Autodisable (AD) sharps-injury protection (SIP) syringes

SECTION ONE: Vaccine compatibility and problem statements addressed by the innovations

Technology overview

AD SIP syringes are single-dose, disposable syringes with a mechanism that covers the needle after use to reduce the risk of accidental needlestick injury.

Summary of vaccine and innovation compatibility:

This innovation applies to all parenteral vaccines and addresses safety issues related to vaccine handling by preventing needlestick injuries and syringe reuse. The innovation is best applied to vaccines intended for routine immunization and mass campaigns (fixed dose immunizations),[a] where health care workers will be delivering intramuscular, subcutaneous or intradermal injections[b] (as shown in Table 1). For all vaccines to which the innovation applies, the comparator is delivery of the vaccine with an autodisable needle and syringe (AD N&S) that lacks the SIP feature. Not all vaccines are compatible with the innovations based on mode of administration (Table 2); for example, vaccines that are delivered non-parenterally.

The problem statement which applies to each vaccine that could potentially be addressed by AD SIPs is presented in Table 1. The key property of AD SIPs that is relevant to the problem statement is their ability to either shield or retract the needle after administration, which could reduce the likelihood of needlestick injury and transfer of bloodborne pathogens to patients, health care workers, and the community after vaccine administration.

The vaccines considered, or not considered for use with AD SIP syringes in this Technical Note are summarised in Tables 1 and 2 respectively.

Problem statement to be addressed:

The problem statement applying to each vaccine that could potentially be addressed by AD SIP syringes is:

- **Needle-stick injuries:** AD SIP syringes have a feature to reduce the risk of needle-stick injury (NSI), as shown in Table 1.

[a] World Health Organization (WHO), United Nations Children's Fund (UNICEF), United Nations Population Fund. *WHO-UNICEF-UNFPA Joint Statement* on the Use of Auto-disable Syringes in Immunization Services*. WHO/V&B/99.25. Geneva: WHO; 2003. https://apps.who.int/iris/bitstream/handle/10665/63650/WHO_VB_99.25_eng.pdf?sequence=1

[b] WHO. *WHO Guideline on the Use of Safety-Engineered Syringes for Intramuscular, Intradermal and Subcutaneous Injections in Health Care Settings*. Geneva: WHO; 2016. https://apps.who.int/iris/bitstream/handle/10665/250144/9789241549820-eng.pdf?sequence=1

Table 1: Profile of VIPS priority vaccines[c] to be assessed for use with the innovation[d] and the comparators[e]

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route[f]	Problem statements to be addressed[g]	Comparator dose(s) per container
Licensed vaccines							
Pentavalent (Diphtheria tetanus pertussis hepatitis B haemophilus inflluenzae type B inactivated poliovirus; DTP, HepB, Hib)	Inactivated subunit plus polysaccharide-protein conjugated vaccine (PS-PCV)	Liquid	Yes (Aluminium-salt based)	Yes	IM	• Vaccine ineffectiveness/wastage due to freeze exposure • Vaccine ineffectiveness/wastage due to heat exposure • Reduced acceptability due to painful administration • Cold chain requirements during outreach • Contamination risk due to multi-dose vial	Single-dose vial (SDV) or 10-dose vial; IM injection with an AD N&S
Hepatitis B (birth dose)	Subunit	Liquid	Yes (Aluminium-salt based)	Yes	IM	• Vaccine ineffectiveness/wastage due to freeze exposure • Vaccine ineffectiveness/wastage due to heat exposure • Cold chain requirements during outreach • Difficult preparation requiring trained personnel • Reduced acceptability due to painful administration	Single-dose vial (SDV) or 10-dose vial; IM injection with an AD N&S.

[c] *From a long list of vaccines, 17 VIPS priority vaccines were selected based on covering a wide spectrum of different vaccine platforms, route of administration, vaccine presentations and delivery strategy to ensure they represent different family of vaccines, such that evaluating one antigen will be representative of the others and innovations for one family member would be applicable to all. The final list includes 11 licensed vaccines that are WHO PQ'd, GAVI funded and UNICEF procured, as well as 6 pipeline candidate vaccines. Refer to the document 'Scope of vaccines' for the detailed explanation.*

[d] *Vaccines to be assessed were selected on the basis of: 1) Technical applicability of the vaccine with the innovation, 2) Identification of vaccine-specific problem statements and 3) Ability of the innovation to solve vaccine-specific problem statements. The vaccines and problem statements are not listed in any priority order.*

[e] *All comparators chosen are a SDV regardless of whether the current presentation of the vaccine is available as single-dose or not, and if available the most commonly used MDV has been selected.*

[f] *Lyophilized vaccines are reconstituted with a reconstitution syringe and in a liquid format the vaccines can be delivered by IM, SC or ID injection using an AD N&S.*

[g] *An online survey was conducted to collect information on key vaccine-specific delivery challenges faced by countries that can be addressed by innovations in the scope of VIPS. The survey was completed by 168 global and country level experts across 54 countries conducted in Q4 2019. Participants were provided with a standard list of problem statements for the licensed vaccines analysed through VIPS and top 5 reported challenges per licensed vaccine were selected as 'vaccine problem statements' to be specifically analysed. They are listed in order importance for each vaccine (most important first). Problem statements that could potentially be addressed by the innovation are shown in bold and problem statements for pipeline vaccines are in italics.*

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route[f]	Problem statements to be addressed[g]	Comparator dose(s) per container
Human papillomavirus (HPV)	Subunit	Liquid	Yes (Aluminium-salt based)	No	IM	• Vaccine ineffectiveness/wastage due to freeze exposure • Reduced acceptability due to painful administration • Cold chain requirements during outreach • Vaccine ineffectiveness/wastage due to heat exposure • Difficult preparation requiring trained personnel	SDV or 2-dose vial and delivery by IM injection with an AD N&S.
Measles rubella (MR)	Live attenuated.	Lyophilised	No	No	SC	• Vaccine ineffectiveness/wastage due to heat exposure • Vaccine wastage or missed opportunities due to multi-dose vial • Reconstitution related safety issues • Cold chain requirements during outreach • **Needle-stick injuries**	SDV or 10-dose vial
Meningitis A (MenAfriVac)	PS-PCV	Lyophilised	Yes, in diluent (Aluminium-salt based)	Yes**	IM	• Vaccine wastage or missed opportunities due to multi-dose vial • Cold chain requirements during outreach • Vaccine ineffectiveness/wastage due to heat exposure • Reconstitution related safety issues • **Needle-stick injuries**	SDV or 10-dose vial

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route[f]	Problem statements to be addressed[g]	Comparator dose(s) per container
Inactivated poliovirus (IPV)*	Whole-inactivated	Liquid	No	Yes	IM or ID	• Vaccine ineffectiveness/wastage due to freeze exposure • Vaccine ineffectiveness/wastage due to heat exposure • Cold chain requirements during outreach • Reduced acceptability due to painful administration • Negative impact on the environment due to waste disposal practices	• IM (0.5ml/dose): SDV or 10-dose vial • ID (0.1ml/dose): SDV (5 fractional doses) or 5-dose vial (25 fractional doses).
Rabies*	Whole-inactivated.	Lyophilised	No	No	IM or ID	• Difficult preparation requiring trained personnel • Vaccine ineffectiveness/wastage due to heat exposure • Reduced acceptability due to painful administration • Vaccine wastage or missed opportunities due to multi-dose vial • **Needle-stick injuries**	• IM (0.5ml/dose): SDV • ID (0.1ml/dose): SDV (5 fractional doses)
Typhoid (conjugate)	PS-PCV	Liquid	No	Yes**	IM	• Vaccine ineffectiveness/wastage due to heat exposure • Vaccine wastage or missed opportunities due to multi-dose vial • Difficult to deliver vaccine to correct injection depth • Difficult preparation requiring trained personnel • Vaccine ineffectiveness/wastage due to freeze exposure	SDV or 5-dose vial

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route[f]	Problem statements to be addressed[g]	Comparator dose(s) per container
Yellow fever	Live-attenuated	Lyophilised	No	No	SC or IM	• Vaccine wastage or missed opportunities due to multi-dose vial • Reconstitution related safety issues • Vaccine ineffectiveness/wastage due to freeze exposure • **Needle-stick injuries** • Negative impact on the environment due to waste disposal practices	SDV or 5-dose vial
Pipeline vaccines[h]							
Ebola (rVSV-ZEBOV) (rVSV-ZEBOV)	Live vector	Liquid, frozen	No	No	IM	• *Cold-chain requirements during outreach (vaccine needs to be kept frozen)* • *Vaccine ineffectiveness/ wastage due to heat exposure*	Recently licensed as SDV vial
Human immunodeficiency virus (HIV) (ALVAC-HIV + bivalent Subtype C gp120)[i]	Heterologous live attenuated recombinant viral vector + recombinant protein booster	Lyophilized prime and liquid booster (gp120)	Yes (MF59 [oil-in-water emulsion]) (recombinant protein booster)	Not known	IM	• *Difficult preparation requiring trained personnel* • *Reconstitution-related safety issues*	As still in Phase 2b/3, assume SDV

