product containing relevant data/information which is communicated to the reader via radio signals. The reader component converts the radio signals into data that is transferred to the middleware to trigger further actions based on the information captured.
- There are three types of RFID tags:
    - Passive tags are the simplest, smallest and least costly version of an RFID tag as they do not contain a built-in power source and consequently cannot initiate communication with a reader. Shelf-life: 20+ years.
    - Semi-passive RFID tags have built-in batteries and do not require energy from the reader field to power the microchip. This enables them to function with a lower signal power and act over greater distances (~30 meters). Shelf-life: 2-7 years. Batteries on tags have a typical maximum shelf life of 2 to 7 years, but when tags are used and interrogated frequently, the batteries can quickly be depleted.[f]
    - Active RFID tags are battery powered devices that have an active transmitter and can communicate over long distances (up to two kilometres with some reader antennas). (Shelf-life: 2-7 years)
- Data can be captured from a range of distances and multiple tags can be read rapidly in a serial format.
- Potential use cases for an RFID tag incorporated on vaccine primary containers (including combination vaccine/delivery device products). An RFID tag is a way to automatically identify an item via a reader, which can enable:
    - Tracking which dose is administered to which patient for immunization record-keeping and adverse events monitoring.
    - Rapid surveying of vaccine inventory in cold rooms or refrigerators, including identifying if there are any expired lots or recalled items.
    - Tracking vials to ensure all unused vials that are taken for outreach are returned, e.g., with monovalent oral polio vaccine type 2 (mOPV2).

[f] https://rfid4u.com/rfid-basics-resources/how-to-select-a-correct-rfid-tag-passive-vs-active/

- Tracking of vaccine product GPS location and time (when the primary container is scanned), which could be mapped to corresponding temperature/weather databases. This could potentially be used for studies (e.g., to understand potential for CTC use of vaccines in particular distribution systems and seasons) based on GPS location/time of the reader device that identifies the RFID tag while also tracking the location of the container and when the dose was delivered through an app. The RFID tag itself does not track GPS, time, or location, but can connect to other systems that have this capability.
- RFID semi-passive hardware has the ability to actually monitor the cold chain using a wireless sensor for deviations in temperature during transport and storage of food products that are sensitive to temperature change resulting in damage (1). This has been used in the food and agricultural industry.

1.3 Examples of innovations and developers:

Table 1.

Product name; Image	**Developer (place); website**	**Brief description, notes**
 Image source: [g]  Image source: (7)	**KITCHECK** https://kitcheck.com/kit-check/tags/	Each Kit Check tag is embedded with an RFID chip. The tags are printed with each medication's information. Kit Check labels are also used for medication packets. The FDA does not specify RFID as the only technology capable of performing track/trace, however, states that RFID is one the best methods for achieving the goal of supply chain visibility and preventing the sale of counterfeit drugs. It is encouraging pharmaceutical companies to experiment with RFID and provide feedback to the FDA.[i]

[g] https://www.rfidjournal.com/lib/x/a/assets/2013/08/full-stacked_trays-web.JPG
[i] Pharmaceutical RFID: From Mandates to Endorsements and Laws. https://www.pharmamanufacturing.com/assets/Media/MediaManager/ptt0602_abi-research_rfid-in-pharma.pdf

Product name; Image	**Developer (place); website**	**Brief description, notes**
 Image source: [h]		
Hipradermic® injection device  Image source: [j]	**HIPRA** The Reference in Prevention for Animal Health https://www.hipra.com/portal/en/hipra/knowledge/postdetail/HIPRA-on-the-cutting-edge-of-innovation-with-smart-vaccination	The UNISTRAIN® PRRS live vaccine for pigs has an RFID label (chip in the label of the vaccine) which automatically provides information to the user by sending signals directly to the vaccine delivery device fitted with an antenna. The information captured by the antenna is recorded and transferred to other Bluetooth devices to analyse traceability data and create vaccination reports.

[h] https://kitcheck.com/wp-content/uploads/2014/03/kit-check-tagged-medications.jpg
[j] https://www.pigprogress.net/Resizes/mainarticleimage/PageFiles/85/36/33685/001_844_rb-image-2823708.jpeg

SECTION 2: Summary of assessment for prioritisation

2.1 Key benefits:

- Improved quality and accuracy of inventory and immunization data for stock management (i.e. prevent stock-outs), traceability issues in supply chains, patient vaccination records, surveillance, which could contribute to reducing missed opportunities.
- RFID tags are easy to apply and ensure successful reading and documentation of information.
- Improved and timely decision making due to real-time data access for health professionals potentially resulting in improved patient health outcomes and safety due to accuracy of patient identification.
- Improves operational processes and workflow, resulting in time and cost saving as well as patient satisfaction.
- Monitoring of patient vaccination records by linking an RFID tag on a primary container to a patient's medical records.

