

Report of the WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector- borne diseases

Geneva, Switzerland

21-22 April 2016

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Table of Contents

Context.....	4
Findings and recommendations.....	6
Question 1 – effectiveness of disinsection	6
Question 2 – methods and products	7
Methods.....	8
Disinsection products.....	8
Question 3 - recommendations	8
Recommendations for Member States.....	8
Recommendations for WHO Secretariat	9
Recommendations for future research.....	9
Appendix 1. Selected Provisions related to disinsection under the International Health Regulations (IHR (2005)).....	10
Appendix 2. Agenda	14
Appendix 3. List of participants	16

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Context

On 1 February 2016, WHO declared the clusters of microcephaly and other neurological disorders, and their potential link with Zika virus outbreaks in Brazil and French Polynesia, to be a public health emergency of international concern (PHEIC). Following the advice of the first meeting of the Emergency Committee under the International Health Regulations (2005) (IHR (2005)), WHO issued several temporary recommendations concerning specific actions for vector control and related issues¹. Given the potential causal relationship between the neurological disorders and Zika virus infection, these recommendations included specific mention of disinsection as a precautionary measure. The temporary recommendations stated that “standard WHO recommendations regarding disinsection of aircraft and airports should be implemented”. The second meeting of the Emergency Committee recommended that “Standard WHO recommendations regarding vector control at airports should be implemented in keeping with the IHR (2005). Countries should consider the disinsection of aircraft”².

The requirements of the IHR (2005) include several provisions for vector control measures, including disinsection, relating to aircraft and other conveyances, as well as measures to maintain airports free from sources of infection³.

However, there is persistent controversy around aircraft disinsection. Given the rapid spread of Zika virus infection in Latin America and other countries, and the mounting evidence on the potential causal link between the Zika virus infection and the occurrence of neurological complications, WHO convened an ad-hoc advisory group to provide further advice to the Organization on the role of aircraft disinsection for preventing the international spread of vector-borne diseases, including Zika virus. The 15 members of the advisory group covered a wide range of expertise, including entomology, virology, vector control, infectious diseases surveillance, chemical safety, mathematical modelling, travel medicine, border security, and aviation operations.

The group met on 21-22 April 2016 in Geneva, Switzerland, and discussed the following three questions:

1. What is the effectiveness of disinsection of aircraft, with currently available agents, on controlling the international spread of mosquito-borne diseases, such as malaria, chikungunya, dengue, yellow fever, and in particular the Zika virus disease?
2. What are the methods and products that should be recommended for controlling the international spread of mosquito-borne diseases?

¹ First meeting (1 February 2016): “Vector control measures and appropriate personal protective measures should be aggressively promoted and implemented to reduce the risk of exposure to Zika virus” ; second meeting (8 March): “Vector surveillance, including the determination of mosquito vector species and their sensitivity to insecticides, should be enhanced to strengthen risk assessments and vector control measures. Vector control measures and appropriate personal protective measures should be aggressively promoted and implemented to reduce the risk of exposure to Zika virus. Countries should strengthen vector control measures in the long term and the Director-General of WHO should explore the use of IHR mechanisms, and consider bringing this to a forthcoming World Health Assembly, as means to better engage countries on this issue.” (<http://www.who.int/mediacentre/news/statements/2016/1st-emergency-committee-zika/en/>)

² See: <http://www.who.int/mediacentre/news/statements/2016/2nd-emergency-committee-zika/en/>

³ Relevant provisions include articles 1, 19-28, 33, 34, 38, 41, 42, 43 and Annexes 4, 5 and 9. Appendix 1 of this document presents a summary of these key requirements. For details on the specific requirements under the IHR (2005), see “International Health Regulations (2005), second edition”. WHO, 2008. Available at: <http://www.who.int/ihr/publications/9789241596664/en/>.

3. What are the possible recommendations, including further research, for the control of international spread of mosquito-borne diseases through air traffic, as they relate to disinsection?

In addition to existing WHO guidance and technical background documentation, the advisory group also took into account views from a wide range of stakeholders, representing industry manufacturers, airline operators, and representatives of civil society and unions. A full list of participants and the meeting agenda are in appendices 2 and 3, respectively.

This document presents the outcome of the group deliberations and its recommendations.

