Finding the Signal through the Noise

A landscape review and framework to enhance the effective use of digital social listening for immunisation demand generation

PROCESS FACILITATED AND REPORT WRITTEN BY SARAH CUNARD CHANEY, PETER BENJAMIN, AND PATRICIA MECHAEL FROM HEALTHENABLED
WITH TECHNICAL GUIDANCE AND SUPPORT FROM GAVI, THE VACCINE ALLIANCE, UNICEF, THE VACCINATION DEMAND HUB AND WHO

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Acronyms

AEFI	Adverse events following immunisation
AI	Artificial intelligence
BeSD	Behavioural and social drivers
CDC	U.S. Centers for Disease Control and Prevention
EPI	Expanded Programme on Immunisation
Gavi	Gavi, the Vaccine Alliance
HW	Health worker
IoGT	Internet of Good Things
KAP	Knowledge, Attitudes, Practices
LMIC	Low- and middle-income countries
MOH	Ministry of Health
NGO	Non-governmental organisation
RCCE	Risk communications and community engagement
SMS	Short message services, text message
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

Glossary of terms

Community engagement	The process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people (CDC, 2011).
Crowdsourcing	Collecting information and feedback directly from clients or the general public on their opinions, ideas and experiences with public services to improve accountability and transparency. Active crowdsourcing is the deliberate soliciting of this information from the public; passive crowdsourcing collects relevant information from interactive and open dialogue communication channels.
Data lake	A repository for large volumes of data from different sources and in different formats that can be analyzed using machine learning, data mining or other computer-aided analytics to visualise trends and formulate insights.
Disinformation	Deliberately engineered and disseminated false information with malicious intent or to serve agendas (Wardle and Derakhshan, 2017).
Infodemic	An overabundance of information from online and offline sources that accompanies an epidemic or other health crisis.
Infodemiology	The science of managing and mitigating an infodemic.
Misinformation	False information shared by people who do not realise it is false and do not intend to cause any harm (Wardle and Derakhshan, 2017).
Risk communication	The exchange of information during emergencies to guide people in making informed decisions for the safety of themselves, their families and their communities.
Social listening	The regular and systematic aggregation, filtering and monitoring of conversations and public discourse in a combination of traditional media, digital media, off-line and on-line sources of information that represent different populations and geographies.
Social media	A collection of internet-based applications and technologies that allow the creation and exchange of user-generated content.
Vaccine demand	The dynamic and context-specific actions of individuals and communities to seek, support, and/or advocate for vaccines and immunisation services (Hickler et al., 2017).
Vaccine hesitancy	The context- and vaccine-specific reluctance or refusal to vaccinate despite the availability of vaccines (MacDonald, 2015).

Executive summary

Listening to people's views and concerns about immunisation in broadcast, social media and other forms of communication is an important step in understanding how to encourage more people to be vaccinated. *Finding the Signal through the Noise: A landscape and framework to enhance the effective use of digital social listening for immunisation demand generation* provides an overview of the current state of digital approaches to social listening for immunisation through a combination of desk research, key informant interviews, a review of relevant frameworks, evidence and learning from country experiences. This report builds on models used to understand vaccine demand, especially the Journey to Health and Immunisation, the Vaccine Misinformation Management Field Guide and other behavioural science frameworks that explore the social and contextual determinants of vaccine acceptance. Efforts to manage the overabundance of information during the COVID-19 pandemic have led to an explosion of interest in infodemiology, the science of managing and mitigating an infodemic. However, a review of the literature shows that there is little published evidence of how social listening can impact vaccine intent or uptake. Interviews with over twenty key informants from international organisations, country teams, academics and companies developing social listening tools provide an understanding of the current range of experiences, lessons and gaps for future application and use of social listening for immunisation demand and health service demand more broadly.

“Although much remains to be learned on how to effectively apply social listening to improve immunisation demand, experiences to-date suggest a process and key considerations to translate social listening data into actionable insights based on community sentiment.”

There are many ways to measure people's attitudes to immunisation, from traditional surveys and interviews to more recent electronic tools. Social listening data collection tools range from sophisticated artificial intelligence and machine learning platforms to telephone hot lines, broadcast radio talk shows and documentation of community dialogues. The private sector has demonstrated that there is value in advanced digital data gathering approaches for commercial activities, but these are just recently being explored for use with public health programmes. The combination of online and offline data sources can and should be used to systematically monitor public sentiment and experiences with vaccine services. Use cases highlighting different applications of these data can reveal barriers to immunisation and inform interventions to improve vaccine demand. The five use cases for the application of social listening to immunisation demand follow the steps along the Caregiver's Journey: Knowledge, Awareness and Beliefs, Intent, Point-of-service & Experience of Care, After Service and the Overall Health and Political System. Experiences from four countries provide lessons learned in applying social listening during the COVID-19 pandemic and demonstrate the importance of the local context, capacity and coordination in applying these tools for practical use.

Although much remains to be learned on how to effectively apply social listening to improve immunisation demand, experiences to-date suggest a process and key considerations to translate social listening data into actionable insights based on community sentiment. These are presented in a Process Map to guide and manage the use of social listening approaches for vaccine demand drawing from the lessons and findings of this review. As with any digital tool, developing the human capacity is often more important than technical systems. Social listening insight is only useful if it leads directly to communications and other interventions to improve demand for vaccination. Social listening is not an end in itself—it must be embedded in the wider health system so it can respond to the needs and concerns of the population. Recommendations for a range of stakeholders suggest the path forward to harness approaches to social listening to play a more valuable role in the effective use of public sentiment data and analysis to increase and support demand for immunisation.

Introduction and Background

Strong demand for vaccines by communities is a key component for reaching all individuals with effective vaccination and 'leaving no-one behind with immunisation.' Just as there may be geographic or financial barriers that prevent access to vaccine services, other barriers may prevent people from *wanting* to be vaccinated. These obstacles can only be understood and addressed by listening and understanding people's views, perceptions, concerns and underlying factors in the local cultural and historical context. The goals of Gavi, the Vaccine Alliance, the WHO Information Network for Epidemics (EPI-WIN), UNICEF and the Vaccination Demand Hub all aim to increase the equitable and sustainable coverage of vaccines and recognise the importance of employing new sources and applications of data to help improve vaccine demand.

Individuals and communities that demand vaccines have a positive attitude towards vaccines, positive perceptions about the quality of services available to them and actively seek out and advocate for others to utilise these services (Hickler et al., 2017). The global COVID-19 pandemic has placed a spotlight on the overwhelming amounts of information (both correct and incorrect) shared and spread among social networks (both offline and online) that create confusion, impact vaccine demand and prevent individuals from making sound decisions about disease prevention and vaccinations for themselves and their children. Misinformation and rumours about the purpose of vaccination, safety and adverse events have caused some communities to reject certain vaccines and has increased the prevalence of *vaccine hesitancy*, the reluctance or refusal of vaccines in certain populations or communities. This overabundance of information that accompanies an epidemic or other health crisis is referred to as an *Infodemic*. The science of managing and mitigating an infodemic is called *Infodemiology* (WHO, 2021).

Social listening is the systematic monitoring of public discourse and sentiment as expressed in traditional media, digital media, off-line and on-line sources of information that represent different populations and geographies. The insights drawn from social listening can be used to inform communication and community engagement strategies, policies, service delivery and quality improvement activities with the intention to influence public opinion and improve community demand for immunisation services. Digital tools and computerised approaches can help "find the signal through the noise" by automating the collection of large amounts of social listening data that can be aggregated, visualised and made available for improved immunisation programming in combination with understanding of the local context, history and application of behavioural and social sciences.

The Demand, Community and Gender Team at Gavi, the Vaccine Alliance, in collaboration with UNICEF, the Vaccination Demand Hub and WHO, have prioritised an investigation into innovations that can help countries make sound investments and effectively use social listening data and analytics to increase and support demand for immunisation.

Finding the Signal through the Noise: A landscape and framework to enhance the effective use of digital social listening for immunisation demand generation provides an overview of the current state of digital approaches to social listening for immunisation through a combination of desk research, key informant interviews, a review of relevant frameworks and evidence, and learning from country experiences. These form the basis of a process map for effective engagement and recommendations for a range of key stakeholders.

Demand Generation for Immunisation Frameworks

The body of research and experiences on vaccine acceptance and demand provides a foundation to help understand where and how social listening can be used as part of broader demand generation efforts. Frameworks that incorporate research from psychology and behavioural science, implementation evidence and practical experiences provide insights into the barriers and enabling factors that contribute to effective vaccination, motivators for vaccine uptake, key behaviors associated with vaccine demand and the spectrum of vaccine sentiment (Brewer et al., 2017; Thomson et al., 2016). These frameworks highlight the need for immunisation programmes to focus on key drivers including:

- Trust in people, institutions, and what contributes to local determinants of trust
- Sources of community influence
- The vaccine decision-making process, including social and contextual influences
- Community access to services
- Quality of care, interpersonal communication and client perceptions of the services

Table 1 summarises the key drivers referenced within existing frameworks that can inform the effective use of social listening data for immunisation demand generation. They serve as the foundation for this landscape analysis and shed light on the range of immunisation demand generation use cases for social listening data.

TABLE 1: FOUNDATIONAL FRAMEWORKS FOR EFFECTIVE SOCIAL LISTENING DATA USE FOR DEMAND GENERATION

Title	Key drivers
The Caregiver's Journey	1. Knowledge, awareness and belief 2. Intent 3. Preparation, cost and effort 4. Point of service 5. Experience of care 6. After service All of these steps occur in the context of local community, health system, the media environment, family and individual factors in an iterative cycle. SOURCE: *(UNICEF, 2019) Also see Use Cases section*
The 5 A's **Determinants of vaccine uptake**	The model highlights the five main motivators for vaccine uptake, namely ▪ Access ▪ Affordability ▪ Awareness ▪ Acceptance ▪ Activation SOURCE: *(Thomson et al., 2016)*
Increasing Vaccination Model	The model highlights determinants and contributions that lead to vaccination, including supply and demand side factors. Perceptions, social factors and motivation combine with supply-side practical issues to result in vaccination behaviour. SOURCE: Behavioural and Social Drivers of vaccination (BeSD) Working Group *of the Vaccine Demand Hub and* Brewer et al. (2017)
Spectrum of Intentions Related to Vaccines	Vaccine intentions exist on a continuum of sentiments: anti-vaccine activism, rejection, hesitation, acceptance, demand, and advocacy. Each requires different communication strategies. SOURCE: *COVID-19 vaccines: safety surveillance manual (WHO, 2020, chapter 9)*

Literature and Evidence Review

A rapid review of published literature and project documents provides an overview of the state of evidence and experiences using social listening approaches, many of which are digital, for the collection, aggregation and use of data for immunisation demand and vaccine hesitancy. See Appendix B for details on the methods, criteria and results of the literature and document review.