2.2 Key challenges:

- Substantial costs related to the requirement for necessary equipment (RFID readers, sensors and data management software, additional servers, middleware and regular upgrades of applications) to support the use of RFID labelling. However, the long-term benefit of tracking and tracing can potential reduce future costs.

2.3 Additional important information:

- A widely adopted technology as a tracking system, commonly used in a variety of industries including agriculture, food, pharmaceuticals and various healthcare practices for the tracking of patients, medical supplies and medical equipment in hospitals.
- The RFID tag itself only automatically identifies a primary container via a reader. The benefits of an RFID tag to track and trace rely on a system in place to read an RFID tag and link to other systems like GPS, temperature, or vaccination records.
- Technological limitations can impede its adoption as the technology can interfere with medical devices in the hospital environment.
- Accuracy of reading the RFID labels depends on multiple factors such as the object that is tagged, tag placement, angle of rotation and reading distance.
- Lack of standards and organizational support at the global level of the industry which prohibits the roll out of RFID deployment at large-scale.
- Privacy concerns due to inappropriate collection of data and its intentional or unauthorized misuse.

SECTION 3: Evaluation criteria

3.1 Health impact criteria

Indicator: Ability of the vaccine presentation to withstand heat exposure

*Legend: Green: **Better** than the comparator: The innovation includes features that may increase heat stability; White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator: The innovation includes features that may decrease heat stability, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 2.

Ability of the vaccine presentation to withstand heat exposure	Parameters to measure against a comparator	Score	Assessment
	Does the innovation have features that may improve heat stability?	Neutral	RFID tags have no impact on the ability of a vaccine to withstand higher temperatures, which is no different to the comparator. (Note: Passive RFID tags have shown a high-degree of tolerance to heat and re-freezing) (2).

	***No difference** to the comparator*

Indicator: Ability of the vaccine presentation to withstand freeze exposure

*Legend: Green: **Better** than the comparator: The innovation includes features that may increase freeze resistance; White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator: The innovation includes features that may decrease freeze resistance, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 3.

Ability of the vaccine presentation to withstand freeze exposure	Parameters to measure against a comparator	Score	Assessment
	Does the innovation have features that may improve freeze resistance?	Neutral	RFID tags have no impact on the ability of the vaccine to withstand freeze exposure, which is no different to the comparator. Note: Passive RFID tags have shown a high-degree of tolerance to heat and re-freezing (2).

	***No difference** to the comparator*

3.2 Coverage and equity criteria

Indicator: Ease of use[k]

*Legend: Dark Green: **Considerably better** than the comparator: Better for all applicable parameters; Green: **Better** than the comparator: Better for some of the applicable parameters AND no difference for the rest of the parameters; White: **Neutral**, no difference with the comparator; Yellow: **Mixed**: Better than the comparator for some of the applicable parameters AND worse than the comparator for the rest of the parameters; Red: **Worse** than the comparator: Worse for some of the applicable parameters AND no difference for the rest of the parameters; Dark Red: **Considerably worse** than the comparator: Worse for all applicable parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 4.

Ease of use • *Assessment of the potential for incorrect preparation based on usability data from field studies (or based on design of innovation if field studies not available)* • *Assessment of the potential for incorrect administration based on usability data from field studies (or based on design of innovation if field studies not available)*	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation avoid reconstitution and is that an improvement?	Neutral	Incorporation of an RFID tag onto a primary container will have no impact on reconstitution of the vaccine, which is no different to the comparator.
	Does the innovation require fewer vaccine product components?	Neutral	A vaccine primary container with an RFID tag would have the same number of vaccine product components as a vaccine without an RFID tag (comparator).
	[l] **Does the innovation require additional components or equipment (such as scanners or label readers)?**	Worse	To use the RFID tag additional equipment (e.g. reader for scanning the RFID tag) would be necessary for capturing and processing data/information and therefore an additional piece of equipment than the comparator. This would also increase the number of steps and complexity, compared to having no RFID system.
	Does the innovation require fewer preparation steps and less complex preparation steps?	Neutral	Incorporation of an RFID tag into a primary container will have the same number and complexity of vaccine preparation steps. The information stored in an RFID tag could provide the vaccinator guidance in preparing the vaccine correctly, through communicating vaccine related information (3). However, the vaccine would still be prepared the same way as without the innovation.