Findings and recommendations

The advisory group were in consensus that mosquito vectors travel on aircraft and other conveyances, and that a small proportion of those may carry pathogens.

From a public health perspective, the group was also in agreement that the ultimate goal of the IHR (2005) is the prevention of international spread of vector-borne diseases. The role of aircraft disinsection for this purpose was discussed at length.

The group noted that pathogen importation in mosquito vectors has a low probability compared to introduction of pathogens by infected human travellers. Currently, there are some documented cases of malaria (“airport malaria”) and dengue caused by mosquitoes carried on an international flight, no documented cases for yellow fever (although the concerns with regards to potential consequences of its introduction in non-endemic areas are very high) and no documented cases for Zika virus to date.

The following section presents the outcome of the deliberations for each of the three questions.

Question 1 – effectiveness of disinsection

Disinsection was considered to be an **effective and important** measure for the avoidance/reduction of importation of new mosquito vectors to a country or region. This was seen as important preventive strategy for countries (particularly islands) where the relevant mosquito vector is not present. Aircraft disinsection is in fact systematically and effectively carried out in Australia and New Zealand where increased numbers of imported vectors have been recorded in recent years. It was also noted that in areas where the relevant mosquito vector is already established, the risk of importing insecticide-resistant strains is an additional concern. It was noted that cargo compartments and other conveyances may be more relevant than aircraft cabins for importation of some mosquito vectors.

Disinsection is also **important** for countries determined to avoid importation of specific infected mosquito vectors (for example, for yellow fever importation into non endemic countries/areas with established mosquito vectors). Countries should develop risk assessment models and may require aircraft disinsection based on the results of such risk assessment.

Effectiveness of disinsection was considered **low** for preventing pathogen importation, as there is a low risk of importation by mosquito vectors compared to infected travellers.

Question 2 – methods and products

Controlling mosquito vectors and disease at source, when implemented well, is the best way to avoid the international spread of pathogens. Institutionalized mosquito vector control in airports and nearby urban areas is a priority intervention to prevent international spread of mosquito vectors. Surveillance and mosquito vector control must be implemented effectively in all international airports in compliance with the requirements of the IHR (2005).

The WHO Vector Control Advisory Group (VCAG) recently reviewed the vector control tools for use in the context of the response to the Zika virus outbreak, and recommended improved implementation of current vector control interventions and better data-gathering on the pilot deployment of new tools⁴.

WHO has provided guidelines on methods and products for aircraft disinsection⁵.

Specifications for aircraft disinsection products have been established by the WHO Pesticide Evaluation Scheme⁶ (WHOPES), including:

- d-Phenothrin technical grade material⁷
- 1R-trans-phenothrin technical grade material⁸
- Permethrin technical grade material⁹.

A risk assessment model to ensure that products and methods used for disinsection do not give rise to unacceptable risks of health effects in passengers, aircrew or ground staff has also been published in 2013¹⁰ and can be accessed at <http://www.who.int/ipcs/publications/ehc/ehc243.pdf>.

"Guidelines for testing the efficacy of insecticide products used in aircraft" have been published by WHO and can be accessed at http://www.who.int/ihr/publications/aircraft_insecticides/en/.

The guidelines include four recommended techniques for aircraft disinsection:

- 1) Pre-flight;
- 2) Blocks away;
- 3) Top-of-descent; and
- 4) Residual treatment (see Annex 1¹¹).

WHO has recently published a handbook on vector surveillance and control¹² and this document should be used for capacity building.

⁴ http://who.int/neglected_diseases/news/mosquito_vector_control_response/en/

⁵ WHO Report of the informal consultation on aircraft disinsection WHO/HQ Geneva, 6-10 November 1995 : http://apps.who.int/iris/bitstream/10665/59700/1/WHO_PCS_95.51_Rev.pdf

⁶ <http://www.who.int/whopes/en/>

⁷ http://who.int/whopes/quality/en/dPhenothrin_Spec_Eval_Oct_2004.pdf?ua=1

⁸ http://who.int/whopes/quality/1R-trans-phenothrin_spec_eval_Sep_2015.pdf?ua=1

⁹ http://www.who.int/whopes/quality/en/Permethrin_40-60_spec_eval_WHO_Sep_2015.pdf?ua=1