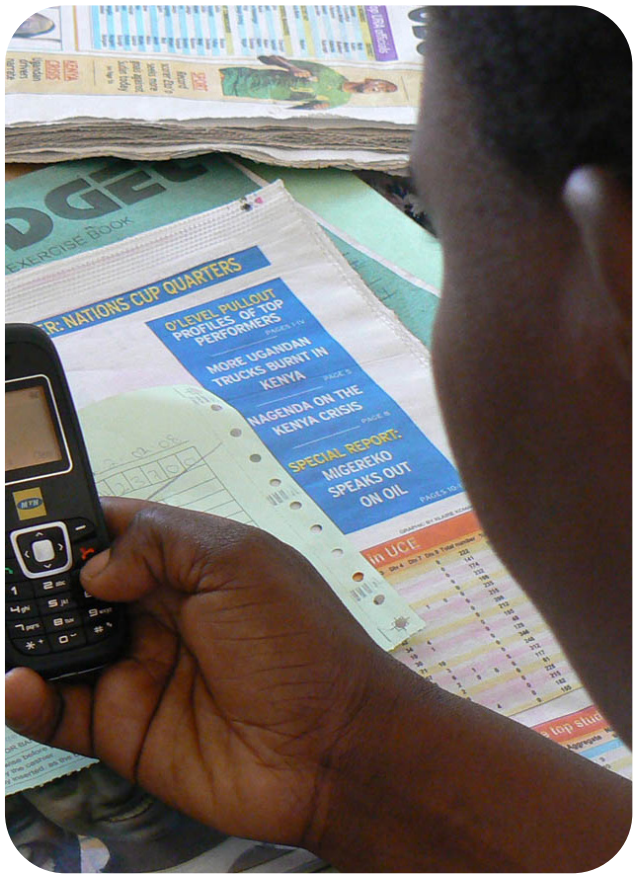
The review uncovered four articles that describe experiences using social listening data and analysis to inform programmatic strategies for demand generation**.** Digital media monitoring was used successfully in Europe to inform vaccine policy development (Bahri et al., 2017). The International Federation of Red Cross documented experiences and community feedback mechanisms established during the Ebola outbreak in West Africa that have been adapted to inform appropriate COVID-19 activities at local-levels including identifying trusted sources of information, cooperation with community leaders to counter misinformation and responding to communities that need handwashing stations (Erlach et al., 2021). A qualitative case study of vaccine advocacy efforts on social media in Australia describes the piecemeal and sporadic use of social listening to inform communication efforts due to lack of funding, time and high-level commitment to engage in a systematic and evidence-based approach (Steffens et al., 2019, 2020). Although many background and guidance documents recommend the systematic use of social listening data to inform immunisation communication strategies and other interventions, evaluations of such systems or reports on experiences and lessons learned are largely missing from the literature (Bahk et al., 2016; Thomson & Watson, 2012; Larson et al., 2016; Larson et al., 2011; Steffens et al., 2020).

Sources of data for social listening

The literature and document review highlights a large body of work describing tools, approaches and sources of information to understand the state of vaccine hesitancy and public opinion about immunisation. Data to inform immunisation demand may originate from digital or offline sources, but regardless of the source, digital technologies make it possible to quickly process and analyse large quantities of social listening data and provide timely and relevant insights that can inform action and response. Social listening encompasses any mechanism or source of information that can provide timely and relevant information on public perceptions about vaccination issues and services (see Table 2). All of these sources of information are part of the wider data ecosystem representing the current state of community willingness and preparation to seek, support and advocate for vaccines.

Social listening approaches may employ techniques to monitor public discussions occurring in open communication channels to better understand current vaccine sentiment and perceptions that influence vaccine demand. Publicly driven dialogue-based communication channels include offline conversations in the community as well as social media and other online discussion platforms. Networks of community volunteers can help collect and report unstructured community concerns and perceptions through established feedback mechanisms to be aggregated, digitised and analysed at a central level, a system that has been used effectively to coordinate

WPP, Group M, & Kantar are companies within the largest global commercial marketing, communications and advertising organisation that contribute research, media content and communication strategies to large for-profit corporations through a variety of media (online, offline, broadcast, word-of-mouth). They are also involved in public health initiatives such as water, sanitation and hygiene behaviour change communications for Unilever in 35 countries, including tools for local non-governmental organisations (NGOs) and governments to implement strategic communications. In partnership with Gavi in India they have engaged in research combining online and offline datasets to detect and analyse vaccine sentiment at 'hyper-local' scale to understand context-specific vaccine hesitancy. Data collection including online surveys, telephone polling and 'feet on the street' interviews contribute to the design of targeted communications, rapid message testing, and follow-up sentiment research and evaluation.



locally-appropriate responses during the Ebola outbreak in West Africa and during the COVID-19 pandemic (Erlach et al., 2021; Sommariva et al., 2021; Baggio et al., 2019). A number of recent initiatives and projects are engaged in systematic and regular collection and aggregation of online digital social media and news content to monitor the state of vaccine hesitancy in the midst of the COVID-19 pandemic and vaccine rollout. Even before the COVID-19 pandemic, there was a steep increase in publications on social media monitoring for vaccine-related content in the past 6 years, with most studies focused on Twitter and other large social media platforms using application programme interfaces provided from the social media company or other proprietary automated data collection tools (Karafillakis et al., 2021). This literature review identified over 130 publications describing data collection tools, research and approaches that focus exclusively on internet-based, social media and other online sources of information to measure public opinion on vaccination issues and concerns. These approaches are often described as 'passive crowdsourcing' since the individuals generating the content are not intentionally engaged in providing insights into vaccine sentiment for the immunisation programme.

Broadcast, expert-driven communication channels such as newspapers (online or print content), radio and television can reflect issues and topics that are important in the community. Radio call-in shows are a rich source of community discussions in many low-resource settings and recent innovations from WHO and UN Global Pulse are able to capture this and other radio content with speech-to-text and machine learning technology, making this untapped source of social listening data available to health programme decision-makers and infodemic managers. Lessons from disease surveillance programmes and recent systematic social listening activities in East and Southern Africa highlight the possibility of incorporating local language print newspaper, radio and television content into digital platforms for aggregation and analysis (Ao et al., 2016; Schwind et al., 2014; Sommariva et al., 2021).

Social listening data for demand generation can be actively collected by the health or immunisation programme through qualitative methods or quantitative surveys specifically designed to gather information on public perceptions, opinions, experiences and other elements that determine vaccine demand. Traditional surveys enable standard comparison of vaccine hesitancy across countries, regions and over time (Larson et al., 2015; Domek et al., 2018; de Figueiredo et al., 2020). Many of the recent efforts to collect data and monitor the state of vaccine

Early AI-supported Response with Social Listening (EARS) is a World Health Organization platform to collect, analyse and share data from online conversations about the COVID-19 pandemic. Data from open digital and social media content is collected and analyzed using automated approaches to reveal insights and analysis on emerging narratives at the country level. Although it is currently focused on COVID-19 virus and vaccine content it is flexible enough to search for expanded topics to cover routine immunisation in the future. The platform integrates structured and unstructured data and has the ability to incorporate offline content if reports from broadcast media or community feedback, for example, are entered into a digital format. Access the platform here.

hesitancy compile country-level results for global comparison (de Figueiredo et al., 2020; Larson et al., 2016). Published examples of sub-national analysis and approaches are largely missing but will be important for targeted engagement and implementation in high-need geographic or socio-economic pockets of vaccine hesitancy (Larson et al., 2013). Rapid surveys and opinion polls can be administered remotely through phone calls, mobile phone interfaces and on social media platforms. Among these tools, UNICEF is leading the Internet of Good Things (IoGT) initiative, a collection of mobile-ready content including COVID-19 vaccine sentiment surveys in collaboration with healthcare workers and Ministries of Health. Immunisation content is among the most accessed topics on IoGT in countries like Kenya where compatibility with basic mobile technology, low connectivity and partnerships with mobile network providers make the informational and interactive content available to a wide range of users.

Routine health system data from immunisation programme activities such as coverage and drop-out rates may also support understanding of the underlying context and barriers to vaccine demand. Information on reasons for non-vaccination during immunisation campaign activities and other established surveillance and reporting systems can provide complementary data on barriers and challenges for vaccine demand (Taylor & Shimp, 2010; Waisbord et al., 2010).

Digital technologies for aggregation and analysis

Some social listening data that can inform vaccine demand are collected with the aid of digital technologies or automated search engines as with monitoring social media content. Other data sources can be transcribed into digital formats to be included in a 'data lake' or repository of large quantities of data (e.g. print newspaper content, radio or TV broadcasts, focus group research).

Digital technology can be leveraged to conduct automated analyses on large and mixed data sets, adding the power of computer analytics, machine learning, automated sentiment analysis, aggregation and visualization that would not be possible without these computer technologies. Social listening data may be aggregated and visualised in a web-based dashboard or in regular reports showing trends in key indicators, themes or topics. Automated sentiment analysis using artificial intelligence and machine learning is becoming more adept at labelling content as positive, negative or neutral (Karafillakis et al., 2021; Du et al, 2017; Müller & Salathé, 2019). Modelling approaches can be applied to some data to predict trends of vaccine confidence levels (de Figueiredo et al., 2020). Risk communication teams, social scientists and people with an understanding of the local context can use these computer-generated insights to uncover the underlying reasons for an individual's vaccine hesitancy or barriers to vaccine demand in a community of interest. These insights can then be used to inform interventions to increase vaccine demand, discussed in more detail in the Use Cases below.

Social listening is a time- and resource-intensive process; even with advanced computer analytics to aid in collection and initial analysis, human effort is required to screen content and make decisions about aggregated data that may be presented weekly or even daily, depending on the sources of data. One study reported that their media monitoring approach required approximately one-half of a full-time equivalent per month (divided between two people) for the content screening and qualitative analysis, a time-consuming approach with a high level of effort

Quilt.AI uses artificial intelligence to convert big data into human insights. Through analysis of public internet content, 'the largest focus group discussion', they help create audience profiles for improved programme design. With projects in 72 countries and the ability to work in 250 languages, their cultural intelligence models help understand patterns in people's behaviours and attitudes with a strong focus on applying behavioural science to nudge behaviour change. In the area of climate change, for example, they identify successful communication messages to inform future campaigns, and have done similar work on sexual and reproductive health, gender equality and mental health. A number of recent projects focus on identifying the motivations and narratives of anti-vaccine sentiment to suggest effective communication techniques to counter rumours and misinformation. The focus is online data use, making their approach most relevant for populations with high levels of internet access and use, though they have also worked in more internet-challenged environments.

by staff trained in qualitative research methods (Bahri et al., 2017). Many of the key informants interviewed for this report indicated the high level of human effort required to systematically and regularly monitor and incorporate social listening data into immunisation programming.