[k] Ease of use can prevent missed opportunities resulting from the complexity of preparation and administration procedures. It could also impact the ability for lesser trained personnel to administer the vaccine (incl. self-administration). It can be assessed based on usability data from field studies (or based on design of innovation if field studies not available).
[l] This parameter is only assessed for RFID/barcodes, for all other innovations it is not applicable (N/A).

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Category: *Labelling*

Innovation: *Radio Frequency Identification Device (RFID)*

Comparator: *Use without innovation (i.e. no RFID)*

Ease of use	Parameters to measure against a comparator	Score	Assessment
• *Assessment of the potential for incorrect preparation based on usability data from field studies (or based on design of innovation if field studies not available)* • *Assessment of the potential for incorrect administration based on usability data from field studies (or based on design of innovation if field studies not available)*	**Does the innovation improve dose control?**	Neutral	RFID tags could theoretically provide prompts to the user for the appropriate dose volume. However, the user would still need to be trained to make use of these features and providing information on dose control might not change the user's behaviour. Also, information on dosing (route and volume) is in the package insert, so the innovation provides the same information in a different way to the comparator. Scanning RFIDs does not control the administration in any way; it is just providing information potentially by providing links to data on websites with dosing, preparation and administration information for the healthcare provider(4). One study had integrated an RFID dosing system in a hospital ward based on the five right method (right patient, right drug, right dose, right route and right time) which had demonstrated high user satisfaction of the system in terms of service delivery and information quality (5), however no indication on whether mistakes were made.
	Does the innovation improve targeting the right route of administration?	Neutral	Same as above. No evidence is available demonstrating the direct impact of RFID on targeting the right route of administration, thus there would be no difference in delivering the vaccine than with the comparator. Studies have demonstrated the ability to use RFID technology in a hospital setting to facilitate administration of medication (4). Medicine cart (see photo) used in hospitals to deliver and administer drugs to patients. RFID tags can be attached to the medication packages containing information on doses, drug images and the five rights which included the right route of administration (4). 

Category: *Labelling*

Innovation: *Radio Frequency Identification Device (RFID)*

Comparator: *Use without innovation (i.e. no RFID)*

	***Worse** than the comparator*

Indicator: Potential to reduce stock outs based on the number of separate components necessary to deliver the vaccine or improved ability to track vaccine commodities

*Legend: Green: **Better** than the comparator for one of the parameters; White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator for one of the parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 5.

Potential to reduce stock outs based on the number of separate components necessary to deliver the vaccine or improved ability to track vaccine commodities • *Assessment of the potential to reduce stock outs based on the innovation's features*	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation require fewer components?	Neutral	As RFID tags/labels are on the primary vaccine containers during storage/transport, and any additional equipment (e.g. scanner/reader) required for this innovation is assumed to be in stock, the innovation would have the same number of components as the comparator. It is assumed that there would be no difference in the components required to deliver the vaccine than with the comparator.
	Or does the innovation include labelling that facilitates product tracking and is it better than the comparator?	Better	RFID tags can facilitate product tracking by having a unique identifier at the primary container-level. This innovation can improve the quality and accuracy of inventory and immunization data for stock management to help prevent stock-outs for traceability issues in supply chains, documentation of patient vaccination records, and surveillance. RFID tags also enable all the tags within range to be identified and every tag does not need to be individually scanned. In the case of the UNISTRAIN® PRRS vaccine, the Hipradermic® needle free vaccine delivery device fitted with an antenna which reads the information from the RFID chip embedded in the vaccine vial label. This equipment would be necessary for the delivery of the vaccine. RFID tags contain data that is easy to access and interpret assuming the appropriate technology/infrastructure and training (described in section 1.2) is in place. Challenges exist regarding the availability of internet servers to power the RFID system, software, readability of the tags,

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			cost/investment to implement and maintain its use, lack of global standards and privacy concerns.