¹⁰ WHO. IPCS Environmental health criteria 243. Aircraft disinsection insecticides. WHO 2013. <http://www.who.int/ipcs/publications/ehc/ehc243.pdf>

¹¹ http://www.who.int/ihr/ports_airports/aircraft_insecticides_annex1.pdf?ua=1

¹² Handbook. Vector surveillance and control at ports, airports, and ground crossings. WHO, 2016. http://apps.who.int/iris/bitstream/10665/204660/1/9789241549592_eng.pdf

Methods

It was noted that the presence of mosquito vectors is not just limited to aircraft cabins, as they can hide in overhead lockers, baggage and cargo holds. The current practice of applying aerosols in aircraft cabins after overhead lockers have been closed is not a good practice. This method excludes the disinsection of cargo/baggage holds and is therefore not effective in keeping the baggage and cargo containers in passenger aircrafts free of mosquito vectors.

Disinsection products

Several concerns were noted regarding the products currently used for aircraft disinsection:

- Only certain pyrethroids have been recommended in technical publications by WHO;
- Only certain chemicals have been approved by the main aircraft manufacturers (Airbus and Boeing) as technically acceptable and compatible with the specialised materials used in aircraft; this information should be made readily accessible;
- There is widespread and increasing resistance of mosquito vectors to many insecticides, in particular to pyrethroids, so the pyrethroid-based disinsection products may not provide the desired efficacy against them;
- There are regulatory restrictions on the use of certain pyrethroids in some Member States and it is possible that certain pyrethroids could be banned by some Member States. Coupled with the lack of suitable alternatives, there is a real risk of having no effective and acceptable products for disinsection available in some regions or countries in the near future; and
- There are substantial regulatory hurdles/barriers to introducing new products on the market.

Question 3 - recommendations

The group agreed on the following recommendations for Member States, for the WHO Secretariat, and for future research.

Recommendations for Member States

- 1) Member States must prioritize achievement of the required International Health Regulations core capacities for surveillance and response, and at designated points of entry under Annex 1 of IHR (2005), as well as capacities necessary to implement all of the many other provisions of the IHR directly relevant to disinsection and vector control.
- 2) Member States should undertake a risk assessment relating to the probability of the importation of mosquito vectors, the presence of mosquito vectors and the probability of infected persons entering the country and use this to inform their disinsection policies.
- 3) In line with the IHR requirements, Member States should ensure that airports (and other points of entry) are free of sources of infection, including mosquito vectors and reservoirs. This may require a perimeter exceeding 400 metres (IHR Art. 22b, Annex 5.4).
- 4) Member States/airlines/airports professionals should improve consistency of disinsection practices.
- 5) Member States should take measures to strengthen awareness of the importance of vector control measures and instructions and training by national/ aviation/ competent authorities/ airlines/ airport authorities for crews/ airport professionals/other contractors to assure correct procedures (including Standard Operating Procedures).

- 6) Member States should ensure dissemination of accurate information on:
 - The WHO recommended products (and relevant national regulations); and
 - The safety of disinsection methods and products.
- 7) Member States should facilitate and reduce barriers to the process of regulatory approval of novel methods and products which can be used for disinsection, making use of WHO recommendations when possible.

Recommendations for WHO Secretariat

- 1) The ad-hoc advisory group recommends to the WHO Secretariat, on the basis of positive experience regarding pre-embarkation disinsection used in Australia and New Zealand, to consider including pre-embarkation disinsection as an additional WHO recommended method; the Emergency Committee on Zika virus disease and the WHO Director-General should consider including this method in a temporary recommendation or other advice on aircraft disinsection.
- 2) WHO should provide guidelines for the risk assessment of pathogen importation by Member States and make a global map available classifying areas on the basis of presence of mosquito vector species and pathogens.
- 3) WHO should develop a framework for assessment and recommendation of new vector-control approaches, applicable to both chemical and non-chemical methods.
- 4) WHO should publish its recommendations on disinsection practices in a clear format similar to those in Australia/New Zealand.