Selecting an appropriate mix of data sources

The selection of appropriate data sources to inform demand generation activities depends on available resources and the questions that need to be answered. Most importantly, the sources of data available in the data ecosystem will have an impact on what information can be detected. Social listening data sources vary in volume of data and frequency of collection but also in sensitivity and the ability to detect relevant information, and to allow disaggregation to specific populations. A knowledge, attitudes, practices (KAP) survey may provide quantifiable and targeted information on vaccine sentiment, but only on the topics and the questions included in the survey - "What we see depends mainly on what we look for", as John Lubbock has said.

Social media monitoring, on the other hand, can detect new public concerns and information gaps, misconceptions and rumours that may indicate a rapidly evolving public conversation, especially during emergencies and infodemics. The most vulnerable populations are not likely to be active on social media and other online forums—information from relevant and preferred communication channels for the target population must be considered in order for their voices to be heard. Each source of information has benefits and drawbacks and can work together to complement each other to create a more holistic picture of the elements of vaccine demand in the area or community of interest. Social listening efforts should be linked with other monitoring activities and routine data to understand the broad picture and suggest new opportunities for improving demand. Data on the distribution of health workers, for example, can help explain client reports of long wait times and suggest an opportunity to improve demand by assigning the right people to the right places. It is important that no single source of data dominates or drowns out the others as they each offer different perspectives, and their use together is more powerful than any one alone.

Premise, a for-profit company, provides clients with real-time data collected by a network of 2.3 million smart phone users in 109 countries, a form of crowdsourcing. The 'contributors' are paid a rate for the data they submit, a form of 'gig economy' work. There are different data collection types: surveys for contributors to answer themselves; interviews for contributors with more training to interview others; location and monitoring when contributors travel to specific places to geolocate and assess them (e.g. mapping health facilities). These tools can support social accountability by monitoring quality of services and customer experience in location-based surveys and data on vaccine sentiment and other public opinions through rapid surveys and polls. Premise has worked with Gavi in nine countries since October 2020 to implement surveys exploring social and behavioural factors of demand generation for immunisation, including how COVID-19 disrupted routine immunisation. Premise has also worked with the Vaccine Confidence Project of the London School of Hygiene and Tropical Medicine on mapping vaccine misinformation. The Cabinet Office in the UK has used Premise's platform as a social listening tool to track the spread of misinformation across siloed social networks (personal communication, key informant interview). They have carried out an internal project tracking changes in vaccine sentiment through surveys in 56 countries since September 2020. Since their tools do not rely on collecting open public social media content but on individual experiences and conversations, their platform has the ability to detect topics that are otherwise only found in private communication spaces online (closed WhatsApp conversations or closed social media groups) or face-to-face conversations.

TABLE 2: DATA SOURCES FOR SOCIAL LISTENING

Communication channels and public exchange of information

These sources generate information from outside of the health system and are systematically monitored to collect historic trends and traffic (passive listening)

Interactive and open data sources	Broadcast, expert-driven data sources
▪ Social media (Twitter, Facebook, blogs, forums, comments, Search terms e.g. Google Trends) ▪ Community sentinel reporting of in-person/offline dialogue through social mobilisers, community leaders ▪ Radio call-in shows	▪ Print newspapers ▪ Radio and television ▪ Digital news ▪ Blogs ▪ Inter-active radio (e.g. Africa's Voice, Red Cross Red Crescent, Radio Ergo)

Active data collection by the health or immunisation programme

Qualitative, sources of unstructured data	Quantitative, sources of structured data
▪ Focus groups ▪ Observation ▪ Interviews with users and caregivers	▪ Rapid polling and surveys—remote data collection (via mobile device, smart phone or phone calls) ▪ Active crowdsourcing, client experience & satisfaction ▪ Chatbots, phone hotlines, interactive SMS or voice-response systems ▪ Rapid surveys ▪ Structured survey (KAP or other)

Health system generated data

Information captured as part of routine programme implementation and monitoring that can be useful for understanding the context and determinants of immunisation behaviours

- Immunisation campaign information and routine surveillance systems that record reasons for non-vaccination
- Immunisation coverage and drop-out rates
- Socio-economic data and other equity measures
- Routine health service data that can inform measures of quality of care, service delivery, human resource and logistics management

The WHO Information Network for Epidemics (EPI-WIN) has produced weekly infodemic intelligence reports since March 2020 in response to the COVID-19 infodemic. The regular analysis of digital media data allows health managers to identify, categorise and understand key concerns expressed in online conversations and other trends and situations in the pandemic. EPI-WIN's approach focuses on infodemic signal detection—identifying or predicting rising areas of concern and information voids in the online information ecosystem to provide immediately actionable intelligence for decision-making and risk communication, to complement rumour tracking activities and provide the "right health information, at the right time, in the right format". From March 2020 to March 2021, almost 1.2 billion digital conversations were analysed for the EPI-WIN reports (for an example of a report, see link here).

Immunisation Demand Generation Use Cases

Social listening is used successfully in commercial marketing to identify the desires of clients, to design goods and services that fulfil those desires and to develop messaging that generates demand for products (Nowak et al., 2015). Social listening can be used to understand how people think and feel about vaccination, suggest the best ways to influence public perceptions and encourage more supportive social processes, all to improve the motivation to be vaccinated (Nowak et al., 2015). The systematic monitoring of public discussion and perceptions about vaccines and immunisation services can help programme managers position and promote vaccines in ways that will meet client's needs and help overcome context-specific challenges to vaccine uptake.

Systematic approaches to collect, aggregate, filter and analyse social listening data can shed light on public opinion and issues that correspond to different aspects of the complex social and environmental determinants that influence immunisation behaviours. The Journey to Health and Immunisation (shown in the box below) provides a framework to understand the interwoven connections between supply, demand, service delivery, environmental and social determinants of a caregiver or individual's behaviour to help identify potential barriers at each point along the journey. This model is relevant for caregivers of children and vaccinations intended for adults, as with COVID-19 immunisation. The five use cases presented here correspond to steps in the Journey to Health and Immunisation to highlight how social listening can help immunisation programme managers understand the range of motivations, perceptions and challenges that impact decision-making and access to immunisation services at different stages of the journey.

Effective, affordable and equitable social listening approaches monitor public conversations from a variety of information sources to represent themes and issues in different populations. Depending on the priorities for the immunisation programme, one or more use case may be targeted to help inform locally relevant interventions. Because of the complexity of immunisation behaviours and the social environment, no single source of information on public opinion will give a complete picture on any single step in the Journey to Health and Immunisation. Likewise, one source of social listening data may provide insights into more than one of the use cases described below. An appropriate and representative combination of data will depend on which barriers are most critical to vaccine demand in a particular time and place and the capacity and resources that programme managers have for integrating and analysing social listening data.

The Journey to Health and Immunisation

A guide to understanding the layers of influence on immunisation decision-making and behaviors (from UNICEF Human Centered Design 4 Health)

1. Knowledge, awareness & belief

Caregivers: Have practical knowledge, understand the value of vaccination, perceive vaccination positively, perceive vaccination as a priority, do not fear side effects, trust vaccines, trust providers, trust Governing entities

Providers/health workers: Have practical competencies, have positive norms and values towards immunisation, have a positive perception of clients

2. Intent

Caregivers: Intend to vaccinate their children, report vaccination as a social norm in their community

Providers/health workers: Are motivated by the work

3. Preparation, cost and effort

Caregivers: Make a plan to access the service, take the time and effort to access the service

Providers/health workers: Make a plan to get to the vaccination site

4. Point of service

Caregivers: Find the services to be available, appropriate, convenient and of adequate technical quality

Providers/health workers: Receive adequate training, job aids and non-threatening supportive supervision, are satisfied with the workload and the facility flow, involve communities in the development of microplans

5. Experience of care

Caregivers: Perceive the experience positively

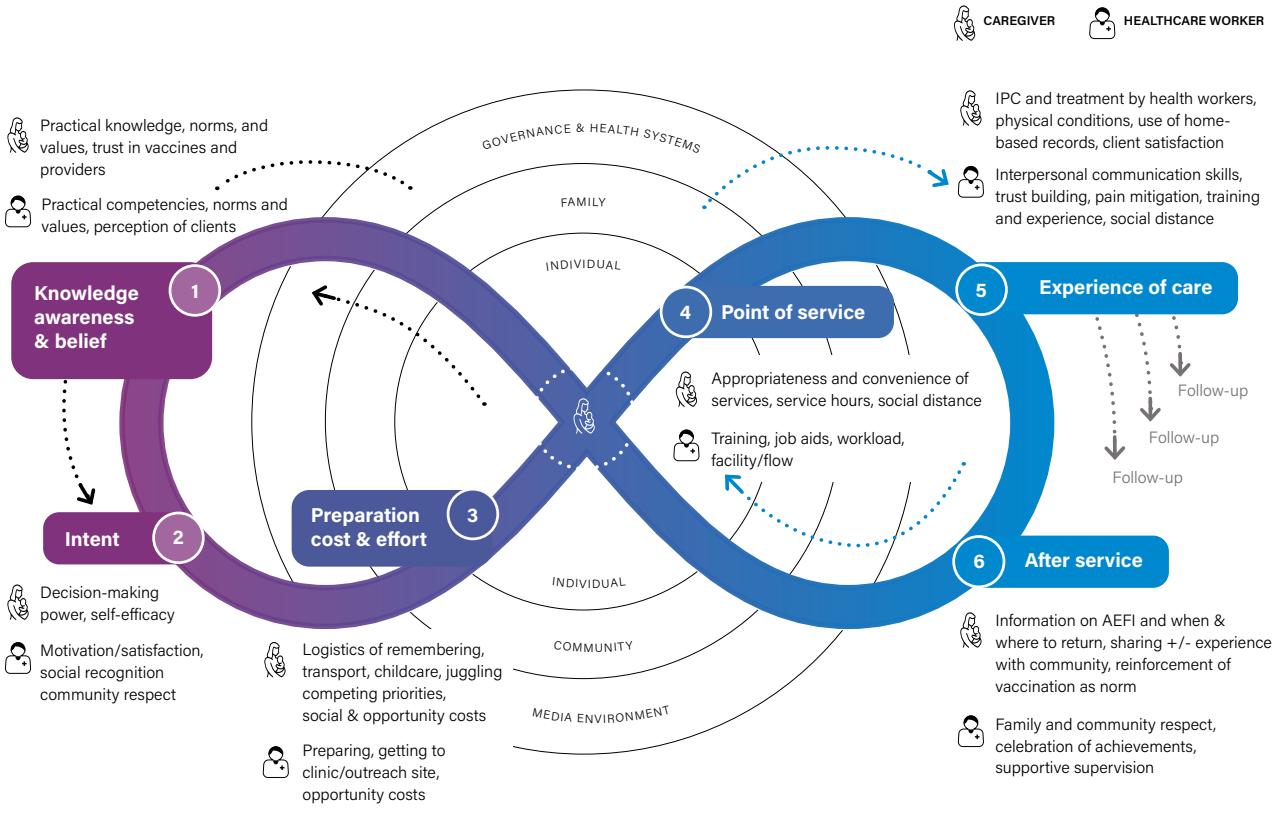
Providers/health workers: Feel technically confident to provide a positive client experience, have an appropriate profile

6. After service

Caregivers: Have enough information and motivation to come back for the next visit, to report AEFI, share their positive experience with their community, reinforce vaccination as a social norm, are able to provide their feedback on the vaccination service

Providers/health workers: Obtain family and community respect, prompt caregivers to come to the next session, inform caregivers about possible AEFI, how to manage them and when and how to report them

FIG 1: THE JOURNEY TO HEALTH AND IMMUNISATION



Trust, influence, gender and equity: a social listening lens for all use cases

A common factor in vaccine confidence is trust: how communities perceive the institutions or individuals that provide vaccination services as empathetic, honest and technically competent (Larson et al, 2011).