	Better *than the comparator*

Indicator: Acceptability of the vaccine presentation and schedule to patients/caregivers

*Legend: Dark Green: **Considerably better** than the comparator: Better for all applicable parameters; Green: **Better** than the comparator: Better for some of the applicable parameters AND no difference for the rest of the parameters; White: **Neutral**, no difference with the comparator; Yellow: **Mixed**: Better than the comparator for some of the applicable parameters AND worse than the comparator for the rest of the parameters; Red: **Worse** than the comparator: Worse for some of the applicable parameters AND no difference for the rest of the parameters; Dark Red: **Considerably worse** than the comparator: Worse for all applicable parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 6.

Acceptability of the vaccine presentation to patients/ caregivers • *Does the innovation include features that may improve acceptability of vaccinees and caregivers*	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Painful or not painful	Neutral	Neither the RFID tag nor the comparator have any impact on pain.
	Perception of ease of administration (i.e. convenience for the vaccinees/caregivers)	Neutral	Vaccinees and caregivers would not interact with RFID tags and it is expected that inclusion of RFID tags on primary containers would not impact their perception of ease of administration, which would be no different with the comparator.
	Any other tangible benefit to improve/impact acceptability to vaccinees/caregivers	Better	RFID could potentially benefit caregivers/vaccinees because improving record keeping of patient/immunization information could reduce wait times and speed up accessing patient information. In hospitals in the United States, RFID technology is used to track, monitor and manage patient medical data electronically, providing enhanced patient safety, quick retrieval of patient information and positively impacting patient satisfaction (6).

	Better *than the comparator*

3.3 Safety criteria

Indicator: Likelihood of contamination

*Legend: Dark Green: **Considerably better** than the comparator: Better for all applicable parameters; Green: **Better** than the comparator: Better for some of the applicable parameters AND no difference for the rest of the parameters; White **Neutral**, no difference with the comparator; Yellow: **Mixed**; Better than the comparator for some of the applicable parameters AND worse than the comparator for the rest of the parameters; Red: **Worse** than the comparator: Worse for some of the applicable parameters AND no difference for the rest of the parameters; Dark Red: **Considerably worse** than the comparator: Worse for all applicable parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 7.

Likelihood of contamination • *Risk assessment of potential for contamination based on design of innovation and on usability data from field studies*	Parameters to measure against a comparator	Score	Assessment
	Does the innovation reduce the risk of contamination while reconstituting the dry vaccine?	Neutral	RFID can provide information on correct delivery/administration of medication to patients which promotes safety and medical quality (7), so based on this evidence information embedded in an RFID tag has the potential to guide the user by providing information on methods for reducing the risk of contamination while reconstituting the dry vaccine. As most of this information is already provided with the vaccine in the form of leaflets, the innovation would likely not reduce the risk of contamination while reconstituting the dry vaccine compared to the comparator, therefore it is neutral. There are no evidence-based studies available to demonstrate the role of RFIDs in reducing vaccine contamination, however RFIDs have been demonstrated to improve patient safety through proper identification of the patients and correct delivery of drugs, thus this can potentially reduce the likelihood of administration of vaccines outside of protocol. It is reported that barcode medication administration systems have reduced the incidence of medication errors by more than 50%, and the risk of adverse drug events by 11% or approximately 20 events per day (8).
	Does the innovation reduce the risk of contamination while filling the delivery device?	Neutral	Neither RFID tags nor the comparator would have any impact on the risk of contamination while filling the delivery device. This parameter would depend on the vaccine/delivery device.

Category: *Labelling*

Innovation: *Radio Frequency Identification Device (RFID)*

Comparator: *Use without innovation (i.e. no RFID)*

Likelihood of contamination • *Risk assessment of potential for contamination based on design of innovation and on usability data from field studies*	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation require fewer preparation steps and less complex preparation steps?	Neutral	Incorporation of an RFID tag into a primary container will have the same number and complexity of vaccine preparation steps as the comparator. The information stored in an RFID tag could provide the vaccinator guidance in preparing the vaccine correctly, through communicating vaccine related information (3). However, the vaccine would still be prepared the same way as without the innovation.
	Does the innovation reduce the potential risk of reuse of delivery technology?	Neutral	Neither RFID tags nor the comparator would have any impact on re-using the delivery technology. This parameter would depend on the vaccine/delivery device and the good practice of the vaccinator. However, it should be noted that RFID has been used to provide information to the nurses/pharmacist on the entire medication process for delivery and administration in hospital settings (3,8). Based on this, it could be possible that if the RFID tag is incorporated into the primary container/delivery device, there is potential that when it is scanned the user is notified that it had already been used and thus prevent reuse.
	Does the innovation reduce the risk of use of nonsterile components?	Neutral	Neither RFID tags nor the comparator would have any impact on the use of nonsterile components. This parameter would depend on the vaccine/delivery device and the aseptic practice of the vaccinator.