[h] *Vaccines included in the 'Pipeline vaccines' section were not approved as of the beginning of the Phase II analysis, therefore the Ebola vaccine although now licensed will be assessed as a pipeline vaccine. Barriers to vaccination for these vaccines were also not evaluated through the online vaccine problem statement survey.*

[i] *Termination of the phase 2b/3 trial of this vaccine was announced in February 2020 (https://www.niaid.nih.gov/news-events/experimental-hiv-vaccine-regimen-ineffective-preventing-hiv). A similar heterologous prime-boost HIV vaccine (Ad26.Mosaic4.HIV + cladeC/Mosaic gp140 vaccine) is still in late stage trials (NCT02935686). Although this is based on a different virus vector and subunit protein, and some of the details of the assessments might be different, the overall challenges facing this type of vaccine (heterologous prime-boost) are the same, so the assessment were not re-run with Ad26.Mosaic4.HIV + clade C/Mosaic gp140 vaccine.*

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route[f]	Problem statements to be addressed[g]	Comparator dose(s) per container
Influenza (pandemic, VAL-506440)	Nucleic acid	Liquid	Not known	Not known	IM	• *Not known* • *Possibly: need to deliver the vaccine to the correct injection depth.*	As still in phase I, assume SDV
Malaria (RTS,S)	Recombinant protein	Lyophilized vaccine; adjuvant in diluent	Yes (AS01E [QS21 + MPL] in diluent)	Not known	IM	• *Difficult preparation requiring trained personnel*	Dry (vaccine) SDV and liquid (adjuvant/diluent) SDV clipped together
Mycobacterium tuberculosis (M.tb) (Next generation BCG: VPM1002)	Live attenuated	Lyophilized	No	No	ID	• *Difficult to deliver vaccine to the correct injection depth* • *Reconstitution-related safety issues* • *Difficult preparation requiring trained personnel*	SDV or 20-dose vial
Respiratory syncytial virus (RSV) (pre-fusion F protein)	Subunit	Lyophilized	No	Not known	IM	• *Difficult preparation requiring trained personnel* • *Reconstitution-related safety issues*	SDV

* SDV if doses given IM; will be MDV if doses given ID.

** Must be discarded after 6 hours

Table 2: Vaccines not assessed due to technical feasibility[j]

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route	Rationale for exclusion
Rotavirus	Live attenuated virus	Liquid	No	No	Oral	Oral vaccine, unlikely to be suitable for parenteral delivery.

[j] *Vaccines not assessed were excluded on the basis of lack of applicability of the vaccine with the innovation. Vaccines that scored 'maybe' in the pairing matrix have been excluded.*

Vaccine	Vaccine type	Formulation	Adjuvant	Preservative	Route	Rationale for exclusion
Enterotoxigenic *E. coli* (ETEC) (ETVAX)	Whole inactivated organism	Liquid vac, lyophilized buffer, lyophilized adjuvant	Yes (dmLT, double-mutant heat labile toxin [of ETEC])	No	Oral	Oral vaccine, unlikely to be suitable for parenteral delivery.

SECTION TWO: Assessment of combined vaccine-innovation products against a comparator

Note: All indicators in Phase I have also been assessed in Phase II.

1.1 Criteria on health impact

Indicator: Vaccine efficacy[k]

Score legend: Green: Better than the comparator (The innovation improves vaccine efficacy); White: Neutral, no difference with the comparator; Red: Worse than the comparator (The innovation reduces vaccine efficacy); N/A: the indicator measured is not applicable for the innovation; Grey: no data available to measure the indicator.

Table 3

Parameter assessment		
Vaccines	***Does the innovation improve vaccine efficacy based on clinical evidence using correlates of protection or a surrogate?***	**Overall score**
All applicable vaccines	This innovation is a standalone delivery device that does not impact the vaccine formulation and therefore does not impact efficacy, which is no different to the comparator (delivery of the vaccine with an AD syringe).	**Neutral**

[k] *For these indicators, we expect that for most of the innovations there will be no available data, therefore the score will be 'no data available'. However, when this data is available, it will be important data that should be used for the assessment*

Indicator: Vaccine effectiveness

*Score legend: Green: **Better** than the comparator (The innovation improves vaccine effectiveness); White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator(The innovation decreases vaccine effectiveness); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 4

Parameter assessment		
Vaccines	***Does the innovation improve vaccine effectiveness as per the following parameters based on field or other evidence?*** ○ ***Cases averted*** ○ ***Outpatient visits averted*** ○ ***Hospitalisations averted*** ○ ***Deaths averted*** ○ ***Vaccine doses given within the recommended age range (timeliness of vaccination)***	**Overall score**
All applicable vaccines	This innovation like the comparator (delivery of the vaccine with an AD syringe) is a standalone delivery device and therefore does not affect vaccine effectiveness.	**Neutral**

Indicator: Ability of the vaccine presentation to withstand heat exposure[l]

Score legend: Green: Better than the comparator (The innovation includes features that may increase heat stability or likely to enable CTC qualification ; White: Neutral, no difference with the comparator (The innovation has the same heat stability and/or CTC qualification as the current vaccine) ; Red: Worse than the comparator (The innovation includes features that may decrease heat stability or less likely to enable CTC qualification); N/A: the indicator measured is not applicable for the innovation; Grey: no data available to measure the indicator.

[l] *Improved heat stability can also be used to increase shelf life, hence no indicator on shelf-life extension is included in the framework.*

Table 5

Vaccines	*Assumed use case*	*Is the vaccine particularly heat sensitive (i.e. VVM2) and does it require special storage conditions (i.e. such as being kept frozen)?* [m]	*Is there evidence that this vaccine can be qualified for CTC use.*	*Would the context of use of the vaccine benefit from CTC use (state which use case scenario)?*	*Does the innovation paired with the vaccine improve heat stability?*
Pentavalent (Liquid SDV or 10-dose vial)	Routine	No. VVM 14	No data	No, unless other routine vaccines that it is co-administered with are also qualified for CTC use.	This innovation does not impact heat stability, which is no different to the comparator (delivery of the vaccine with an AD syringe).
Hepatitis B (birth dose) (liquid SDV or 10-dose vial)	Health facilities Outreach Home births	No. VVM30	Yes. CTC qualification in process for one or more vaccines.	Yes. For birth-dose outreach to homes and for storage at remote health facilities without cold chain.[n]	
HPV (liquid SDV or two-dose vial)	Outreach to schools and communities	No. VVM30	Quadrivalent HPV vaccine (Merck) is qualified for CTC use (up to 3 days, below 42°C).[o]	Yes. For outreach to schools and communities.[p]	

[m] *This parameter is not used for scoring purposes, it is contextual/background information.*

[n] WHO, PATH. *Controlled Temperature Chain: Strategic Roadmap for Priority Vaccines 2017–2020.* Geneva: WHO; 2018. https://www.who.int/immunization/programmes_systems/supply_chain/ctc_strategic_roadmap_priority_vaccines.pdf?ua=1.

[o] WHO website. WHO prequalified vaccines page. Type: Human Papillomavirus (Quadrivalent). Commercial Name: Gardasil. https://extranet.who.int/gavi/PQ_Web/PreviewVaccine.aspx?nav=0&ID=178. Accessed February 29, 2020.

[p] WHO, PATH. *Controlled Temperature Chain: Strategic Roadmap for Priority Vaccines 2017–2020.* Geneva: WHO; 2018. https://www.who.int/immunization/programmes_systems/supply_chain/ctc_strategic_roadmap_priority_vaccines.pdf?ua=1.

Vaccines	*Assumed use case*	*Is the vaccine particularly heat sensitive (i.e. VVM2) and does it require special storage conditions (i.e. such as being kept frozen)?* [m]	*Is there evidence that this vaccine can be qualified for CTC use.*	*Would the context of use of the vaccine benefit from CTC use (state which use case scenario)?*	*Does the innovation paired with the vaccine improve heat stability?*
MR (Lyophilized SDV or 10-dose)	Routine Special immunization campaigns Outbreaks	No. VVM 14	No data.	Yes. For use in outbreak and campaigns (1).	
Meningitis A (MenAfriVac) (Lyophilized SDV or 10-dose vial)	Campaign settings during initial introduction	No. VVM 30	MenAfriVac can be used under CTC conditions (up to four days at temperatures not exceeding 40°C).[q]	Yes. For initial campaign use.[r]	
IPV (IM: Liquid SDV or 10-dose) (ID: Liquid SDV or 5-dose)	Routine Campaign	No. VVM 7	No data.	Yes, for use in campaigns	
Rabies (IM: Lyophilized SDV) (ID: Lyophilized SDV)	Emergency basis for post-exposure prophylaxis	No. VVM 30	No data.	Yes. For storage in remote communities without cold chain, and for emergency outreach for post-exposure prophylaxis.[s]	

[q] WHO website. WHO prequalified vaccines page. Type: Meningococcal A Conjugate 10 µg. Commercial Name: Meningococcal A Conjugate MenAfriVac. https://extranet.who.int/gavi/PQ_Web/PreviewVaccine.aspx?nav=0&ID=196. Accessed February 29, 2020.