Trust is so important in how people interpret and internalise information that the level of trust in the source of information is often more important than the message that is conveyed. Understanding what drives and creates trust in vaccines is as important as learning the trusted sources of information about health and vaccines in the target populations. Every possible use of social listening to inform demand generation requires simultaneous research into the locally relevant determinates of trust to help inform appropriate and effective interventions intended to address barriers. Exploring and partnering with networks of community influencers and trusted communication channels will help determine the best means of delivering and promoting demand generation activities.

Another key consideration for all uses of social listening is to determine which approach and combination of data sources best captures the concerns of the relevant population. For example, many of the recently developed tools obtain data from online communications (e.g. Facebook, Twitter, Google searches). Research is needed in each country to understand if the users of such digital services are representative of the zero-dose and under-vaccinated population. If the people intended to be reached with interventions and service improvements do not have access to any digital technology, even the most sophisticated AI-based social media analytics will be irrelevant. Literacy and gender play an important role in the digital divide and must be carefully considered when designing and conducting equitable social listening activities.

Issues and concerns about vaccination, the underlying reasons for hesitancy and equitable sources of data on vaccine sentiment are not uniform across any country or population—research into the local factors of trust and equity is essential to find effective solutions to increasing vaccination uptake.

In the context of the global COVID-19 pandemic many social listening activities for immunisation focus on monitoring the rapid outbreak of misinformation, disinformation and rumours. Most of the guidance, lessons and country experiences explored for this review have focused on the application of social listening to inform strategic communications to improve '*Knowledge, awareness & belief*' as well as targeting the social and behavioural determinants that lead to '*Intent*'. However, social listening can and should also be used to understand barriers to immunisation at subsequent steps of the Journey to Health and Immunisation as described in the other use cases below.

Investment in the data collection tools, capacity and structures necessary to monitor and analyse the spread of misinformation and disinformation will position immunisation programmes to apply these same approaches to other use cases. These include long-term monitoring of public discourse and the sustainable use of social listening approaches to identify and monitor the underlying reasons for non-uptake of immunisation services, suggest new ways to reach zero-dose and under-immunised communities and advocate for improvements in service delivery, policies and sustained engagement with the community. While much of the focus in 2021 is on COVID-19 and Covid vaccine roll-out, these tools and techniques are also relevant to generating demand for routine immunisation.

Knowledge, awareness & belief

The first step in a successful journey to immunisation is for the individual or caregiver to know that the service exists, who should receive vaccination, when to present for vaccination and how to access these services.

A structured survey intended to measure knowledge and attitudes can provide answers about information gaps in groups or priority communities. Social listening by monitoring open dialogue channels such as social media or online discussions can be more complex but give rapid feedback—misconceptions or misinformation about vaccines or services can suggest topic areas that need immediate attention and strategic communications. Other approaches may monitor trends and web traffic for reliable or popular sources of information on the internet or common questions asked through hotlines or chatbots.

In Kenya an interactive community radio programme combined live call-in question and answer shows with an SMS-hotline to understand the community's knowledge, attitudes and practices related to the COVID-19 outbreak and to respond quickly through the same channels to fill the identified information gaps and misconceptions (Kioi, 2020).

Many studies have demonstrated that factual knowledge about immunisation is rarely sufficient to create direct

Social listening for understanding Knowledge, awareness & belief can help identify gaps in information related to how to access immunisation services as well as facts about the purpose, benefit and value of immunisation for different populations.

How can it improve immunisation demand? Insights can inform public health communication campaigns to engage the public with clear messages on the reasons for immunisation, how to access immunisation services and increase understanding of the benefit, risks and value of immunisation—targeted to general population and also to specific sub-populations that are identified with particular gaps in knowledge and awareness.

Key considerations: Knowledge on its own is rarely enough to change people's behaviour; other barriers to vaccination likely exist and should be addressed in parallel.

Limitations: Analysis of data on knowledge, awareness and beliefs is only relevant for those communities and populations include in the sample, whether from social media monitoring, dedicated surveys or other data sources; the information may not represent marginalised communities, low-income households or other target population groups. Identifying what information is missing will not tell you how best to reach the population or which messages or approaches will result in effective behaviour change. These insights must come from research into other local determinants of vaccination behaviour and experience in risk communications and behaviour change communications.

Example tools, projects & experiences: Implementers highlight the importance of preventing an information vacuum—in the absence of good factual information about vaccines the public will fill the void with their best guess or rumours. Immunisation communications teams should flood the field with good information from multiple angles through a variety of communication channels to ensure that quality messages are repeated, consistent and widespread.

behaviour change, but knowing how, when and where to access services is an essential component of promoting demand in communities (Taylor & Shimp, 2010; UNICEF, 2018; Brewer et al., 2017; Favin et al., 2012). The complex relationship between knowledge, intention and action includes other social determinants that contribute to an individual's choice. So, although social listening activities can help identify the gaps and needs for targeted communications about why, where and how to access immunisation services, the strategies for addressing these needs in the community should be coordinated with and implemented in concert with strategies to address other barriers that likely exist alongside any knowledge gaps. Often the most important barrier to realising improvements in health behaviours is the gap between knowledge and practice, which in the case of immunisation demand may require interventions that target practical barriers such as reminders, nudges or incentives that fall outside of the education and communication domain. In parallel, learning about trusted sources of information, key influencers in the community and power dynamics in decision-making (see Trust, influence, gender and equity text box) will make the resulting interventions to increase knowledge and awareness about vaccination more effective.

The insights from sustained social listening activities can inform strategic communications to guide the public to available immunisation services. No matter where individuals fall on the spectrum of vaccine sentiment, everyone should receive factual and practical information about where and how to access services through trusted channels of communication.

Social listening activities can help identify knowledge gaps for targeted communication, but the strategies for addressing knowledge in the community must be conducted in concert with strategies to address other barriers to vaccination that likely exist alongside any knowledge gaps.

Intent

An individual's attitudes, perceptions and surrounding social norms about vaccination play an important role in their motivation to seek out and use immunisation services for themselves or their children. It is within this domain that the circulation of rumours, misinformation and disinformation has significant impact and can create barriers along the journey to immunisation. The COVID-19 pandemic has highlighted the problems that can arise from an overabundance of information, or *infodemic*, with recent interest and discussion about tools and approaches to increase vaccine acceptance and uptake while addressing valid concerns and containing the spread of misinformation and disinformation about vaccines. Efforts to listen to and understand public sentiment can help target communications and plan immunisation programme activities more effectively.

Vaccine sentiment exists along a spectrum of intentions, ranging from the small group of people who adamantly reject vaccines, to those with some vaccine hesitancy, to people who actively demand immunisation, and even people who act as advocates and champions for vaccination in their communities. In the centre of this spectrum are the majority of the population who are either accepting of vaccinations or have some reservations and legitimate concerns that make them hesitant to receive

Social listening for understanding Intent can identify current themes and issues related to immunisation in public discussion, including rumours or misleading information that can have a negative impact on immunisation demand.

How can it improve immunisation demand? Provides actionable information that can inform strategic communications initiatives to minimise, contain, and/or reverse the effects of misinformation / disinformation created and spread by vaccine rejectors, skeptics or hesitant groups in the community. It can also identify areas of concern unrelated to misinformation (e.g. efficacy and side effects) to understand what topics public health communications should target.

Key considerations: For this area in particular, the way people respond to questions about perceptions and attitudes may be different from how they actually think. Therefore, social listening data sources that monitor public open dialogue may be more appropriate for observing how people actually communicate and the issues they discuss with their family and friends, rather than how they might respond to survey questions in an artificial setting (where respondents frequently say what they believe the interviewer wants to hear, satisficing).

Limitations: Digital social media monitoring is becoming easier and more affordable with many new tools to track online dialogue, rumours and misinformation spread. However, the conversations represented in these communication channels do not always reflect the opinions and voices of groups most in need of immunisation services. The repeated forwarding / reposting of some content that bounces around an "echo chamber" may give disproportionate attention to voices of a small minority who influence very few others.

> **“Systematic social listening activities to understand and monitor public sentiment about vaccines can be very useful for understanding the specific concerns of the movable middle. They may be receiving misinformation or have concerns about safety and efficacy influenced by local and global dialogue.”**

or present their child to receive a vaccine. This group of vaccine hesitant individuals has been called "*the movable middle*"—those who can likely be nudged along the curve to become vaccine acceptors. In the absence of any action, the repeated exposure to false and misleading information about vaccines can nudge this group in the other direction to become vaccine rejectors. Communications efforts should be focused on this movable middle to most effectively increase demand for immunisation.

Systematic social listening activities to understand and monitor public sentiment about vaccines can be very useful for understanding the specific concerns of the *movable middle*. They may be receiving misinformation or have concerns about safety and efficacy influenced by local and global dialogue. Social listening activities can monitor and detect topics being discussed in the public sphere and use the aggregation and analysis of this information to take action to correct, contain and minimise the spread and negative effects of harmful misinformation, disinformation and hoaxes. Strategic communications that systematically address current and specific public concerns and engage the movable middle with empathy, honesty and openness has great potential to increase positive perceptions of the institutions and programmes delivering vaccine services and influence the public's intent to receive vaccinations.

Experiences explored for this review focus mainly on strategic communications as an immediate response to the spread of misinformation and disinformation during the COVID-19 vaccine development and rollout. Established risk communication strategies and evidence-based approaches are being applied to the unique and rapidly evolving infodemic surrounding the new COVID-19 vaccines in the social media age. The objective of social listening activities and the infodemic situation in the local context will dictate the focus of communications and behavioural interventions, whether to increase trust and encourage *the movable middle* to accept vaccination or to mitigate and prevent the spread of harmful disinformation and rumours. These practices that target *what people think and feel* make up one component of vaccine demand. The WHO's new Infodemic Management Training programme is building the skills and providing the tools to a cohort of specialists who can begin to make the leap from raw data to the analysis of social listening insights for action and implementation of risk communications.