	No difference *to the comparator*

Indicator: Likelihood of needle stick injury

*Legend: Dark Green: **Considerably better** than the comparator: Better for all applicable parameters; Green: **Better** than the comparator: Better for some of the applicable parameters AND no difference for the rest of the parameters; White: **Neutral**, no difference with the comparator; Yellow: **Mixed**: Better than the comparator for some of the applicable parameters AND worse than the comparator for the rest of the parameters; Red: **Worse** than the comparator: Worse for some of the applicable parameters AND no difference for the rest of the parameters; Dark Red: **Considerably worse** than the comparator: Worse for all applicable parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

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Table 8.

Likelihood of needle stick injury • *Risk assessment of the presence of sharps during the process of preparing and administering the vaccine*	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation contain fewer sharps?	Neutral	Neither RFID tags nor the comparator are associated with sharps and have no direct impact on the number of sharps.
	Does the innovation use sharps for preparing and/or administering the vaccine and is that better than the comparator?	Neutral	The use of RFID tags and the comparator do not involve sharps. Use of sharps would depend on the vaccine/delivery device.
	Does the innovation include an auto disable feature and is that better than the comparator?	Neutral	As neither RFID tags nor the comparator are associated with sharps, they have no impact on the inclusion of auto disable features. This would depend on the vaccine/delivery device.
	If the innovation uses sharps, does it include a sharps injury prevention feature and is that better than the comparator?	Neutral	As neither RFID tags nor the comparator are associated with sharps, they have no impact on the inclusion of SIP features. This would depend on the vaccine/delivery device.
	Does the innovation reduce the risk of injury after vaccine administration?	Neutral	The use of RFID tags and the comparator do not involve sharps, thus neither would have any impact on injury after vaccine administration.

	No difference *to the comparator*

3.4 Economic costs criteria

Indicator: Total economic cost of storage and transportation of commodities per dose[m]

*Legend: Dark Green: **Considerably better** than the comparator: Reduces the volume per dose for applicable parameters; Green: **Better** than the comparator: Reduces the volume per dose for either of the applicable parameter, and there is no difference for the other; White: **Neutral**, no difference with the comparator; Yellow: **Mixed**: Reduces the volume for one of the parameter, and increases the volume for the other parameter compared to the comparator; Red: **Worse** than the comparator: Increases the volume per dose for either of the applicable parameters, and there is no difference for the other; Dark Red: **Considerably worse** than the comparator: Increases the volume per dose for both parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 9.

Total economic cost of storage and transportation of commodities per dose	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation reduce the volume per dose stored and transported in the cold chain?	Neutral	An RFID tag would be incorporated into the primary container and therefore would have the same volume per dose stored in the cold chain as the comparator.
	Does the innovation reduce the volume per dose stored and transported out of the cold chain?	Neutral	An RFID tag would be incorporated into the primary container and therefore would have the same volume per dose stored out of the cold chain as the comparator.

	***No difference** to the comparator*

Indicator: Total economic cost of the time spent by staff per dose

*Legend: Dark Green: **Considerably better** than the comparator: Reduces time for all applicable parameters; Green: **Better** than the comparator: Reduces time for either, and there is no difference for the other one; White: **Neutral**, no difference with the comparator; Yellow: **Mixed**: Reduces the time for one of the parameters, and increases the time for the other parameter; Red: **Worse** than the comparator: Increases the time for either of the applicable parameters; and there is no difference for the other one; Dark Red: **Considerably worse** than the comparator: Increases time for all applicable parameters, N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

[m] The assessment of the indicator is volume-related and builds upon PATH's VTIA analysis. A directional estimation is made at this stage, and a better evaluation will be done in Phase II with more antigen-specific data.

Table 10.

Total economic cost of the time spent by staff per dose	**Parameters to measure against a comparator**	**Score**	**Assessment**
	Does the innovation have attributes that can save time for the vaccinator in preparing and administering the vaccine?	Neutral	The innovation does not have any attributes that save time for the vaccinator in preparing and administering the vaccine.
	[n]Does the innovation have attributes that save time for staff involved in stock management?	Better	The use of RFID is likely to save time for staff involved in stock management as it makes tracking of stock more efficient. (9–12).