[r] WHO website. Meningococcal meningitis page. https://www.who.int/immunization/diseases/meningitis/en/. Accessed February 29, 2020.

[s] WHO. *WHO Expert Consultation on Rabies, Third Report.* Geneva: WHO; 2018. WHO Technical Report Series, No. 1012. https://apps.who.int/iris/handle/10665/272364.

Vaccines	*Assumed use case*	*Is the vaccine particularly heat sensitive (i.e. VVM2) and does it require special storage conditions (i.e. such as being kept frozen)?* [m]	*Is there evidence that this vaccine can be qualified for CTC use.*	*Would the context of use of the vaccine benefit from CTC use (state which use case scenario)?*	*Does the innovation paired with the vaccine improve heat stability?*
Rotavirus (Liquid SD plastic tube)	Routine	No. VVM 7	No data.	No, unless other routine vaccines that it is co-administered with are also qualified for CTC use.	
Typhoid conjugate (Liquid SDV or 5-dose)	Catch up vaccination Outbreak response Routine	No. VVM 30	No data.	Yes. For school and community-based vaccination and outbreak response (2).	
Yellow Fever (Lyophilized SDV or 10-dose)	Routine Campaigns Outbreak response	No VVM 14	No data.	Yes, for both use case scenarios	
Ebola (rVSV-ZEBOV) (Liquid SDV or 10-dose)	Campaigns Outbreak response	Yes. Stored as frozen liquid at -80°C for long term storage.[t] Can be stored at 4°C for four weeks after thawing.[u]	No data, but unlikely.	Yes, for both use case scenarios.[v]	

[t] WHO, *Ebola vaccines – Background paper for SAGE deliberations. Overview of the Current Research, Development and Use, of Vaccines Against Ebola*. Geneva: WHO; 2019. https://www.who.int/immunization/sage/meetings/2019/october/CICG_sitting_plan.pdf.

[u] Merck. ERVEBO® (Ebola Zaire Vaccine, Live) suspension for intramuscular injection [package insert]. Silver Spring: MD: US Food and Drug Administration; 2019. https://www.fda.gov/media/133748/download.

[v] WHO website. Immunization, Vaccines and Biologicals: WHO Ebola vaccine target product profile page. https://www.who.int/immunization/research/target-product-profile/ebolavaccine/en/. Accessed February 29, 2020.

Vaccines	*Assumed use case*	*Is the vaccine particularly heat sensitive (i.e. VVM2) and does it require special storage conditions (i.e. such as being kept frozen)?* [m]	*Is there evidence that this vaccine can be qualified for CTC use.*	*Would the context of use of the vaccine benefit from CTC use (state which use case scenario)?*	*Does the innovation paired with the vaccine improve heat stability?*
ETEC (ETVAX) (Liquid SDV)	Routine vaccine that is likely to be delivered in areas of high endemicity	No data	No data.	No, unless other routine vaccines that it is co-administered with are also qualified for CTC use.	
HIV (ALVAC-HIV + bivalent Subtype C gp120) (Prime: lyo. SDV. Boost: liquid SDV)	Routine vaccine in areas of high endemicity Targeted outreach and campaigns to susceptible populations	No data	No data.	Yes. For outreach and campaigns	
Influenza (pandemic) (VAL 506440) (Liquid SDV)	Campaigns Outbreak response	No data	No data.	Yes, for both use case scenarios	
Malaria (RTS,S) Lyophilized SDV or 2-dose vial, recon with diluent containing adjuvant)	Routine and Campaign use in areas of high endemicity.[w]	No data	No data.	Yes. For campaign use.[x]	

[w] WHO. *WHO Preferred Product Characteristics (PPC) for Malaria Vaccines*. WHO/IVB/14.09. Geneva: WHO; 2014. https://apps.who.int/iris/bitstream/handle/10665/149822/WHO_IVB_14.09_eng.pdf?sequence=1

[x] WHO. *WHO Preferred Product Characteristics (PPC) for Malaria Vaccines*. WHO/IVB/14.09. Geneva: WHO; 2014. https://apps.who.int/iris/bitstream/handle/10665/149822/WHO_IVB_14.09_eng.pdf?sequence=1

Vaccines	*Assumed use case*	*Is the vaccine particularly heat sensitive (i.e. VVM2) and does it require special storage conditions (i.e. such as being kept frozen)?* [m]	*Is there evidence that this vaccine can be qualified for CTC use.*	*Would the context of use of the vaccine benefit from CTC use (state which use case scenario)?*	*Does the innovation paired with the vaccine improve heat stability?*
Mycobacterium tuberculosis (M.tb) (Next generation BCG: VPM1002) (Lyophilized SDV or 20-dose)	Routine-use in neonates and adolescents Could be co-administered with hepatitis B birth dose.	No: VVM 14 or 30 (based on BCG)	No data.	CTC use could be beneficial for birth-dose outreach to homes, storage at remote health facilities without cold chain, or outreach to adolescents.[y]	
RSV (pre-fusion F protein) (Lyophilized SDV)	Expected to be a routine maternal vaccine, and possibly administered on a seasonal basis.	No data	No data.	Not essential. Assumed to be delivered during an anti-natal visit.	**Neutral**

Indicator: Ability of the vaccine presentation to withstand freeze exposure

*Score 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.*

[y] WHO. *WHO Preferred Product Characteristics for New Tuberculosis Vaccines.* Geneva: World Health Organization; 2018. https://apps.who.int/iris/bitstream/handle/10665/273089/WHO-IVB-18.06-eng.pdf?ua=1

Table 6

Parameter assessment		
Vaccines	***Does the innovation paired with the vaccine prevent damage due to freeze exposure?***	**Overall Score**
All applicable vaccines	This innovation is a standalone delivery device and like the comparator (delivery of the vaccine with an AD syringe) does not impact vaccine damage due to freeze exposure.	**Neutral**

1.2 Criteria on coverage and equity

Indicator: Number of fully or partially immunized (relative to target population)[z]

*Score legend: Green: **Better** than the comparator (The innovation increases the overall coverage); White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator (The innovation decreases the overall coverage); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 7

Parameter assessment		
Vaccines	***Does the innovation improve the overall coverage for the vaccine within a target population for one or all doses?***	**Overall Score**
All applicable vaccines	This innovation is a standalone delivery device and like the comparator (delivery of the vaccine with an AD syringe) does not impact coverage.	**Neutral**

Indicator: Ease of use from clinical perspective based on product attributes[aa]

*Score 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*

[z] *For these indicators, we expect that for most of the innovations there will be no available data, therefore the score will be 'no data available'. However, when this data is available, it will be important data that should be used for the assessment*

[aa] *Ease of use also affects timeliness of vaccination (vaccine doses given within the recommended age range), however it was decided that timeliness of vaccination should be captured under vaccine effectiveness based on country data.*

*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 8

Parameter assessment						
Vaccines	***Does the innovation avoid reconstitution and is that an improvement?***	***Does the innovation require fewer vaccine product components?***	***Does the innovation require fewer preparation steps and less complex preparation steps?***	***Does the innovation improve dose control?***	***Does the innovation improve targeting the right route of administration (accuracy in terms of route and/or depth of injection)?***	**Overall score**
All applicable vaccines	The innovation, like the comparator (delivery of the vaccine with an AD syringe), does not impact whether or not a vaccine requires reconstitution and would not be used for the reconstitution process.	AD SIP syringes have the same number of components as an AD syringe without SIP features.	The preparation steps are unchanged from a user's perspective as the SIP components are integrated into the AD syringe.	AD SIPs are similar to AD syringes without SIP features for withdrawing the accurate amount of vaccine for administration.	AD SIPs are similar to AD syringes without SIP features for targeting the right route for vaccine administration.	**Neutral**
	Neutral	**Neutral**	**Neutral**	**Neutral**	**Neutral**	

Indicator: Ease of use based on ability of a lesser trainer person to administer the vaccine or self-administration

*Score 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 9

Parameter assessment					
Vaccines	**Assumed use case**	**Would the context of use of the vaccine benefit from delivery by a lesser trained person and self-administration (state which setting/use case scenario)?**	***Does the innovation enable a lesser trained person (e.g. caregivers/parents/lesser trained personnel) to administer the vaccine?***	***Does the innovation enable self-administration?***	**Overall score**
All applicable vaccines	For each vaccine use-case refer to Table 5.	Even if there is a specific use-case to deliver a vaccine by a lesser trained health care worker or by self-administration, AD SIPs do not have any features that enable this.	AD SIPs do not have any features that enable delivery similar to the comparator (delivery of the vaccine with an AD syringe). **Neutral**	AD SIPs do not have any features that enable self-administration, which is no different to the comparator. **Neutral**	**Neutral**

Indicator: Ability to facilitate dose sparing

*Score legend: Green: **Better** than the comparator (The innovation improves dose sparing); White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator (The innovation does not improve dose sparing); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 10

Parameter assessment		
Vaccines	***Does the innovation improve dose sparing of the vaccine?***	**Overall score**
All applicable vaccines	The innovation is a standalone delivery device and has no impact on the ability to use dose sparing.	**Neutral**

Indicator: Availability of the innovation in a single-dose presentation or multi-dose with preservative to avoid missed opportunities and reduce vaccine wastage.