Recommendations for future research

- 1) Assess the mechanisms and impact of mosquito vector resistance to pyrethroids;
- 2) Clarify/establish the pathways by which the international spread of mosquito vector-borne pathogens is occurring, and the extent to which air travel contributes to the international spread;
- 3) Clarify/establish the pathways by which the international spread of mosquito vectors is occurring, and the extent to which air travel contributes to the international spread;
- 4) Explore the use of risk-modelling approaches to map mosquito vector presence and inform mosquito vector control programmes; and
- 5) Explore new chemical and non-chemical methods for disinsection, such as air blowers and net curtains, including also strategies combining multiple approaches.

Appendix 1. Selected Provisions related to disinsection under the International Health Regulations (IHR (2005))¹³

A wide range of IHR (2005) provisions address State Party health measures relevant to disinsection of conveyances and airports. Some provisions are general in scope (referring to all conveyances or health measures); others are more specific to air transport, airports and disinsection. The following selection of articles highlights key provisions relevant to this particular context.

Definitions

Under the IHR (2005) definition of “disinsection”, the measure is not limited to aircraft or even conveyances. “Disinsection” means “the procedure whereby health measures are taken to control or kill the insect vectors of human diseases present in baggage, cargo, containers, conveyances, goods and postal parcels.” “Vector” means “an insect or other animal which normally transports an infectious agent that constitutes a public health risk”. “Reservoir” means “an animal, plant or substance in which an infectious agent normally lives and whose presence may constitute a public health risk.

CONVEYANCES

Under the IHR (2005), conveyance operators should keep conveyances permanently free of sources of infection or contamination, including vectors and reservoirs, and communicate accordingly to national authorities.

When disinsection can be required or authorized for conveyances:

- If the national authority has evidence or factual information of a public health risk on board a conveyance (including aircraft) it must consider the conveyance affected, and may disinsect it or require disinsection (or other health measures) to be carried out under its supervision (Article 27.1).
- Additionally, a conveyance may be regarded as suspect and should be inspected for vectors and reservoirs if: it has a possible case of vector-borne disease on board, or a case has occurred on board on an international voyage, or it has left an affected area within the period that on-board vectors could still carry disease (Annex 5.6).
- Every conveyance leaving an international point of entry in an area where WHO vector control is recommended by WHO should be disinsected and kept free of vectors. The presence of vectors on board conveyances and the control measures used to eradicate them must be included, in the case of aircraft, in the Health Part of the Aircraft General Declaration unless waived by the State Party (Annex 5.2).
- In general, States Parties may inspect conveyances/baggage/cargo/containers for public health purposes on arrival or departure, and to apply certain additional health measures (Article 23.1(b), 23.2, 43), subject to varying requirements.

¹³ Scope of list: All of the provisions included here apply at a minimum to **disinsection of aircraft** or at **airports**. As indicated while some provisions are specific only to disinsection/aircraft/airports, many are much broader and apply to **other conveyances** which may be relevant for this meeting (including **ships** on international voyages), and other points of entry (including **ports**). To the extent this meeting focuses on disinsection of ships, cargo or ports, other provisions specific to those contexts will also apply.

- Competent authorities at points of entry are to advise conveyance operators of their intent to apply control measures to a conveyance, including written information concerning the methods where available (Article 22.1(d)).

Techniques/methods/materials. It is generally up to the country to decide on the technique used to obtain an adequate level of control of the public health risk at issue; where specific methods or materials are advised by WHO these should be used (Article 27.1; Annex 5.2). States Parties should accept disinsection and other control measures for conveyances applied by other states if methods and materials used by WHO are used (Annex 5.3). Control measures applied to baggage/cargo/conveyances/containers must be carried out to avoid potential injury or discomfort to persons or damage as far as possible (Annex 4B.1).

Technical/standing recommendations (TRs/SRs). The non-exhaustive list of potential temporary or standing recommendations includes potential treatment of conveyances to remove infection or contamination, including vectors and reservoirs, when the requirements for these IHR recommendations are met (Article 18).

Reapplication of measures on arrival. Health measures recommended by WHO in TRs/SRs, including disinsection of conveyances arriving from an affected area may be reapplied on arrival if there is verifiable indication/evidence that measures on departure were unsuccessful (Art. 22.2).