	Better *than the comparator*

[n] This parameter only applies to barcodes and RFID to capture the benefits for stock management processes, not based on the number of components, but the specific features of the innovation.

Category: *Labelling*

Innovation: *Radio Frequency Identification Device (RFID)*

Comparator: *Use without innovation (i.e. no RFID)*

Indicator: Total economic cost of one-time/upfront purchases or investments required to introduce the vaccine presentation and of recurrent costs associated with the vaccine presentation (not otherwise accounted for)

*Legend: White: **Neutral**: NO there are no one-time/upfront or recurrent costs and this is not different than the comparator; Red: **Worse** than the comparator: YES there are one-time/upfront or recurrent costs.*

Table 11.

Total economic cost of one-time/upfront purchases or investments required to introduce the vaccine presentation and of recurrent costs associated with the vaccine presentation (not otherwise accounted for)	Parameters to measure against a comparator	Score	Assessment
	Are there one-time upfront costs that will be incurred for use of this innovation or recurrent costs that will be incurred for use of this innovation?	Worse	Yes RFID have upfront costs for equipment such as the readers and software. RFID also has recurrent cost for items such as software updates and maintenance. Similar to any innovation, there would be training costs associated with introducing the innovation.

	***Worse** than the comparator*

3.5 Secondary criteria on potential breadth of innovation use

Indicator: Applicability of innovation to one or several types of vaccines

Table 12.

Applicability of innovation to one or several types of vaccines • *What vaccines/antigens does the innovation apply to, based on technical feasibility?*	Assessment
	This innovation potentially applies to all vaccines. There are no restrictions based on technical feasibility.

Indicator: Ability of the technology to facilitate vaccine combination

Table 13.

Ability of the technology to facilitate novel vaccine combination • *Does the innovation facilitate novel combination vaccine products?*	**Assessment**
	The innovation has no impact on the ability to combine vaccines.

SECTION 4

4.1 Robustness of data:

Table 14.

Category	**Assessment**	
Type of study	Various types of field studies and literature review on RFID use, mainly non-vaccine. Manufacturer data on a pig vaccine using RFID. Costing data are available from various types of studies ranging from expert opinion, small-scale country evaluations, to systematic reviews.	
Inconsistency of results	low	
Indirectness of comparison • *Indicate the setting in which the study was conducted (low, middle or high income setting);* • *Comment if the data is on non-vaccine application of the innovation*	Studies primarily in HICs, in health, food and agriculture industry. Very few vaccine specific studies.	
Overall assessment:	*Low to moderate*	*The quality of data available scores low-moderate based on lack of vaccine specific data despite numerous studies available on RFID.*

4.2 List of technical experts, manufacturers and/or technology developers interviewed for inputs:

Table 15.

Expert/type	Organisation/contact details	Notes
HIPRA The Reference in Prevention for Animal Health	HIPRA Headquarters Avda. la Selva 135 17170 Amer (Girona) Spain Tel.: (+34) 972 43 06 60 Fax: (+34) 972 43 06 61 hipra@hipra.com https://www.hipra.com/portal/en/hipra/contact%20us	

4.3 List of technical experts, manufacturers and/or technology developers that have reviewed and provided feedback/input to the technical notes (TN):

Table 16.

Reviewers	Organisation/contact details	Notes
Fatema Kazi	GAVI, the Vaccine Alliance fkazi-external-consultant@Gavi.org	Developed and reviewed TN
PATH Medical Device and Health Technology Team Debra Kristensen Courtney Jarrahian Mercy Mvundura Collrane Frivold	PATH Debra Kristensen dkristensen@path.org	Reviewed TN
Brian Taliesin	PATH, Center of Digital Excellence btaliesin@path.org	Reviewed TN
Matt Morio	PATH, Supply Systems and Equipment P mmorio@path.org	Reviewed TN

Reviewers	Organisation/contact details	Notes
Julian Hickling	Working in Tandem Ltd julian@workingintandem.co.uk	Reviewed TN

4.4 References:

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Category: *Labelling*

Innovation: *Radio Frequency Identification Device (RFID)*

Comparator: *Use without innovation (i.e. no RFID)*