*Score legend: Dark Green: **Considerably better,** The innovation is available in a much improved presentation from the perspective of missed opportunities and reducing vaccine wastage (for example, a single dose presentation compared to a multidose presentation without preservative); Green: **Better** than the comparator, The innovation is available in an improved presentation from the perspective of missed opportunities and reducing vaccine wastage (for example, a single dose presentation compared to a multidose presentation with preservative); White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator (The innovation is not available in an improved presentation from the perspective of missed opportunities and reducing vaccine wastage); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

***Note:* All SDV comparators will score neutral compared to an innovation that is a single-dose presentation**

Table 11

Parameter assessment		
Vaccines	***Is the innovation available in a single-dose presentation or multi-dose with preservative to avoid missed opportunities (e.g., due to reluctance to open a MDV) and reduce vaccine wastage?*** ***(State whether the comparator is SDV or MDV)***	**Overall score**
All applicable vaccines	The innovation can be used with vaccines in SDV or MDV and does not affect the presence of preservatives.	**Neutral**

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

*Score 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 12

Parameter assessment				
Vaccines	***Does the innovation include features that may improve pain experienced by the recipient following vaccination?***	***Does the innovation include features that may improve perception of ease of administration (i.e. convenience for the vaccinees/caregivers)?***	***Does the innovation include features that may improve/impact any other benefit related to acceptability by vaccinees/caregivers?***	**Overall score**
All applicable vaccines	One study showed that retractable syringes did not affect recipient pain in intradermal and intramuscular injections (3), and another found no significant pain from safety devices (4).	Vaccinees and caregivers are unlikely to be aware of the SIP feature in an AD SIP syringe as the SIP feature is activated after administration of the vaccine. An AD SIP syringe is therefore likely to be perceived as similar to the comparator (delivery of the vaccine with an AD syringe).	The assumption is it would be no different to the comparators as the device has a needle. However, there is no data available on this from the perspective of the recipient.	**Neutral**
	Neutral	**Neutral**	**No data**	

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

*Score 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 13

Parameter assessment			
Vaccines	***Does the innovation require fewer components?***	***Or does the innovation include labelling that facilitates product?***	**Overall score**
All applicable vaccines	AD SIPs have the same number of components similar to the comparator (AD syringes without SIP features).	AD SIPs do not include labelling that improves product tracking.	**Neutral**
	Neutral	**N/A**	

1.3 Criteria on safety

Indicator: Number of vaccine product-related adverse events following immunisations[bb]

*Score legend: Green: **Better** than the comparator (The innovation decreases the frequency of serious AEFIs); White: **Neutral**, no difference with the comparator; Red: **Worse** than the comparator (The innovation increases the frequency of serious AEFIs); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 14

Parameter assessment		
Vaccines	***Does the innovation reduce the frequency of serious AEFIs?***	**Overall score**
All applicable vaccines	There are no data available to suggest that AEFIs are reduced by AD SIP syringes.	**No data**

[bb] *For these indicators, we expect that for most of the innovations there will be no available data. However, when this data is available, it will be important data that should be used for the assessment*

Indicator: Likelihood of contamination and reconstitution errors due to use of wrong diluent

(This indicator is further measured in Phase 2 only if the comparator is a MDV)

*Score 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 15

Parameter assessment							
Vaccines	***Does the innovation reduce the risk of contamination while reconstituting the dry vaccine?***	***Does the innovation reduce the potential risk of reuse of delivery technology?***	***Does the innovation reduce the risk of use of nonsterile components?***	***Does the innovation reduce the risk of contamination while filling the delivery device?***	***Does the innovation require fewer preparation steps and less complex preparation steps)?***	***Does the innovation reduce the likelihood of using an incorrect diluent during reconstitution?*** [cc]	***Overall score***
All applicable vaccines	An AD SIP would not be used for reconstitution, similar to the comparator (delivery of the vaccine with an AD syringe). A reuse prevention (RUP) SIP (variable dose) could be used for reconstitution but is not the focus of this evaluation.	Both AD SIPs and the comparator, cannot be reused.	Both AD SIPs and the comparator are used in the same manner to withdraw vaccine from a vial and deliver the vaccine and both have AD features to prevent reuse.	The preparation steps for AD SIPs are the same as the comparator.	The preparation steps for AD SIPs are the same as the comparator.	An AD SIP would not be used for reconstitution, similar to the comparator. An RUP SIP (variable dose) could be used for reconstitution but is not the focus of this evaluation.	**Neutral**
	Neutral	**Neutral**	**Neutral**	**Neutral**	**Neutral**	**Neutral**	

[cc] *Incorrect diluent – use of the wrong substance as opposed to the wrong volume of diluent.*

Indicator: Likelihood of needle stick injury[dd]

*Score 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 16

Vaccines	*Does the innovation contain fewer sharps?*	*Does the innovation use sharps for preparing and/or administering the vaccine and is that better than the comparator?*	*Does the innovation include an auto disable feature and is that better than the comparator?*	*If the innovation uses sharps, does it include a sharps injury prevention feature and is that better than the comparator?* [ee]	*Does the innovation reduce the risk of injury after vaccine administration?*	Overall score
All applicable vaccines	Though AD SIPs shield or retract the needle after administration to mitigate the risk of needlestick injury, AD SIPs and the comparator (delivery of the vaccine with an AD syringe) have the same number of sharps.	The preparation steps for AD SIPs are the same as the comparator and do not affect preparation or administration.	This is an evaluation of AD SIPs against traditional AD syringes, so by definition both the innovation and the comparator have an AD feature.	The innovation has SIP features whereas the comparator does not. This is better because AD SIP syringes either shield or retract the needle after administration, mitigating the risk of needlestick injury after administration and during and after disposal.	Based on a systematic review and metanalysis, there is moderate quality evidence that SIPs reduce needlestick injuries to health care workers (5).[ff] In 2003, WHO estimated that the annual proportions of health-care workers exposed to bloodborne pathogens (attributable to a workplace percutaneous injury) was 2.6% for hepatitis C, 5.9% for hepatitis B and 0.5% for HIV, corresponding to about 16,000 hepatitis C	**Better**

[dd] *For all vaccines being assessed the assessment and score of this indicator remains the same as in Phase 1.*

[ee] *NOTE: In Phase I, sharps-free innovations were scored as N/A for this feature since SIP features are not applicable. Scoring methodology was revised to reflect the added value of a sharps-free innovation.*

[ff] WHO. *WHO Guidelines on the Use of Safety-Engineered Syringes for Intramuscular, Intradermal and Subcutaneous Injections in Health Care Settings*. Geneva: WHO; 2016. https://apps.who.int/iris/bitstream/handle/10665/250144/9789241549820-eng.pdf?sequence=1

Vaccines	*Does the innovation contain fewer sharps?*	*Does the innovation use sharps for preparing and/or administering the vaccine and is that better than the comparator?*	*Does the innovation include an auto disable feature and is that better than the comparator?*	*If the innovation uses sharps, does it include a sharps injury prevention feature and is that better than the comparator?* [ee]	*Does the innovation reduce the risk of injury after vaccine administration?*	Overall score
					infections and 66,000 hepatitis B infections in health care workers worldwide.[gg] In India, a 2005 of 266 health care workers found that 63 percent had at least one percutaneous injury in the last year and 73% within their lifetime (6). On a similar note, a 2012 study in three hospitals and two clinics in Zambia found the average annual sharps injury rate was 1.3 injuries per worker, and service workers had a higher rate of 1.9 per year (7). A study in Tigray, northern Nigeria showed that the prevalence of needlestick injury among health care and auxiliary workers 25.9% (8).	
	Neutral	**Neutral**	**Neutral**	**Better**	**Better**	

[gg] Prüss-Üstün A, Rapiti E, Hutin Y. *Sharps injuries: Global Burden of Disease from Sharps Injuries to Health-Care Workers*. Geneva: WHO; 2003. https://www.who.int/quantifying_ehimpacts/publications/en/sharps.pdf.