Point of service & Experience of care

Satisfaction with immunisation services and perceptions of the quality of care received are determined by a client's interaction with the health system, including interpersonal communication, professionalism and competency as well as the facility's readiness to provide quality vaccination services in a timely and reliable manner. These factors all play a role in the client's willingness and motivation to seek out vaccine services. Social listening activities can help understand client perceptions and user experiences to inform targeted quality and service delivery improvements. Routine data collection and surveillance systems may also provide insights on opportunities for immunisation during other health service encounters, an effective strategy for reaching zero-dose and under-immunised children.

Mobile technology used to promote transparency, accountability and public participation by actively engaging citizens in reporting on health system performance are a potential source of data on client satisfaction with vaccine service delivery (Holeman et al., 2016; Schaaf et al, 2018). These and other platforms and tools for remote data collection and crowdsourcing (e.g. Premise, Kantar) have the potential to gather real-time client experiences and feedback for social accountability; reports may also be gathered through face-to-face exit interviews, SMS surveys or call-centre data (Lechat et al., 2019). The client's experience interacting with health workers is crucial to promote demand for services: "*the quality of the interaction between health workers and caregivers is a key factor in ensuring completion of the vaccination schedule*" (UNICEF, 2017).

Clusters of negative client experience reports may indicate a need for more outreach activities, quality improvements, supportive supervision, facility maintenance or supply chain management to improve service delivery and the client's experience and perceptions about the institutions and people providing immunisation services. Triangulation with other data sources such as immunisation coverage rates and socio-economic status can suggest underlying reasons why people are not utilising services. Engagement with community influencers and trusted sources of information can guide the meaningful engagement and partnership between communities and the local immunisation programme.

Social listening for understanding Point of Service & Experience of care can provide insights into client experiences and satisfaction with immunisation services.

How can it improve immunisation demand? Client experience, perceptions and complaints can help identify service delivery units or health workers in need of supportive supervision and training, supply chain improvements or facility maintenance to address quality of care. Taking action to improve services based on feedback can also generate demand. After changes have been made based on info collected through listening activities, informing the patients or other feedback providers about the changes made ("closing the feedback loop") can build approval and trust by people seeing that their feedback was considered and acted upon.

Key considerations: Unprompted discussion about details and experiences of being vaccinated may not surface with enough regularity in public open dialogue (e.g. social media), making active data collection tools such as surveys, polling, observation and interviews a more reliable source of information on client service experiences. Remote data collection tools can be employed to ask for confidential client feedback with demographic and location information. The health system has direct contact with clients at this stage, and so direct targeted communications are appropriate - phone calls, SMS platforms, smartphone or online survey tools can be tailored depending on client access to technology.

Limitations: No matter what format or platform is used to solicit client feedback, regular data from a representative sample of clients may be difficult to attain. Successful citizen engagement is built on a foundation of trust and meaningful partnership between the community and the immunisation programme – remote data collection of client satisfaction can provide a tool to support this partnership. Clients submitting their views directly to the health system could discourage honest criticism, especially in situations where there are low levels of trust in the health system.

After Service

Rumours and misunderstanding of the after-effects and safety of vaccination can fuel vaccine hesitancy and discourage people from utilising services. An immunisation programme's response to adverse events following immunisation (AEFI) plays an important role in how the community perceives vaccine safety. A system to monitor vaccine safety is an essential component of immunisation programmes but cannot function without reliable reporting mechanisms and honest communication with the target population about potential risks and side-effects. Social listening approaches have the potential to provide real-time feedback, encourage community reporting on post-vaccination experiences and improve the relationship and communication between the community and the immunisation programme.

Systems to solicit remote post-vaccination feedback, such as SMS contact, phone calls or more sophisticated smart phone or internet surveys can improve the rate of AEFI reporting and provide the health system more opportunity to respond appropriately to side effects and adverse events (Cashman et al., 2017; Tsafack & Ateudjieu, 2015). A system for active surveillance of acute flaccid paralysis using community informants and mobile phones has been successfully deployed in high-risk areas for polio transmission, demonstrating another potential approach that could be adapted or could incorporate post-vaccination event reporting in the same platform (Ticha et al., 2020). These reporting systems must be supported by coordinated response mechanisms and the capacity to investigate and respond rapidly and effectively in order to maintain trust, respect and vaccine confidence in the community. Although this is an underexplored area in LMIC settings to-date, the use of social listening approaches for AEFI reporting has the potential to facilitate rapid response and maintain good relations and trust within the community.

Social listening for understanding After Service can help identify and track adverse events following immunisation.

How can it improve immunisation demand? Provide actionable information on potential safety concerns for rapid and appropriate response and follow-up to help maintain public confidence and trust in vaccines and the immunisation programme.

Key considerations: Social listening activities can only provide a source of information—the coordinated and rapid response to reports of vaccine side-effects requires an established system with trained case investigators and protocols to respond systematically and appropriately.

Limitations: Eliciting responses from a representative and equitable sample of clients is a challenge—investigate data collection options that are appropriate for the target community.

Health & Political System

The Journey to Health and Immunisation framework recognises the underlying influence of the social and political environment as the context and foundation where individual's vaccination behaviours take place. Information from social listening can help understand barriers to service access and vaccine uptake that stem from the organisation of the health system or the influences of the political environment to demonstrate areas of unmet need for targeted improvements in policies and systems management.

As an example, real-time monitoring of global online discussions about the human papillomavirus vaccine was used to inform a policy and safety review by the European Medicines Agency (Bahri et al., 2017). The collection and analysis of global online news and blog content informed the development of questions that summarised the concerns, information gaps, needs and expectations of the public. These questions were used to create the official policy statement and to prepare responses to journalist questions throughout the regulatory review process. The study shows the ability of social listening to guide talking points and policy development to accurately reflect and respond to current public concerns (Bahri et al., 2017).

Although this area is underutilised to-date, there is potential for social listening in LMIC settings to monitor locally-appropriate data sources to inform policy development that responds to the needs and concerns of the public. Systematic approaches to social listening could also identify gaps in service delivery, coverage and equity that can help advocate to decision-makers for improvements in identified areas of concern.

Social listening for understanding Health and Political System can help identify factors in the underlying health system, policies or wider political environment that help or hinder immunisation service uptake. It can also be used to inform policy development and advocate for systemic improvements.

How can it improve immunisation demand? Suggest solutions in the systems and management of immunisation services and supportive policy development in a way that can remove barriers to immunisation and advocate to government decision-makers about the need for systemic improvements.

Key considerations: This area draws from all of the other use cases for social listening in a way that can inform the enablers for immunisation demand generation.

Responsible data use

Monitoring social media content as a way to understand public sentiment, concerns and conversations presents data security and privacy issues as well as the ethics of monitoring public speech. Even with appropriate anonymisation of content, vaccine sentiment data gathered from social media websites can be linked to locations and identities. Accountability systems and technology privacy policies are not keeping pace with new uses of people's data, including the passive monitoring or data scraping of public social media content for social listening. This secondary use of people's data may technically fall within legal bounds but still presents the question of ethics when users are not fully aware of what is happening to their data. Just because data on social media is easily accessible doesn't make the use of that data ethical.

Someone posting a comment on a public Facebook page is probably not aware that their comment could become part of a dataset on vaccine sentiment even though they may have "agreed" to the company's privacy policy. Who has ownership over content posted in social media, what the users think it is being used for and how it is actually used are not clearly understood by most users. Closed social media groups like private WhatsApp or Facebook groups give the community an illusion of privacy but are easily monitored by outsiders with intentions other than sincere participation in the discussion. There are no standards, ethics or codes of conduct for engaging in public or private social media monitoring and very few research projects using social media content as a source of data ask for consent from the online community or from ethical review boards (Gustafson & Woodworth, 2014).

The recent explosion in internet-based social media has left many privacy and ethics issues unanswered. Countries need to establish supportive policies that address these issues, including:

- Ensuring the privacy and security of data collected from online platforms
- Consent from 'passive' data collection participants
- Clear boundaries and disclosure to users on the intent and applications of data gathered from virtual communities and platforms.

Guidance on responsible data use can be found in Considerations for using data responsibly at USAID, WHO's Guidelines on Ethical Issues in Public Health Surveillance and UN Global Pulse Risks, Harms and Benefits Assessment Tool for data innovation projects.

Country Experiences

The following four case studies provide examples of different country experiences in harnessing aspects of social listening data and analysis to engage effective actions to improve vaccine acceptance.

The field of vaccine demand generation, understanding the determinants of vaccine decision-making and best practices to improve and maintain vaccine coverage is still growing and developing. The COVID-19 pandemic has pushed the contribution of public perceptions, thoughts and feelings about vaccines to the forefront as countries struggle to manage rumours and misinformation in the age of social media and digital news. The pandemic has spurred a flurry of discussion and development of tools and strategies for understanding public attitudes towards vaccines, government policies and infection control measures. The global nature of the pandemic means that nearly every country is participating in a massive experiment on how to manage misinformation and vaccine hesitancy at different scales and with varying levels of transparency and success.

Although some countries with a history of monitoring politically motivated public speech are well-prepared to assess and influence vaccine sentiment and rumours related to vaccines, these approaches are not transparent and do not take into consideration individuals' data privacy and security. Other countries are overwhelmed or do not have access to reliable data on the infodemic and base their programme demand generation activities on best-guesses or gut feelings. No country is currently implementing an effective comprehensive approach to vaccine demand using social listening.

The following four case studies provide examples of different country experiences in harnessing aspects of social listening data and analysis to engage effective actions to improve vaccine acceptance. Indonesia is building on past experiences of negative rumours that contributed to vaccine refusal with a strong civil society leading digital and community engagement. Pakistan is addressing vaccine hesitancy with an established network of community influencers to coordinate misinformation management with both online and offline channels. South Africa has formed a strong multi-sectoral collaboration of implementing agencies, civil society and NGOs to coordinate risk communication strategies for boosting COVID-19 vaccine acceptance. The Vaccine Demand Observatory is providing significant capacity building with Burkina Faso and other West African countries to better manage the infodemic using evidence-based tools. Each of these examples offer insights and lessons for the evolving knowledge base and best practices for monitoring and addressing vaccine demand using social listening data.

Considerations for Countries

In many countries, social listening is recognised as an important tool but is not an immediate priority for overworked communications staff, especially in Ministries or Departments of Health. Among several of the country-level stakeholders we interviewed during the COVID-19 pandemic, there was agreement that listening to popular perceptions about vaccines was necessary to increase vaccine acceptance. However, most MOHs in LMICs have less than 10 people on their health communications teams and limited capacity to take on additional activities related to data collection and analysis via social listening. During the COVID-19 pandemic, many country Risk Communications and Community Engagement (RCCE) teams have formed collaborations with international organisations, NGOs, research bodies, media and community organisations.