Additional measures. Where there is evidence or factual information of such a public health risk, the competent authority may implement additional health measures, including isolation of conveyances, as necessary to prevent spread of disease (Article 27.1; see also 23.2). However, such additional measures are subject to the requirements of Article 43, including that they be based on scientific principles, available scientific evidence of risk to human health or related information from WHO or other relevant organizations, and available WHO advice/guidance (including applicable Temporary Recommendations). Such measures should be reported to WHO with the public health justification within 48 hours.

Vector control in and around airports is also part of the IHR, as States Parties are requested to ensure that airport facilities are kept in a safe and effective and sanitary condition and free from sources of infection and contamination, including vectors and reservoirs, and expand this vector-free zone to a minimum distance of 400 meters from the facilities that are used for operations involving travellers, conveyances, containers, cargo and postal parcels, with extension of the minimum distance if vectors with a greater range are present (IHR Annex 5).

The national authority is also responsible for ensuring that disinsection is carried out so as to avoid injury and as far as possible discomfort to persons, or damage to the environment in a way which impacts on public health, or damage to baggage, cargo, containers, conveyances, goods or postal parcels (IHR Article 22).

Charges. Any charges from States to individuals or operators for health measures applied to conveyances/cargo/containers must be based on a single national tariff, limited to actual cost, without discrimination and published at least 10 days in advance (Article 41).

Required documentation and information to be provided on disinsection on aircraft:

- Where disinsection has been carried out on aircraft during the flight, documentation of the disinsection operation (including place, date, time, method), or if not done during the flight, details of the most recent disinsection operation, must be included in the Health Part of the

Aircraft General Declaration (Article 38, and Annex 9).¹⁴ This is to be delivered by the pilot in command or agent while in flight or upon landing to the competent authority for the first airport in the country, except when the State Party does not require it.

- The pilot or agent must also supply any information concerning health conditions on board during an international voyage, and health measures applied, as required by the State Party. The State Party must inform the conveyance operators, or their agents, of these informational requirements (Article 38; Annex 4A.2).
- If a State Party is itself responsible for health measures applied to conveyances/cargo, the government must provide in writing the parts treated, measures employed and reason for application (Annex 4B.2).

Denial of free pratique/prevention of aircraft/ships from calling at port/airport for health reasons.

Subject to various exceptions/requirements:

- International aircraft/ships are not generally to be prevented for public health reasons from calling at any port/airport; and
- International ships/aircraft are not generally to be refused free pratique by States for public health reasons, in particular from embarking/disembarking, discharging/loading cargo or stores, or taking on fuel/water/food and supplies. Granting of free pratique may be subject to inspection, and if a source of infection/contamination is found on board, the implementation of necessary health measures to prevent spread of infection/contamination (Article 28.1-3).

POINTS OF ENTRY (including airports/ports and in some cases ground crossings)

Vector information/reporting. States parties must give to WHO, as far as practicable, when requested in response to a specific potential public health risk, relevant data concerning sources of infection or contamination, including vectors and reservoirs, at its points of entry, which could result in international disease spread (Article 19(c)).

Responsibilities of Competent Authorities at points of entry

- Monitoring baggage, cargo, containers, conveyances, goods, postal parcels and human remains departing and arriving from affected areas, so that they are maintained in such a condition that they are free of sources of infection or contamination, including vectors and reservoirs;
- Supervision of any deratting, disinfection, disinsection or decontamination of baggage, cargo, containers, conveyances, goods, postal parcels and human remains or sanitary measures for persons, as appropriate under these Regulations; and
- Advising conveyance operators, as far in advance as possible, of their intent to apply control measures to a conveyance, and shall provide, where available, written information concerning the methods to be employed (Article 22.1(b)(a,c,d)).

Requirements for containers and container loading areas. States Parties must ensure, as far as practicable, that (1) shippers use international traffic containers that are kept free from sources of infection or contamination, including vectors and reservoirs, particularly during the course of packing; and (2) container loading areas are kept free from sources of infection or contamination, including vectors and reservoirs (Article 34.1 and 34.2).