1.4 Criteria on economic costs

Indicator: Commodity costs of a vaccine regimen[hh] (per person vaccinated)

*Score legend: Red: **Worse than the comparator:** The projected wastage-adjusted total costs for vaccine, delivery device and safety box procurement costs per regimen is increased; White: **Neutral:** no difference with the comparator; Green: **Better than the comparator:** The projected wastage-adjusted total costs for vaccine, delivery device, and safety box procurement costs per regimen is reduced; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 17

Vaccines	*Does the innovation reduce the purchase cost of a vaccine regimen, accounting for wastage?*	*Does the innovation reduce the purchase cost of delivery devices (injection syringes or other components needed for vaccine preparation and administration), accounting for wastage?*	*Are the safety box costs reduced because of a change in the waste disposal volumes and / or types of sharps waste generated?*	*Score*
All applicable vaccines	This innovation like the comparator (delivery of the vaccine with an AD syringe), would not impact the purchase price of the vaccine regimen or the wastage of the vaccines. Therefore, there would be no difference on the purchase cost of the vaccine regimen.	An AD SIP syringe is likely to be more expensive than an AD syringe with no SIP, so the innovation would increase the purchase costs of injection syringes. For example, 0.05 mL AD syringes without the SIP feature are priced at approximately $0.04[ii] compared to $0.065 for a similar size retractable AD SIP syringe,[jj] i.e. an additional cost of $0.025, or	The safety box costs are impacted by the volume of the AD SIP syringe. The volume of the AD SIP syringe will vary by manufacturer. The VanishPoint® 0.5 mL retractable AD syringe has a volume of 54 cm^3 per unit[kk] while the Haiou retractable AD syringe has a volume of 29 cm^3 per unit.[ll] This can be compared to the volume of 0.5 mL non-SIP AD syringes from other manufacturers that have volumes ranging	Overall score: **Worse** • No impact in the purchase cost of the vaccine regimen. • Likely more expensive than an AD syringe. Compared to a 0.05 mL AD syringe without the SIP feature, the price

[hh] *Vaccine regimen cost refers to the vaccine product and innovation cost times number of doses for complete immunization.*

[ii] UNICEF. *Auto-Disable and Re-Use Prevention Syringes and Safety Boxes Current Price Data*. New York: UNICEF; 2018. https://www.unicef.org/supply/files/Auto-Disable_and_Re-Use_Prevention_Syringes_and_Safety_Boxes_-_current_price_data.pdf

[jj] WHO. Haiou retractable auto disable syringe 0.05ml [product specification sheet]. E008/068. Geneva; WHO; 2017. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=3f8f2cb7-1be6-4dd7-a9ec-741cf03f549f&TipoDoc=DataSheet&ID=0

[kk] WHO. Vanishpoint® retractable AD syringe 0.5ml [product specification sheet]. E008/025. Geneva; WHO; 2005. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=f3025136-636d-4139-9773-fdbf824276e1&TipoDoc=DataSheet&ID=0

[ll] WHO. Haiou retractable auto disable syringe 0.5ml [product specification sheet]. E008/056. Geneva; WHO; 2013. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=11f5c996-387e-43ba-98a1-84ac417c36b4&TipoDoc=DataSheet&ID=0

Vaccines	*Does the innovation reduce the purchase cost of a vaccine regimen, accounting for wastage?*	*Does the innovation reduce the purchase cost of delivery devices (injection syringes or other components needed for vaccine preparation and administration), accounting for wastage?*	*Are the safety box costs reduced because of a change in the waste disposal volumes and / or types of sharps waste generated?*	*Score*
		63% per syringe. Note: Price data are only available for 0.05 mL AD SIP syringes on the WHO PQS website. There is no publicly available price for 0.5 mL AD SIP syringes.	between 31 cm^3 and 43 cm^3 per unit.[mm,nn] The volume of the Haiou 0.05 mL retractable AD syringe is 26 cm^3 per unit,[oo] and this is similar to the volume of a similar size AD syringe, which is approximately 30 cm^3 per unit.[pp] Given that the volume is dependent on the manufacturer and design of the syringe, and the range of sizes of AD SIP and AD syringes overlap, we score this as neutral. It should be noted that the safety box costs are <$0.01 per AD syringe since about 100 AD syringes can fit into a safety box which costs $0.45.	• would increase by $0.025 or 63% with the SIP feature. • No change in safety box costs.
	Neutral	**Worse**	**Neutral**	

Indicator: Delivery costs of the vaccine regimen (per person vaccinated)[qq]

*Score legend: Red: **Worse than the comparator**: Increases the economic/delivery costs for the vaccine regimen; White: **Neutral:** no difference with the comparator; Green: **Better than the comparator**: Reduces the economic/delivery costs of for the vaccine regimen**; Yellow**: Mixed**:** Increases some economic/delivery costs and decreases others or has unknown impact on other costs. N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

[mm] WHO. Auto-disable syringe 0.5ml BD SoloShot™Mini [product specification sheet]. E008/035. Geneva; WHO; 2009. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=16a9c2d3-7175-4670-9384-139176dc8051&TipoDoc=DataSheet&ID=0

[nn] WHO. AD SoloShot™ IX 0.5ml [product specification sheet]. E008/013. Geneva: WHO; 2005. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=f7f64ac3-f485-4040-bcae-3b7dd6fc4c10&TipoDoc=DataSheet&ID=0

[oo] WHO. Haiou retractable auto disable syringe 0.05ml [product specification sheet]. E008/068. Geneva; WHO; 2017. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=3f8f2cb7-1be6-4dd7-a9ec-741cf03f549f&TipoDoc=DataSheet&ID=0

[pp] AD syringe 0.05ml BD SoloShot™Mini [product specification sheet]. E008/037. Geneva; WHO; 2009. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/LinkPDF.aspx?UniqueID=7428e5d6-104b-49ba-9dc9-c73e2044efb1&TipoDoc=DataSheet&ID=0

[qq] *Same indicators as for Phase I but further assessed under Phase II due to the antigen/vaccine pairing*

Table 18

Parameter assessment					
Vaccines	***Does the innovation reduce the economic costs of cold chain storage and transport for a vaccine regimen?***	***Does the innovation reduce the economic costs of out of cold chain storage and transport for a vaccine regimen including delivery technology(ies)?***	***Does the innovation reduce the economic costs of time spent by the vaccinators when preparing and administering the vaccine?***	***Does the innovation reduce the economic costs of time spent by staff involved in stock management***	**Overall score**
All applicable vaccines	This innovation like the comparator (delivery of the vaccine with an AD syringe), is not stored in the cold chain and would not impact the volume of vaccines stored in the cold chain. Therefore, there would be no difference in the costs of cold chain storage and transport.	As noted in Table 17, the volume of the AD SIP syringe depends on the manufacturer and the volume can be the same, larger or smaller than an AD syringe. Therefore, we assume the volume of the AD SIP syringe is the same as that of the AD syringe and hence the economic costs of out of cold chain storage and transport will be the same.	This innovation like the comparator (delivery of the vaccine with an AD syringe), would not change the time vaccinators spend on preparing and administering the vaccine and so there is no difference on the economic costs of time for vaccinators.	For each vaccine regimen, the AD SIP has the same number of components as the AD syringe, and it does not have any features that change the process for stock management. Therefore, the use of the AD SIP would not impact the economic costs of time spent on stock management.	Overall score: **Neutral** • Delivery costs are unchanged assuming that the packaged volume of the AD SIP syringe is the same of the comparator.
	Neutral	**Neutral**	**Neutral**	**Neutral**	

Indicator: Introduction and recurrent costs of the vaccine regimen (per person vaccinated)

*Score legend: White: **Neutral**: There are no one-time/upfront or recurrent costs and this is not different than the comparator; Red: **Worse** than the comparator: There are one-time/upfront or recurrent costs.*

Table 19

Parameter assessment		
Vaccines	***How much are the introduction costs (e.g., purchase of hardware or training of health workers) and/or any recurrent or ongoing costs for this innovation, other than vaccine and delivery technology commodity costs, while taking into account the potential breadth of use of the innovation with other vaccines?***	**Score**
All applicable vaccines	Training costs: Training would be required to introduce AD SIP syringes.	Overall score: **Worse** • Vaccinators would need to be trained on how to use SIP syringes. • There are no other upfront or recurrent costs with SIP syringes.
	Worse	
	Other costs: There are no upfront costs for hardware, recurrent or ongoing costs with SIP syringes.	
	Neutral	