All country representatives who were interviewed acknowledged the importance of the field of Infodemiology, including debunking misinformation and disinformation. However, the process of deciding the focus of communications efforts continues largely as usual with guidance from the Minister of Health and other officials, responding to media stories, monitoring what is being said on the MOH's social media pages as well as the personal experience and impressions of the communication professionals themselves. Where new sources of information are available, they are welcome and used, such as regional and country-level social media listening reports from Talkwalker in Eastern and Southern Africa, or national, regional, and/or global collaborations with Google or Facebook. It is unlikely that most Gavi focus countries and other LMICs are prepared to develop social listening systems themselves and will have little interest or time to compare the relative merits of different listening approaches (large-scale panel surveys, social media listening, AI-powered internet analysis) or the various companies providing these services.

Since the first quarter of 2021, UNICEF has been working with the Public Goods Project and other partners to develop a customizable platform that can be made available to partner countries based on the experiences of a similar platform used by over 400 public health departments in the United States. The system will combine data from numerous sources, both online and offline, structured and non-structured. Capacity building is underway in pilot countries for programme teams targeting the spread of vaccine misinformation and disinformation. This platform and support for in-country capacity strengthening and systems development will be an important step towards increasing the ability of national MOHs to take advantage of social listening to inform more effective demand generation activities.

Indonesia

Indonesia, a country with a large and diverse population, is no stranger to the negative effects that misinformation can have on vaccine uptake. In 2018 the national measles-rubella vaccine campaign was severely impacted by wide circulation of negative rumours and religious backlash against the vaccine (Rochmyaningsih, 2018). Decentralisation and a polarised political atmosphere have contributed to uncoordinated vaccine communication from national, regional, and local government bodies, but the country benefits from a strong sense of community engagement, participation and solidarity that fosters an environment where grassroots and civil society organisations create opportunities for multi-sectoral collaboration to counter vaccine-related misinformation (Astuti, 2020).

Trusted civil society organisations in Indonesia have a strong foundation of monitoring and engaging with public conversations as part of the country's history of hoaxes and misinformation. An independent fact-checking grassroots organisation, Mafindo, has been monitoring and countering misinformation since 2016. They are now an integral part of the national government collaborative response initiative for monitoring misinformation, "hoax busting" and reaching communities with positive and targeted vaccine messages for the COVID-19 vaccine communication strategy. They have a sophisticated network of research, tracking, monitoring and community activists resulting from their years of experience operating at the community level to identify and challenge misinformation across multiple digital platforms and information sources (Astuti, 2020).

Civil society is also playing a large role in creating a foundation of digital literacy, part of the government commitment to creating communities that are resilient and resistant to the negative effects of misinformation. A collaborative initiative of government, civil society, business and community influencers are implementing training programmes and digital literacy curricula to foster a society that regularly evaluates information on social media. A trusted non-governmental organisation, The Digital Literacy Activists Network (Japelidi), has been active since 2017 and is now a member of SiberKreasi, Indonesia's national initiative for digital literacy. The digital literacy movement, from the national government and civil society grassroots organisations, is working to create a long-lasting foundation of a society that can stop the spread of disinformation and misinformation (Adelayanti, 2020).

Pakistan

Pakistan faces a large gap to provide complete and equitable routine childhood immunisation, continues to tackle active polio transmission and has also been plagued by the widespread circulation of misinformation and disinformation surrounding both routine immunisation and new COVID-19 mandates and vaccine rollout (Ali et al., 2019; GPEI, 2021; Ittefaq et al., 2020). The cycle of rumours, vaccine hesitancy and distrust have damaged vaccine acceptance, hindered campaign activities and resulted in violent and even deadly attacks against health workers and vaccinators (Bhattacharjee & Dotto, 2020).

In order to mitigate and address public health and infodemic challenges, the Expanded Programme on Immunisation (EPI), in close partnership with the UNICEF country office, has built a strong system of collating and analysing multiple sources of qualitative and quantitative data. Social listening is achieved by monitoring digital conversations in social media and news sources, traditional surveys, feedback from the national phone hotline, chatbots and standard immunisation epidemiological data. These efforts are supported in a partnership with Facebook Data for Good that provides topic analysis and information on digital conversations and traffic (Durrani & Shadid, 2020).

The social listening data and analysis are translated into action and engagement through a sophisticated network of community influencers using multiple modes of action to target messages in rapid response to potentially harmful disinformation and rumours. Local community elders, paediatricians, religious leaders, public and closed group bloggers, journalists, social media campaigns, SMS messages and printed education material for school children form a mix of online, offline and traditional communication that can be quickly mobilised with coordinated messages. The partnership with Facebook has helped the communications team identify trusted sources of online information and digital influencers on social media, test content messages and uncover insights into user demographics.

A network of trusted sources of information can only result from research to understand gender dynamics, mobile and internet use demographics, trusted influencers and established community networks at multiple layers and with regional variation, recognizing that there is no one-size-fits-all solution or single catch-all channel of risk communication. This established foundation allows the immunisation programme in Pakistan to rapidly address misinformation from multiple angles and target interventions to critical pockets of refusal or hesitancy (Durrani & Shadid, 2020).

South Africa

National immunisation coverage rates for South African children under five years old fell from 82% in April 2019 to 61% in April 2020 (Voigt, 2020). There had been little hesitancy towards routine childhood vaccinations in South Africa over the last few decades. However, the COVID-19 pandemic has weakened the health system's delivery of routine services and the country is experiencing an upsurge in misinformation about immunisations since late 2020, with several surveys indicating that up to 50% of the adult population would not accept a COVID-19 vaccination (Wiysonge & Cooper, 2021).

The priority to increase demand and widespread coverage of the COVID-19 vaccination to reduce disease, especially in vulnerable populations, has added motivation for strong national coordination. The national Department of Health established the Risk Communications and Community Engagement (RCCE) team in 2020, which was expanded in early 2021 to bring together partners with different capacities: UNICEF brings access to social media listening reports (including Google and YouTube search trends, Twitter and other digital data from Talkwalker and Facebook's CrowdTangle); the International Federation of the Red Cross engages a network of 2,000 community informants reporting on-the-ground rumours; the Praekelt Foundation has a COVID-19 WhatsApp platform with 8 million active users; Media Monitoring Africa NGO runs a digital debunking system that works with social media companies to remove offending content; and a new COVID-19 People's Coalition brings together over 500 civil society organisations. The RCCE team is working with academic and professional polling organisations to identify which vaccine concerns are top priority in different populations. The South Africa RCCE team also benefits from support by the Africa Infodemic Response Alliance which provides tools and guidance (see box).

As an example of this coordinated effort, misinformation was spread by church leaders about the COVID-19 vaccination in late 2020, reaching the large portion of the population who are Christian. As the rumours rapidly gained influence in the Christian community, the RCCE worked with the South Africa Council of Churches to publish a strong pro-vaccination statement in response. Anecdotally, this Christian pro-vaccination message has been influential in faith communities, and research on the impact of this should be available by May 2021.

Many separate, strong health communication organisations that were fragmented before the national priority of the COVID-19 vaccination campaign now find a path to national collaboration using the model provided by the Vaccine Misinformation Management Field Guide. This collaborative, multi-stakeholder effort is tackling the spread of misinformation and addressing community concerns by monitoring and broadcasting on a variety of communication channels with trusted influencers.

The African Infodemic Response Alliance (AIRA) is an example of a regional collaboration formed in response to the COVID-19 pandemic and infodemic on the African continent. Started in December 2020 by the WHO Regional Office for Africa, the partnership includes a growing number of countries as well as regional member organisations such as the Africa CDC, The International Federation of Red Cross and Red Crescent Societies, UN agencies, UNICEF, Gavi and WHO. Five independent journalism and civil society organisations participate with active fact checking to rapidly identify regional and local rumours and respond to prioritised misinformation through 'Viral Facts', a rapid response media unit that develops high-quality video and infographics to debunk and correct misinformation on social media. AIRA provides support for country-level Risk Communications and Community Engagement (RCCE) teams to develop infodemic management plans, tools and resources for data collection and analysis and trainings for effective management of infodemic response through the Africa-wide network. Although the initiative is still young and in the start-up phase, it is a great example of regional collaboration and a mechanism to share resources and country-level experiences and challenges. For more information see link here.

Burkina Faso

Together with Côte d'Ivoire, Congo Brazzaville and Liberia, Burkina Faso is working with the Vaccine Demand Observatory (see box) in developing social listening and infodemiology capacity. This work focuses on polio vaccinations as well as COVID-19. The Burkina EPI department has two social listening systems: the traditional rumour map collating reports from local health centres that is captured in an Excel spreadsheet; and the new electronic social listening system they are using with UNICEF and partners. While a minority of Burkinabe have access to the internet, they have learnt that misinformation and rumours circulating on social media (mainly Facebook and WhatsApp) are spread by influential people with smart phones in communities throughout the country. Misinformation tends to spread more readily in the cities where the communities are more fractured, rather than in the rural areas where families are more stable and there is higher trust in the health system.

The EPI communications team is small and would not have the capacity to develop digital social listening themselves, so they have found the partnership with the Vaccine Demand Observatory very useful. The EPI department has learnt that detecting what is trending in social media gives them about two weeks fore-warning of topics that will be actively discussed in communities. This allows the Ministry of Health to prepare speeches for the Health Minister and encourage good reporting in newspapers to head-off misinformation before it becomes more broadly influential.

Rumours linking polio vaccination with HIV infection and mistrust of the intentions behind COVID-19 vaccines have been widely circulated, even by medical doctors. In response, the Ministry of Health held trainings for newspaper and broadcast journalists three times in 2020 and now send press releases to these supportive media partners.

The dashboards to monitor trends in social media are used to develop communications plans and show that these tools can be valuable in lower resource settings.

The Vaccine Demand Observatory is a multi-sectoral partnership with UNICEF, the Public Goods Project and Yale Institute for Global Health to help countries develop, implement and manage locally appropriate tailored systems for understanding and responding to misinformation and disinformation. In addition to building national infodemic management capacity, the partnership developed a customisable platform that combines both online and offline data sources into a single data lake with analytical tools to help translate data into evidence-based behavioural science recommendations for risk communication, community engagement and other interventions. Users can register to access ongoing curation, regional dashboards and learn more here.

Process Map

The Process Map has been developed as a guide to help implementers harness social listening data for vaccine demand generation based on the lessons and findings of this landscape review. It draws heavily from the various frameworks and can be applied to any of the use cases described to support the Journey to Health and Immunisation.