¹⁴ See also International Standards and Recommended practices. Annex 9 to the Convention on International Civil Aviation. Facilitation, inter alia stating that "Contracting States shall ensure that their procedures for disinsection are not injurious to the health of passengers and crew and cause the minimum of discomfort to them". Appendix 1. ICAO, 2011. Available at: <http://cockpitdata.com/Gallery/download/36>

Designation of areas where conveyances should be subject to vector control. WHO is to publish a list of areas where disinsection or other vector control measures are recommended for conveyances arriving from these areas. Determination of such areas shall be made pursuant to the procedures regarding temporary or standing recommendations, as appropriate (Annex 5.1).

Core Capacity requirements for State “designated” points of entry (ports/airports/ground crossings). While the above requirements apply to points of entry generally, the following pertain specifically to the points of entry designated to develop particular core capacities, including:

- At all times - to provide as far as practicable a programme and trained personnel for the control of vectors and reservoirs in and near points of entry.
- For response to events that may constitute a public health emergency of international concern - to apply recommended measures to disinsect, derat, disinfect, decontaminate or otherwise treat baggage, cargo, containers, conveyances, goods or postal parcels including, when appropriate, at locations specially designated and equipped for this purpose.

Appendix 2. Agenda

WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases

World Health Organization, Geneva, Switzerland
21-22 April 2016, Salle M 405

Agenda

Thursday 21 April 2016

Date and time	Session	Presenter
08:45 – 09:15	Registration	
09:15 – 09:30	Introduction of participants and selection of the Chair Background and meeting objectives	Guenael Rodier, Director GCR
10:00 – 10:30	Question 1: <i>What is the effectiveness of disinsection of aircraft on controlling the international spread of mosquito-borne diseases, such as malaria, chikungunya, dengue, yellow fever, and in particular Zika virus disease?</i> <ul style="list-style-type: none"> Stakeholders' perspectives <ul style="list-style-type: none"> product manufacturers Group discussion	Chair Andrew Grimes, Callington, Australia (via WebEx)
10:30 – 11:00	<i>Coffee break</i>	
11:00 – 12:30	<i>Question 1 – continued</i> <ul style="list-style-type: none"> Current practice and experience with aircraft disinsection Stakeholders' perspectives <ul style="list-style-type: none"> airlines perspective products manufacturers Group discussion	Chair Jenny Firmin, Australia Carolyne Keaveny, Virgin Airlines, UK (via WebEx) Dieter Vervaecke, Aero-sense, Brussels, Belgium
12:30 - 13:30	<i>Lunch</i>	
13:30 – 15:00	Question 2: <i>What are the methods and products that should be recommended for controlling the international spread of mosquito-borne diseases?</i> <ul style="list-style-type: none"> WHO recommendations on methods and products Stakeholders' perspectives <ul style="list-style-type: none"> product manufacturers Group discussion	Chair Richard Brown, Technical Officer, PHE Amira Khaled, PSA Paris, France (via WebEx)
15 :00 – 15 :30	<i>Coffee break</i>	
15:30 – 18:00	<i>Question 2 – continued</i> <ul style="list-style-type: none"> Stakeholders' perspective <ul style="list-style-type: none"> flight attendants' views 	Chair Judith Anderson, AFA, Seattle, USA (via WebEx)

Date and time	Session	Presenter
	<ul style="list-style-type: none"> – new methods – air curtain and non-chemical methods • Pre-embarkation disinsection <p>Group discussion</p>	<p>Jerome Hogsette, USDA Florida, USA (via WebEx)</p> <p>Steve Gay, New Zealand</p>

Friday 22 April 2016

Date and time	Session	Presenter
9 :00 – 10 :30	<p>Question 3: <i>What are the possible recommendations, including further research, for the control of international spread of mosquito-borne diseases through air traffic?</i></p> <ul style="list-style-type: none"> • Recommendations <p>Group discussion</p>	Chair
10 :30 – 11 :00	<i>Coffee break</i>	
11 :00 – 12 :30	<p><i>Question 3 – continued</i></p> <ul style="list-style-type: none"> • Research gaps and need for future work <p>Group discussion</p>	Chair
12 :30-13 :30	<i>Lunch</i>	
13 :30 – 15 :00	<p>Summary conclusions and next steps</p> <p>Closing remarks</p>	<p>Chair</p> <p>Guenaël Rodier, Director GCR</p>

Appendix 3. List of participants

WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases

WHO Headquarters, Geneva, Salle M405

21-22 April 2016

List of Participants

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