1.5 Criteria on environmental impact

Indicator: Waste disposal of the vaccine regimen (per person vaccinated) and delivery system[rr]

*Score legend: Red: **Worse than the comparator:** Increased volume of medical and/or sharps waste and composed of materials/packaging that does not improve the environmental impact on waste disposal; White: **Neutral:** no difference with the comparator; Green: **Better than the comparator:** Reduced volume of medical and/or sharps waste and composed of materials/packaging that improves the environmental impact on waste disposal; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator*

[rr] *This indicator is based on the assessment of waste disposal practices based on the current waste treatment management used in resource-limited settings (incineration/disinfection).*

Table 20

Parameter assessment				
Vaccine	***Does the innovation reduce the volume of medical (biohazard) disposal waste?***	***Does the innovation reduce sharps waste disposal?***	***Is the innovation, and its packaging, composed of more sustainable materials that improves waste disposal?***	**Overall score**
All applicable vaccines	For non-sharps waste, AD SIPs would not increase the volume of waste, similar to the comparator (delivery of the vaccine with an AD syringe).	The volume of an AD SIP syringe thrown in a sharps waste disposal is comparable to the volume of a 0.5 mL non-SIP AD syringe currently used for vaccines (specific volumes vary by manufacturer).	AD SIPs are composed of similar materials to the comparator.	**Neutral**
	Neutral	**Neutral**		

SECTION THREE: Assessment of feasibility for vaccine innovation product development, without comparator

1.6 Criteria on technology readiness

Indicator: Clinical development pathway complexity[ss]

Use the legend to assess and score the indicator in an absolute manner stating the level of complexity (not against a comparator)

*Score legend: **High complexity:** Lacks a clear licensure pathway; **Moderate complexity**: Will likely require a phase III efficacy study and it should be possible to run a trial with a clinical endpoint (as case definitions and clinical endpoints have been agreed upon, there is sufficient disease burden to evaluate the effect of the vaccine, and trial sites and capacity are available); **Low complexity**: Will likely require a non-inferiority trial (as there is an available metric of potency (surrogate or correlate of protection (CoP)) to compare with the existing vaccine); **No complexity:** Will likely not require a phase III efficacy study or non-inferiority trial (as there is no change in formulation, route of administration, or delivery mechanism); N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

Table 21

Parameter assessment		
Vaccines	***Is the clinical development pathway complex?***	**Overall score**
All applicable vaccines	The innovation does not require a phase III efficacy study or non-inferiority trial as there is no change in the formulation, route of administration, or delivery mechanism (needle and syringe).	**No complexity**

Indicator: Technical development challenges

Use the legend to assess and score the indicator in an absolute manner stating the level of complexity (not against a comparator)

*Score legend: **High complexity** of technical development challenges that are unlikely to be overcome; **Moderate complexity** of technical development challenges that might be overcome with longer development time and/or more funding; **Low complexity** of technical development challenges, e.g. applying an existing barcode; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

[ss] *This indicator will be evaluated in an absolute manner, not relative to a comparator*

Table 22

Parameter assessment		
Vaccines	***How complex are the technical challenges to overcome for successful product development (i.e. difficulties applying the innovation to a combination vaccine, reformulation requirements, vaccine not well characterized, etc.)?***	**Overall score**
All applicable vaccines	AD SIPs are a well-defined product already being manufactured at commercial scale.	**No complexity**

Indicator: Complexity of manufacturing the innovation

Use the legend to assess and score the indicator in an absolute manner stating the level of complexity (not against a comparator)

Score legend: ***Very high complexity:*** *Novel manufacturing processes not yet under development;* ***High complexity****: Novel manufacturing processes under development;* ***Moderate complexity****: Novel processes demonstrated at pilot scale ;* ***Low complexity****: Established manufacturing processes, but cannot leverage current capacity ;* ***No complexity:*** *Established manufacturing processes available at commercial scale and access to production facilities if relevant.*

Table 23

Parameter assessment		
Vaccines	***How complex is the manufacturing process?*** ***(Specify if special materials are used)***	**Overall score**
All applicable vaccines	AD SIPs are currently being manufactured at commercial scale.	**No complexity**

Indicator: Robustness of the innovation-vaccine pipeline

Notes:

In table 24 it has been assumed throughout that:

- There are multiple 'developers of the technology' (see phase I TN for details). A couple of examples include BD, VanishPoint retractable syringe and Hindustan Syringes & Medical Devices Kojak Selinge with fixed safety needle. A list of the current AD SIP syringes is available on WHO's PQS catalogue.
- AD SIP syringes can be applied to all vaccines without the need for a clinical vaccine programme and therefore the robustness of the innovation-vaccine pipeline has not been evaluated at the vaccine-specific level.

Use the legend to assess and score the indicator in an absolute manner stating the level of robustness (not against a comparator)

Score legend: ***Not robust:*** *There is only one single technology developer or one single vaccine supplier/manufacturer;* ***Moderately robust:*** *There are multiple technology developers, but each developer's product is unique or there are multiple vaccine manufacturers but each manufacturer product is unique;* ***Highly Robust:*** *There are multiple technology developers and they all use the same device format / manufacturing process or there are multiple vaccine manufacturers and they all produce a similar vaccine; N/A: the indicator measured is* ***not applicable*** *for the innovation; Grey:* ***no data*** *available to measure the indicator.*

Table 24

Vaccines	*Are there multiple developers of the technology?*	*Are there multiple suppliers/manufacturers of the vaccine?*
All applicable vaccines	Yes. A list of the current AD SIP syringes and their manufacturers are available in the WHO PQS catalogue.[tt] They all follow ISO 7886 and ISO 23908 standards. As a delivery device and not a combination product, AD SIP syringes do not require a clinical vaccine development programme and separate development at the vaccine-specific level. Therefore, these devices could be used with any of the applicable vaccines, so these are not assessed on a vaccine-by-vaccine basis.	Different vaccines are at various stages of development and robustness in terms of manufacturing and production processes. This parameter bears no impact on the adoption of the innovation and the overall score as it is independent of the vaccine.
	Highly robust	**Not robust to highly robust**

1.7 Criteria on commercial feasibility[uu]

Indicator: Country interest based on evidence from existing data[vv]

Summary feedback from country consultation:

- AD SIPs were ranked #6 useful innovation

[tt] WHO. PQS catalogue website. Category E008 auto-disable syringe for fixed dose immunization page. http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/categorypage.aspx?id_cat=37. Accessed April 4, 2019.

[uu] *These indicators will be evaluated in an absolute manner, not relative to a comparator.*

[vv] *As part of VIPS phase II activities, in-depth country consultations were conducted in 6 countries (Ethiopia, Mozambique, Nepal, Senegal, Uganda, Nigeria) gathering information from X respondents representing immunisation staff and decision makers/purchasers on vaccine specific delivery challenges faced by immunization programme and which innovations they perceived could address these challenges and provide additional benefits. The interviews were conducted between November 2019 and February 2020 by PATH and CHAI using semi-structured and open-ended questions.*

- Immunisation staff ranked SIPs as 6th out of 9 VIPS innovations that would have the greatest impact in helping address their immunisation programme's challenges and decision-makers 7th - based on weighted scores approach.
- Both groups mentioned the benefits of improved safety by reduced needle-stick injuries, easier use and logistics, improved waste disposal and saved health care worker time.
- Both groups raised concerns about the overall cost.
- Immunisation staff reported complexity of the technology use and time to use the technology as possible challenges.
- Decision makers were also concerned about price per dose and training needs - though 16 out of 28 decision makers interviewed expressed interest in purchasing SIPs, 5 stated potential interest, 7 participants said they would not be interested.
- Decision makers preferred the retractable version over the needle shield version and commented2 that if SIP syringe was only available in immunization program it might get diverted to other areas of the health center.
- Immunisation staff (health workers) mentioned that they have seen these types of syringes. They are available in the market and some clients purchase them for use.
- Immunisation staff also preferred the retractable version over the needle shield version. Safety concerns were raised with the needle shield version given that it requires manual manipulation so close to the needle and also concerns about the shield getting in the way during injections.

Use the legend to assess and score the indicator in an absolute manner stating the level of country interest (not against a comparator)

Score legend: ***No country interest:*** *There is interest from countries but unfavourable in LMIC contexts OR there is no interest;* ***Mixed country interest:*** *Yes, there is some interest – but with concerns, e.g. with regards to implementation in LMICs, price/willingness to pay, etc.;* ***Demonstrated country interest:*** *Stakeholders demonstrated interest in LMICs; N/A: the indicator measured is* ***not applicable*** *for the innovation; Grey:* ***no data*** *available to measure the indicator.*

Table 25

Parameter assessment		
Vaccines	***Have countries expressed interest to suggest demand for the vaccine-innovation pairing and potential country uptake?***	**Overall score**
All applicable vaccines		**No data**

Indicator: Potential breadth of the target market

Note:

- Estimates of market size have been based mostly on information available from WHO, UNICEF or Gavi and are based on number of doses, not the US$ value of the market for the vaccine.
- It is possible that a vaccine-innovation combination would only be used in particular settings. This possibility has not been captured in the table, which is a high-level, superficial assessment of the market.