The purpose of collecting and analysing social listening data is to translate actionable insights about community sentiment into applications and interventions to improve vaccine demand. Evidence-based interventions that are tailored, targeted and based on the findings and analysis of social listening activities can contribute to improved quality and accessibility of services and inform strategic communications to correct or counter misinformation. Insights from the data may also suggest policy changes, institutional changes to improve service delivery or may highlight barriers in underlying social processes.

The *Vaccine Misinformation Management Field Guide* (UNICEF, 2020) provides a framework and guidance for the use of social listening as a strategy to mitigate the effects of misinformation and disinformation promoted by vaccine rejectors and can also be used for addressing the concerns of the vaccine hesitant and support the desire to take up immunisation services by vaccine acceptors.

The challenge of transforming raw data on public conversations into an effective intervention that can improve immunisation demand is no small task. The process of sifting through social listening data is made more manageable with dashboards and computer analytics developed by media monitoring companies that can visualise and show trends for large volumes of information, but the task of deciding what information is actionable and should be prioritised for programming or strategic communications requires human insight, effort and practice. The *Field Guide* presents a risk evaluation matrix to determine the areas to focus on. This review uncovered a variety of projects and tools for gathering and visualizing social listening data but very few practical experience, successes or lessons learned in how best to apply the findings from social listening data and analysis to effective interventions.

Having clear objectives for the social listening activities from the beginning can help identify appropriate data sources, necessary levels of analysis and approaches to make use of the insights. The Process Map (Figure 2) has been developed as a guide to help implementers harness social listening data for vaccine demand generation based on the lessons and findings of this landscape review. It draws heavily from the various frameworks and can be applied to any of the use cases described to support the Journey to Health and Immunisation.

FIG 2: PROCESS MAP

Recommendations

This review of experiences using systematic approaches to social listening for vaccine demand generation highlights the gaps in knowledge and the need for more coordinated action and sharing of experiences in the immediate future. The COVID-19 pandemic has brought the issue of monitoring and responding to public sentiment to the forefront even though the issue of vaccine hesitancy has been a priority for years. These recommendations are meant to guide investment and coordinate efforts to harness social listening data to increase vaccine demand.

> **“These recommendations are meant to guide investment and coordinate efforts to harness social listening data to increase vaccine demand.”**

Recommendations for Social Listening Programme Implementers

- Apply the Principles for Digital Development as well as Responsible Data and AI practices to social listening activities and uphold privacy and security policies of the countries in which activities are being implemented. Be transparent in data collection, analysis and engagement activities.
- Consider the goal of social listening activities and the existing data ecosystem to create an optimal mix of sources that will address priority vaccine demand bottlenecks. Map the context-specific trusted sources of information and communication, media types, social media and digital penetration in different groups.
- Form collaborations and partnerships with local civil society organisations, health worker associations, local non-governmental organisations and trusted community influencers to coordinate data collection and strategic communications activities.
- Develop the capacity to understand and strategies for engagement with target communities based on insights from social listening data—partner with risk communication and community engagement teams and resources that are increasingly becoming a critical part of EPI programmes.
- Build platforms for inter-agency coordination on social listening as these processes should not happen in silos, e.g. including the Ministry of Health, WHO, UNICEF, Red Cross Red Crescent and other relevant parties. RCCE approaches need to be harmonised and complementary. Ideally there should be active discussion between different organisations conducting social listening to identify insights, decide on priorities and track action on the main findings.
- Create a library of tested content, messages and communication channels to rapidly respond to critical situations detected in social listening activities.
- Triangulate multiple data sources. No single source of social listening data can provide a complete picture of vaccine demand, but the combination of a variety of sources together can be a powerful tool to understand current opinions, barriers and challenges.
- When designing and implementing vaccination communication strategies, use evidence-based approaches and lessons from past experiences rather than hunches and guess work. Always evaluate successes and failures to apply lessons learned to the next implementation strategy.
- Advocate to national decision-makers to demonstrate the importance and value of vaccine demand generation social listening data collection and activities.

Recommendations for Policy Makers

- Within vaccine demand generation priorities, consider the role that social listening can play and what social listening data will be most useful to inform those priorities.
- Dedicate capacity and resources to develop strategic and evidence-based risk communication teams as part of the national immunisation programme.
- Support a foundation of digital and health literacy in the general population to foster long-term resiliency and resistance to misinformation and disinformation.
- Ensure that appropriate policies and legal environment exists to safeguard data privacy and security at all stages of social listening activities.
- Be aware of the objectives of different agencies and enterprises providing services or platforms for social listening. Be clear with any providers on how they are managing data privacy, security and data ownership. Adapt global responsible data and AI principles and practices within policies.

Recommendations for Researchers

- Local research for sub-national and sub-population levels is essential to develop locally-relevant interventions that can address public concerns in a systematic and sustained way.
- Identify and share priority learning questions that can be answered through implementation research by country teams that are building systems and learning from experiences.
- More research is needed on the psychology of vaccine decision-making, determinants of vaccine hesitancy, determinants and sources of trusted information with emphasis on country-specific variation and sub-national variation (gender, income, geographic and community-specific).
- Develop methods and approaches for understanding and measuring how different categories of demand data (i.e. social media monitoring, KAP surveys, sentinel community surveillance) accurately represent the sentiments and perceptions of the local community. How does exposure to misinformation via different sources impact vaccine hesitancy and other health behaviours?
- Experiences, evaluations and lessons learned from social listening for vaccine hesitancy should be transparent, documented and shared.

Research the theory of change of social listening—what are the steps between identifying someone retweeting a vaccine-sceptical message and someone else choosing whether to be immunised. The many factors influencing this chain need further exploration.

Recommendations for Funders

- Apply the Principles for Donor Alignment in Digital Health to investments in social listening activities and where possible foster collaborations that can produce economies of scale.
- Invest in national capacity, tools and resources for robust immunisation communications teams for data management, analysis and risk communications.
- Support a set of collaborations with large-scale global digital information monitoring companies or other global data collection tools to provide countries with subscription options while maximizing economies of scale with support from the donor community.
- Encourage and support the development of tools and approaches that can be tailored to country needs and can provide data and analyses at sub-national levels
- Support the development and sharing of experiences on methods and best practices for selecting, implementing and evaluating effective vaccine demand communication messages.
- Advocate to national health agencies and EPI programmes to promote the importance of demand generation tools and analysis.
- Support countries to coordinate activities within existing frameworks of tools and guidance from the WHO, UNICEF and others.
- Consider including funding for social listening, digital demand generation and infodemiology management as a core component of budgets for immunisation programmes. A recommendation of one percent of total programme costs being allocated to this was made by several key informants.

Conclusion

Digital social listening is a relatively new technology development which has only recently been used for public health. Electronic tools provide a means of rapidly gathering huge volumes of information shared on public social media which can augment more traditional community feedback and survey information. Methods of integrating online and offline, as well as structured and unstructured, data are being developed in many countries, especially over the past year in response to the COVID-19 pandemic. Social listening should be integrated as part of health emergency preparedness and response systems, following the WHO model of Prepare, Prevent, Detect, Respond and Sustain (WHO, 2018). This is necessary for social listening to be a valuable tool to respond rapidly in an outbreak or humanitarian emergency when networks and health services are disrupted, including immunisation. This is not an optional "extra" activity that is only useful under normal conditions. COVID-19 has shown in real time what happens when health systems are not ready for a pandemic. This has been a repetition of the challenges and difficulties evident during the Ebola epidemic in West Africa from 2014 to 2016.

The development of sophisticated Artificial Intelligence tools and approaches go beyond analysis of positive/neutral/negative sentiment and are beginning to predict intent, obtaining rich insight from huge volumes of unstructured data. This opens exciting new possibilities, but it is unproven whether these applications lead to improved actionable information that justify the cost, both in money and in the limited capacity of small communications teams in LMICs. There are many elements that are as yet unexplored and need further evidence before providing sound, evidence-based guidance for resource-constrained countries, especially the effective ways to combine traditional, largely offline information with newer digital technologies in ways that do not overwhelm the capacity of small teams.

Some lessons are already clear: these tools can add value, but LMICs do not have the capacity to identify which system and company to use. The assistance from global organisations such as Gavi, UNICEF, WHO and others is very needed, especially the work of the Vaccine Demand Observatory. As well as global support, local ownership at national level is key to effective implementation. Developing the human capacity is more important than technical systems. Social media insight is only useful if it leads directly to communications and other interventions to improve demand for vaccination. Social listening is not an end in itself—it must be embedded in the wider health system, to be a channel for communications so that the system can respond to the concerns of the population. The response to community insights should not just be "messaging" to communities. When concerns are raised, the response should not simply be saying 'Everything is alright, this is what you must do'. Instead, health system officials need to take time to reflect on the insights, consider adaptations of ways of working and then share how the health system will respond to the concerns raised by communities (closing the feedback loop). Trust can only be built by providing evidence that the health system is listening and that there is a willingness to work in partnership with communities.

> **"The future is already here, it's just not evenly distributed."**

Social listening technology, especially using Artificial Intelligence, will continue to evolve and will present an ongoing challenge to determine which of the new tools developed by industry and academia are mature and stable enough to be used in public health around the world. Social listening must be included in wider health strategies, healthcare worker trainings and health service delivery. Further investment in global collaborations is warranted.

Continued exploration of the application of digital social listening to vaccine demand generation is encouraged, with an emphasis on producing evidence and best practices in building local capacity and effective implementation in ways that are ethical and equitable. New digital tools that are used commercially in high income countries could add great value to vaccine demand generation in LMICs. As William Gibson has said, "The future is already here, it's just not evenly distributed". It is the job of the global public health community to apply the best tools available in responsible appropriate ways to ensure that no one is left behind unimmunised.

APPENDIX A

Key Informant Interviews

HealthEnabled would like to thank all of the respondents for their generous contributions to this landscape.

Name	Organisation
Susan Mackay	Gavi, the Vaccine Alliance
Gustavo Correa	Gavi, the Vaccine Alliance
Angus Thomson	UNICEF
Helena Ballester Bon Silvia Sommariva	UNICEF–Eastern and Southern Africa Regional Office
AdelHalim AbdAllah	WHO–Regional Office for Africa (WHO Afro), Africa Infodemiology Response Alliance
Tim Nguyen	WHO
Eva Erlach	WHO East Mediterranean Regional Office (WHO EMRO)
Popo Maja	Department of Health, South Africa
Joe Smyser	The Public Goods Project (PGP)
Elisabeth Wilhelm	U.S. Centers for Disease Control and Prevention (CDC)
Michael Coleman Pauline Kabitsis Amel Benzerga	Common Thread
Chris Watson Jenny Shapiro Arthur Soames	Premise
Walter Curioso	Universidad Continental, Lima, Peru
Abhishek Singh	Group M, WPP, Kantar
Santi Astuti	Mafindo, Indonesia
Dr. Saad Omer	Yale Institute for Global Health
Anurag Banerjee	Quilt.AI
Rosalyn Mahashin Lauren Balog Wright Kadeem Khan	Facebook (CrowdTangle and Insights for Impact)
Caitlin Loehr	mHero, Intrahealth International
Dr. Annick Sidibe	Ministry of Health, Burkina Faso

APPENDIX B

Literature review methodology

Articles, publications and grey literature were extracted from two databases using the same search terms (see key words text box): PubMed and Cochrane Library. All citations were imported into Mendeley citation manager for review and selection based on criteria outlined below. The initial database search results were combined with articles and documents discovered through iterative searching to result in 1,909 unique citations. See the flow diagram below for details on the literature review process and results.