Use the legend to assess and score the indicator in an absolute manner stating the magnitude of the market size (not against a comparator)

Scoring legend: ***Small:*** *Limited LMIC market (e.g. use case targeting sub-population or a specific setting)* ; ***Moderate:*** *No HIC market but broad use case scenario in LMIC market (e.g. vaccine available for all immunization settings);* ***Large:*** *Broad use case scenario in both HIC and LMIC markets (e.g. vaccine available for all immunization settings, as well as sub-populations and specific settings);* *N/A*: *the indicator measured is* ***not applicable*** *for the innovation;* *Grey*: ***no data*** *available to measure the indicator.*

Table 26

Vaccines	*How broad is the potential target market?*	Overall score
Pentavalent (DT-containing) (Liquid SDV or 10-dose vial)	Global demand for wP containing pentavalent vaccines has been estimated to be between 300 – 350 M doses per year between 2015 – 2035.[ww] Most HICs and upper-middle income countries use aP, rather than wP-containing vaccines. This should not impact the feasibility of use with the innovation however, but this would need to be confirmed.	**Large**
Hepatitis B (birth dose) (Liquid SDV or 10-dose MDV)	WHO recommends a birth dose of hepatitis B. In 2015, 97 (49%) of countries had introduced HepB birth dose, but coverage rates vary and were approximately 35% globally in 2015 (9). Adoption of birth dose by national immunization programmes has not matched the implementation of 3-dose hepatitis B vaccination starting later in infancy (9).	**Large**
HPV (SDV or 2-dose vial)	The WHO recommends that all countries should introduce HPV vaccination into national immunization programmes (10). As of May 2018, 81 countries (42% of UN Member States, corresponding to 25% of target population) had introduced HPV into the national routine immunization schedule. But, despite carrying the greatest share of disease burden, LICs and MICs are lagging in the introduction of HPV vaccine. To date, the majority of the countries have self-procured HPV vaccines (74% in 2017).[xx] A global demand forecast for HPV vaccine has been developed; base demand is estimated to be 55M doses in 2019, reaching ~100M doses in 2025 and stabilizing at ~110M annual doses from 2028 onward (10).	**Large**

[ww] Gavi. *Pentavalent Vaccine Supply and Procurement Roadmap*. Geneva: Gavi; 2016. https://www.gavi.org/sites/default/files/document/penta-roadmap-public-summarypdf.pdf.

[xx] WHO. *HPV: Global Market Study HPV*. Geneva: WHO; 2018. https://www.who.int/immunization/programmes_systems/procurement/mi4a/platform/module2/WHO_HPV_market_study_public_summary.pdf.

Vaccines	*How broad is the potential target market?*	Overall score
Measles rubella (Lyophilised SDV or 10-dose)	The average forecasted global MR demand through 2021 is approximately 400 million doses per year, split between the Gavi 71 countries (approx. 37%), India (39%), Indonesia (10%) and other non-Gavi-countries (14%).[yy] Most HIC and MIC countries use MMR rather than MR vaccine. It is possible that a MR-MAP would be used to target specific, hard-to-reach populations only, or be used only in campaigns (11).	**Large**
Men A (MenAfriVac) **(**Lyophilized SDV or 10-dose vial)	For Men A conjugate vaccines, WHO recommends mass vaccination campaigns in countries in the African meningitis belt, followed by introduction into routine childhood immunisation (12). For quadrivalent meningococcal vaccines, WHO recommends that countries with high or intermediate endemic rates (of invasive meningococcal disease and countries with frequent epidemics should introduce appropriate large- scale meningococcal vaccination programmes (routine, SIAs or private vaccination services). In countries where the disease occurs less frequently meningococcal vaccination is recommended for defined risk groups, such as children and young adults residing in closed communities (13). HICs (such as USA, UK, Australia) are increasingly introducing vaccination of adolescents with polyvalent meningococcal vaccines, and they are a requirement for Hajj pilgrims (14). Demand for MenACWY conjugate vaccine outside China and the meningitis belt was estimated to be 16.7M doses.[zz]	**Moderate (MenA)** **Large (polyvalent)**
Polio (IPV) (IM: Liquid SDV or 10-dose) (ID: Liquid SDV or 5-dose)	The market for IPV is uncertain. IPV was introduced into all routine immunization schedules in 2016. However long-term future markets will depend on the timing of polio-eradication, post-certification polio-vaccination strategies and country preferences for stand-alone IPV vs. IPV in combination vaccines such as hexavalent vaccines. High-income and many middle-income countries have already introduced IPV either as a stand-alone antigen or, more commonly, in a combination vaccine. In 2016, 42 countries reported using the hexavalent (DTaP-Hib-HepB-IPV) combination vaccine and 39 reported using pentavalent (DTaP-Hib-IPV) vaccine in their routine immunization schedules.[aaa]	**Moderate**
Rabies (IM: Lyophilized SDV) (ID: Lyophilized SDV)	Rabies vaccines are not included in national immunization schedules but are recommended for special at-risk groups in HICs and for post-exposure prophylaxis following a bite or exposure to a rabies-infected animal. Over 15 million people receive PEP treatments each year (15). Gavi estimates cumulative demand of 304M doses (20M/year) between 2021 and 2035.[bbb]	**Small / moderate**

[yy] Gavi. *MR Vaccine Supply and Procurement Roadmap Update November 2017.* Geneva: Gavi; 2017. https://www.gavi.org/sites/default/files/document/measles-rubella-vaccine-roadmap--public-summarypdf.pdf.

[zz] WHO. *Global Market Study: Meningococcal Meningitis Vaccines.* Working document. Geneva: WHO; 2019. https://www.who.int/immunization/programmes_systems/procurement/mi4a/platform/module2/WHO_meningococcal_vaccines_global_market_update_May2019.pdf.

[aaa] WHO. *Polio Post-Certification Strategy: A Risk Mitigation Strategy for a Polio Free World*. Geneva: WHO; 2018. http://polioeradication.org/wp-content/uploads/2018/04/polio-post-certification-strategy-20180424-2.pdf.

[bbb] Gavi. *Vaccine Investment Strategy Programme and Policy Committee Meeting: Annex C—Rabies Investment Case*. Geneva: Gavi; 2018. https://www.gavi.org/sites/default/files/document/ppc-meeting-18-19-october-2018---vis-06a---annex-c--rabies-investment-casepdf.pdf.

Vaccines	*How broad is the potential target market?*	Overall score
Typhoid conjugate (Liquid SDV or 5-dose)	Gavi TCV demand forecast for Gavi 73 supported countries has wide range of estimated demand from over 100 million doses per year to as low as 10 million doses per year.[ccc] Factors such as whether the vaccine is used for routine vaccination of infants or vaccination of high-risk infants' impact forecast demand by approximately 4-fold (16).	**Small / moderate**
Yellow Fever Lyophilized SDV or 10-dose	Use of YF vaccine is predominantly in the YF belt in South America and Asia. Gavi estimates suggest global demand is expected to grow from 133 million doses in 2018 to approximately 140 md in 2021.[ddd] To date YF is not endemic in Europe, N America or Asia, though it has been suggested that the risk that YF might spread to these areas is increasing (17).	**Moderate**
Ebola (rVSV-ZEBOV) (Liquid SDV or 10-dose)	The future demand for Ebola vaccines is unknown and it is likely that the commercial market will be limited. Governments and non-governmental organizations will be the only likely buyers.[eee] Presumably primarily for stockpiling to control outbreaks, e.g., by ring vaccination with rVSVΔG-ZEBOV.	**Small**
HIV (ALVAC-HIV + bivalent Subtype C gp120) (Prime: lyo. SDV. Boost: liquid SDV)	The estimated market size for an HIV vaccine will depend on whether it prevents infection only, or also decrease viral load in those who acquire infection. One model study estimated that demand for vaccines that would prevent infection only was 22–61 million annual doses. Depending on the model inputs, HICs represented ~30% of the market size, but 70% of the value, whereas LICs were ~45% of the market size (17M doses), but only 10% of the value (18).	**Large**
Influenza (pandemic) (VAL 506440) (Liquid SDV)	In theory, in the event of a pandemic, there would be enough vaccine for the entire global population (approximately 7.4 bn). Current manufacturing capacity for influenza vaccines is ~6.3 bn doses, sufficient to immunize 43% of the population if two doses are required (19). However, this assumes production of a pandemic vaccine after the start of a pandemic and once the pandemic strain has been isolated. Other strategies, such as stockpiling vaccine are possible.	**Small**
Malaria (RTS,S) Lyophilized SDV or 2-dose vial, recon with diluent)	Wide, country-level introduction of RTS,S has not yet been recommended by the WHO (20). Use is likely to be country, setting and population-dependent. Demand forecasts for Gavi countries estimate 665M doses from 2023 – 2035 (peaking at approximately 75M doses per year at the end of this period.[fff] It is likely there will be a significant non-Gavi market too.	**Moderate**

[ccc] Gavi. *Typhoid Conjugate Vaccine (TCV) Supply and Procurement Roadmap*. Geneva: Gavi; 2018. https://www.gavi.org/sites/default/files/document/typhoid-conjugate-vaccine-roadmap--public-summarypdf.pdf.