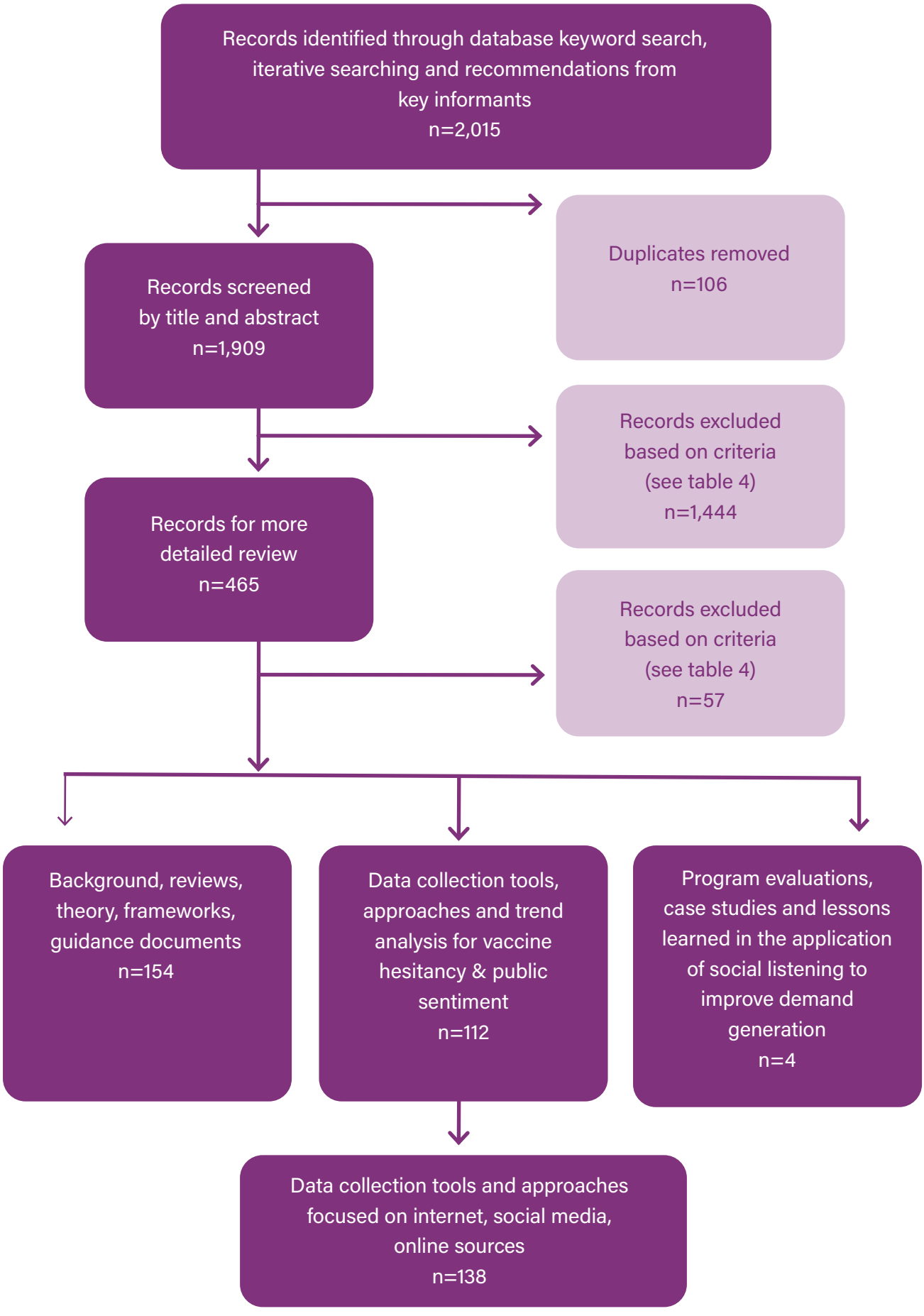
This rapid survey of the landscape identified 408 relevant articles, many of which contributed to the development and background information for this report and are referenced throughout the document. The vast majority of these articles provided background information and described tools and approaches for data collection, many focusing on online internet data collection. Only four articles provide lessons, experiences or evaluations on the application of social listening data to immunisation programmes. These are discussed in detail in the Literature and Evidence review section of the report.

TABLE 3: KEY WORDS USED IN TITLE/ABSTRACT DATABASE SEARCHES

vaccin*		active surveillance	citizen-sourcing
inoculat*		media monitoring	crowdsourcing
immuniz*		media surveillance	social accountability
immunis*	AND	social media	community-based monitoring
jab		U-Report	citizen-generated data
jabs		web 2.0	fake news
shot		exit interview	social network analysis
shots		client experience	participant-centered/centred
		customer satisfaction	participatory surveillance

TABLE 4: CRITERIA USED FOR DOCUMENT REVIEW AND SELECTION

Inclusion criteria	Exclusion criteria
Setting or location: Global with a focus on low- and middle-income counties	Exclusively focused on high-income country setting that is not applicable to other settings
Topics: The use of digital technology for the collection or use or analysis of data that is both digital or non-digital in origin; data to understand and influence demand for childhood immunisation services	Not related to vaccines and human health (i.e. zoonotic disease or animal vaccines); Studies reporting on the state of vaccine hesitancy
Publication years: Jan 1, 2000—Dec 31, 2020	Older than Jan 1, 2000
Languages: English, Spanish, Portuguese	Other languages
Publication types: Peer-reviewed articles, qualitative and quantitative studies, case studies, observational studies, project reports	Newspaper articles, blogs, editorials, letters to the editor, commentary


Records identified through database keyword search, iterative searching and recommendations from key informants
n=2,015
Duplicates removed
n=106
Records screened by title and abstract
n=1,909
Records excluded based on criteria (see table 4)
n=1,444
Records for more detailed review
n=465
Records excluded based on criteria (see table 4)
n=57
Background, reviews, theory, frameworks, guidance documents
n=154
Data collection tools, approaches and trend analysis for vaccine hesitancy & public sentiment
n=112
Program evaluations, case studies and lessons learned in the application of social listening to improve demand generation
n=4
Data collection tools and approaches focused on internet, social media, online sources
n=138

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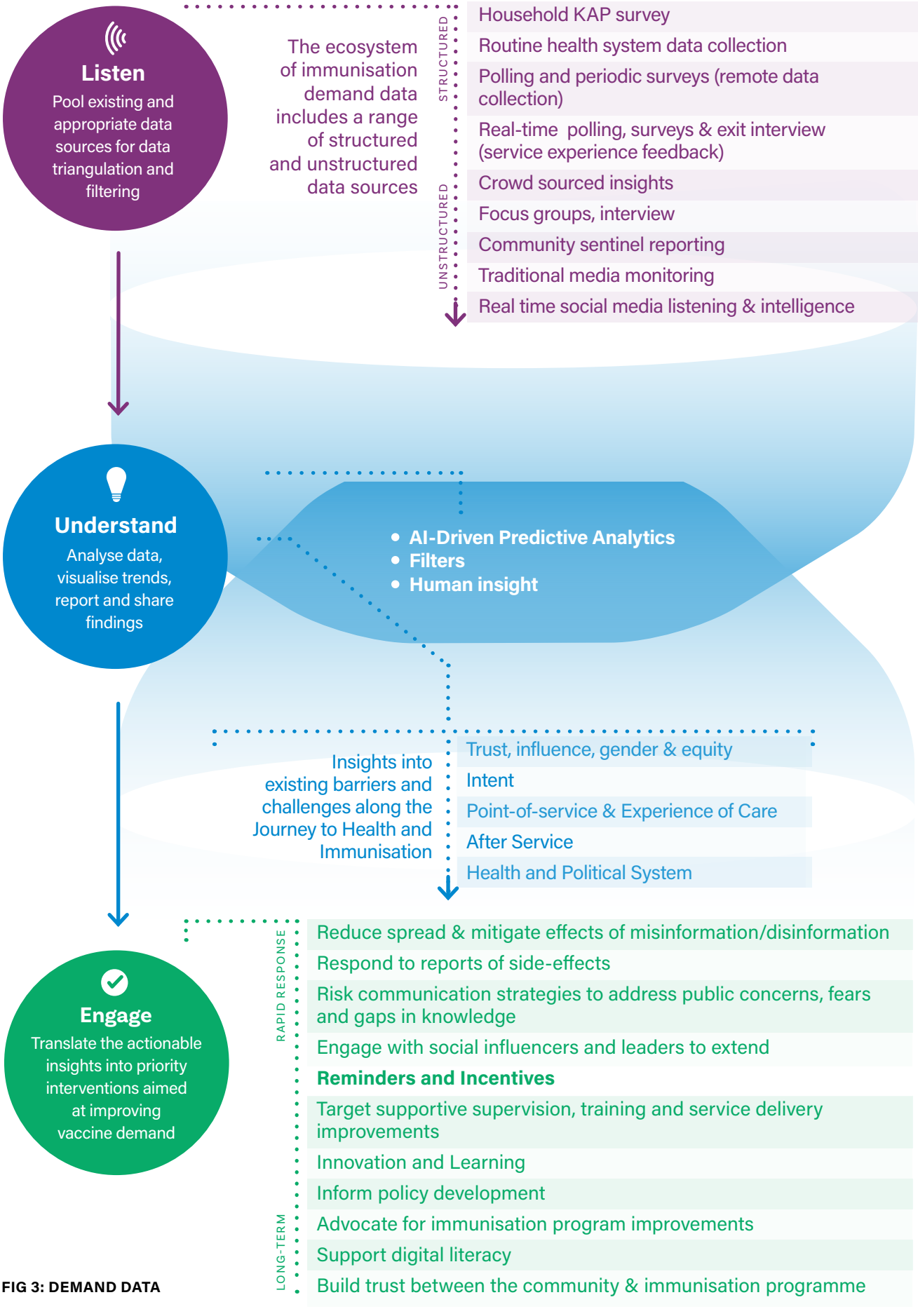

FIG 3: DEMAND DATA

FOR MORE INFORMATION CONTACT: INFO@HEALTHENABLED.ORG

Gavi The Vaccine Alliance | unicef for every child | World Health Organization | Vaccination Demand Hub | health.enabled