[ddd] Gavi. *Yellow Fever Vaccine Supply and Procurement Roadmap*. Geneva: Gavi; 2017. https://www.gavi.org/sites/default/files/document/yellow-fever-roadmap-public-summarypdf.pdf

[eee] Gavi. *Ebola Vaccine Supply and Procurement Roadmap*. Geneva: Gavi; 2018. https://www.gavi.org/sites/default/files/document/ebola-roadmap---public-summarypdf.pdf.

[fff] Gavi. *Vaccine Investment Strategy Programme and Policy Committee Meeting: Annex C—Malaria*. Geneva: Gavi; 2018. https://www.gavi.org/sites/default/files/document/ppc-meeting-18-19-october-2018---vis-appendix-3--malaria-vaccine-analysispdf.pdf.

Vaccines	*How broad is the potential target market?*	Overall score
M. Tb (next generation, VPM 1002) (Lyophilized SDV or 20-dose)	The WHO recommends BCG vaccination in countries or settings with a high incidence of tuberculosis and/or high leprosy burden. In these countries, a single dose of BCG vaccine should be given to all healthy neonates at birth (21). The estimated global demand for BCG vaccine is ~325 M doses in 2019.[ggg]	**Large**
RSV (pre-fusion F protein) (Lyophilized SDV)	Gavi has estimated the cumulative demand for RSV vaccine for maternal immunization for 2021-2035 to be 289M doses for Gavi supported countries. There is expected to be a large market in HICs, for example RSV is the leading cause of hospitalization in infants in the USA (22).	**Large**

Indicator: Existence of partnerships to support development and commercialisation[hhh]

Use the legend to assess and score the indicator in an absolute manner stating the level partnership/support (not against a comparator)

*Score legend **for donor and/or stakeholder support column:** **No interest:** No known donor and/or stakeholder support; **Moderate interest**: Donors and/or stakeholders have expressed interest by funding or providing technical support to research; **Significant interest:** Support from donors and/or stakeholders with intent or mandates to bring the innovation to market; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

*Score legend **for technology developer and vaccine manufacturer partnership column**: **No interest:** No known technology developer and vaccine manufacturer partnerships, even for early stage work; **Moderate interest**: Technology developer and vaccine manufacturer partnerships have expressed interest by funding, conducting, and/or collaborating on research (e.g., on preclinical or early stage clinical trials for combined vaccine/delivery products or on feasibility or pilot studies for labelling products); **Significant interest:** Technology developer and vaccine manufacturer partnerships are committed to commercialise the innovation-vaccine combination; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

*Score legend **for overall score**: **No interest:** No known interest from donors/stakeholders AND technology developer/vaccine manufacturer partnerships; **Mixed interest:** Different levels of interest from donors/stakeholders and technology developers/vaccine manufacturer partnerships; **Moderate interest**: Moderate interest from donors/stakeholders AND technology developer/vaccine manufacturer partnerships; **Significant interest:** Significant interest from donors/stakeholders AND technology developer/vaccine manufacturer partnerships; N/A: the indicator measured is **not applicable** for the innovation; Grey: **no data** available to measure the indicator.*

[ggg] WHO. Global market study. BCG vaccine. Geneva: WHO; 2019. https://www.who.int/immunization/programmes_systems/procurement/mi4a/platform/module2/WHO_BCG_vaccine_global_market_update_Feb2019.pdf.

[hhh] *If the innovation is a stand-alone device and does not require a partnership with a vaccine manufacturer for commercialization, this indicator is not applicable.*

Table 27

Parameter assessment			
Vaccines (current presentations)	***Is there current donor/stakeholder support for the vaccine-innovation pairing?***	***Do partnerships exist between at least one of the technology developers and a vaccine manufacturer or have vaccine manufacturers expressed interest?***	**Overall score**
All applicable vaccines	Yes, International Organization for Standardization (ISO) standards are developed for SIP syringes.[iii] WHO recommends the use of syringes with SIP features for health care workers delivering intramuscular, subcutaneous or intradermal injectable medications to patients.[jjj] The WHO Performance, Quality, and Safety (PQS) group is planning to assess in 2020 whether SIP features should be required for all immunization syringes.[kkk,lll]	The innovation is a stand-alone device and does not require a partnership with a vaccine manufacturer for commercialization.	**Established support**
	Established support	**N/A**	

Indicator: Known barriers to global access to the innovation

Use the legend to assess and score the indicator in an absolute manner (not against a comparator)

Score legend: ***Yes:*** *IP not accessible and no freedom to operate;* ***Mixed:*** *IP and freedom to operate accessible within 5-10 years;* ***No:*** *No known barriers to access and/or IP is in the public domain; N/A: the indicator measured is* ***not applicable*** *for the innovation; Grey:* ***no data*** *available to measure the indicator.*

[iii] WHO. *WHO Guideline on the Use of Safety-Engineered Syringes for Intramuscular, Intradermal and Subcutaneous Injections in Health Care Settings*. Geneva: WHO; 2016. https://apps.who.int/iris/bitstream/handle/10665/250144/9789241549820-eng.pdf?sequence=1

[jjj] WHO. *WHO Guideline on the Use of Safety-Engineered Syringes for Intramuscular, Intradermal and Subcutaneous Injections in Health Care Settings*. Geneva: WHO; 2016. https://apps.who.int/iris/bitstream/handle/10665/250144/9789241549820-eng.pdf?sequence=1

[kkk] WHO calls for worldwide use of "smart" syringes [press release]. Geneva, Switzerland: WHO; February 25, 2015. https://www.who.int/mediacentre/news/releases/2015/injection-safety/en/.

[lll] WHO. *How Smart Technology Can Help Make Injections Safe*. Geneva: WHO; 2017. https://www.who.int/infection-prevention/tools/injections/IS_IndustryMembers_Leaflet.pdf

Table 28

Parameter assessment		
Vaccines	***Are there known barriers to Global Access to the innovation as applied to the vaccine?***	**Overall score**
All applicable vaccines	Global access issues are unlikely given the number of suppliers and because different suppliers use different technologies to achieve the innovation.	**No**

SECTION FOUR: Summary

ABILITY OF THE INNOVATION TO ADDRESS IMMUNIZATION ISSUES

Based on a systematic review,[mmm] evidence suggests that SIPs reduce needlestick injuries in the target population and health care workers administering the vaccine, increasing safety and reducing the transfer of bloodborne pathogens. They have broad applicability across all parenteral vaccines, the clinical development pathway has no complexity (i.e., does not require a phase III efficacy study or non-inferiority trial/no clinical development is required) nor are there any technical development challenges. However, in terms of cost, an AD SIP is likely to be more expensive than an AD syringe with no SIP, so the innovation would increase the purchase costs of injection syringes. In addition, there are one time/upfront costs with AD SIPs as their use would require training of vaccinators on how to use these syringes.

While this technology note is evaluating standalone AD SIP syringes, AD SIP features could also be added to other VIPS injection technologies - specifically compact prefilled autodisable (CPAD) devices and dual chamber delivery devices. Their use would also be compatible with heat stable/controlled temperature chain liquid vaccines in vials and freeze-resistant liquid vaccine formulations in vials.

SYNERGIES WITH OTHER VIPS INNOVATIONS:

As with all parenterally delivered vaccines, safety improvements could be realized through the use of AD SIPs with:

[mmm] WHO. *WHO Guideline on the Use of Safety-Engineered Syringes for Intramuscular, Intradermal and Subcutaneous Injections in Health Care Settings*. Geneva: WHO; 2016. https://apps.who.int/iris/bitstream/handle/10665/250144/9789241549820-eng.pdf?sequence=1

- Heat stable/CTC liquid vaccines;
- Freeze-resistant (liquid) vaccine formulations;
- Compact prefilled auto-disable (CPAD) devices and
- Dual chamber delivery devices.

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