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AFRICA

Health communication in selected African states from colonial times

Margaret Kaseje and Verah Okeyo

1. Introduction

This chapter discusses the development and role that science communication has played in Africa, with illustrations from different countries in sub-Saharan Africa and using the field of health to demonstrate some of the challenges faced by communities and governments.

Before making a critique of science communication in Africa, it is worth noting that the discipline developed differently in Africa compared to countries in the Global North such as the US and UK. This distinction introduces an often-ignored contestation in the field: between the public understanding of science, a paradigm that anchors the justification for science communication for example in Kenya, and science communication per se. The latter may be defined as a form of contact for sharing information on science in a society using various means including institutions and communication entities such as media houses, but this is not yet settled. This is hardly surprising because it is an arena in which 'many different stakeholders battle for attention and the power of definition, because there is money in the game, there are jobs to be captured, and there are professional identities at stake' (Weingart and Guenther, 2016, p. 2), and caution is needed in its definition (Stilgoe, Lock and Wilsdon, 2014). Du Plessis (2011) defines science communication as the 'use of the impact of the media and other channels of communication to disseminate science findings' with a focus concentrated on a communication process that is reliant on multimedia through journalistic reporting on mainstream and social media, and exhibition of science in museums.

On the other hand, public understanding of science communication is, according to Bauer (2008), many activities aimed at narrowing the gap between science and the people. It also refers to research that appreciates and employs empirical methods to investigate the public's appreciation and uptake of science—or lack thereof—and how these two vary across time and context. In the West, science communication and public understanding of science exist as two different disciplines but in most countries in Africa, the lines are blurred. This can be attributed to how science was introduced in each region.

Even in developed democracies such as European countries and the United States, there is a perceived communication gap between scientists and the public, and a view that people have not the simplest grasp of basic science or the social benefits arising from science (Bensaude-Vincent, 2001). Scanty research has gone into questioning the perceived deficiency of scientific knowledge of members of the public, and most of the claims stem from an assumption of the scarce coverage of science in the mass media and other public fora (Lublinski et al., 2014; Murcott and Williams, 2013). Many reasons have been advanced to explain this gap such as the ivory towers in which science exists and the arcane nature of its practices, as well as the ostensibly dispassionate scientific discourse that scientists use (Allan, 2009). Calls for bridging this gap include efforts to make knowledge production in science open and accessible (Brenner, 1998)—the rise of many open-access journals—and also funding ways to improve science communication: training scientists to be media savvy and improving the quality of science journalism. In Africa, the gap in science communication has been wide, particularly where access to scientific journal publications is restricted by fees and membership requirements. This gap has been particularly evident in the health domain because information is restricted to populations who in the end depend on their personal active engagement with health providers.

The utilitarian reason for science education was to enable populations to improve their living conditions, and communicators of science adopted this approach when working with schools and the media. Science education aimed to improve production practices in agriculture and animal husbandry, and populations were expected to boost food production for their use and for sale and export, and to improve health and life expectancy. Science education ultimately influenced attitudes and behaviours of the population, where practices were seen to be 'civilised' if emanating from science education and 'uncivilised' if they came from people's beliefs and practices.

2. Colonisation of Africa

Colonisation of Africa reached its peak in the early 1900s when land, the most prized asset for the people living on the continent was taken by colonisers. Colonising activities slackened off after World Wars I and II, due to new priorities and worsening economies of the colonial powers in Europe, together with a growing sense of nationalism and the wave of independence in African nations. The need to revive Europe's economy, devastated by two world wars, led to a focus on what the African continent could provide. The major benefits to colonial powers were the land they seized from indigenous populations and gave to settlers to farm, and mineral resources. South Africa, in particular, became attractive due to availability of these two commodities: land and minerals. This was exemplified by the establishment of the British South African Company (Wilson, 2011).

With growing awareness of self-rule, African countries such as Kenya, Angola, Algeria and Mozambique fought battles of freedom from colonial rule. Colonial governments, most notably Britain, France and Portugal, made little effort to prepare their colonies for independence, and instead tried to absorb them. Britain perhaps was an exception in one way, investing in the education of the population in its colonies, which gave rise to African leaders such as Kwame Nkrumah (the first President of Ghana); these leaders eventually fought for independence for their countries.

The colonial governments' attitude towards science was from the standpoint of providing science education to their territories. The curriculum was limited to general knowledge of the basic sciences of biology, chemistry and physics taught at elementary levels in primary schools and later elaborated in secondary schools. Post–secondary school science education required more advanced skills and this was provided to the initial group of indigenous students. A few students advanced to higher levels of diploma and degrees, some offered in Europe through scholarships provided by the colonisers and largely to fulfil the need for trained workforces for the post-independence era in the continent.

When African countries became independent, science communication content consisted of basic sciences in these newly emerging nations where workforces needed to be equipped with necessary skills to take over the governance of their new nations. Priorities for governments in the emerging independent countries were for development and economic growth, propelled through education, technology and human resources. Thus, science communication

became a key priority for the population, filling the need for knowledge and skills to increase food production and levels of literacy for improved livelihoods.

With the departure of the colonisers, remnants of their rule were apparent in the colonies' legal, educational, political, security and health systems, some of which remain today. When the newly independent countries took over the reins, politics played a big role and politicians propagated messages to rally people and consolidate their rule. Science communication was not in the forefront; yet it could have offered an alternative view of and evidence-based solutions to problems. Instead, research institutions were the custodians of communication and were more accepted within the education system than in the public domain.

3. Science communication and the public in post-colonial times

Since the growth of science communication in the 1970s in Africa, a pocket of communication researchers has argued that the gap between science and the public was created by popularisers for their own self legitimisation as brokers of science communication (Brenner, 1998; Jurdant, 1969). Far from exploring the lack of knowledge in the public about science, this chapter takes as a starting point the acceptance of 'third parties' in the development and practice of science communication in Africa in general. It presents the interests, methods and effect of the third parties in the media as an arena. These, as we will illustrate later, include the influence of public relations and funding on science journalism and the choreographed public presentation by scientists. This chapter situates science communication in terms of Jurgen Habermas' notion of the 'public sphere'. Habermas is one of the most widely read social theorists in the post-WWII era and his writings have deeply influenced humanities and social science scholarship. His argument was that all speech acts have an inherent purpose: the goal of mutual understanding, and that human beings possess the communicative competence to bring about such understanding (see Habermas et al., 1974; Calhoun, 1992; Goode, 2005).

Arguments have been put forward for the right of citizens to have accessible science information to inform their choices on issues. The importance of science communication is not reflected in the editorial space given to science issues: in South Africa, for instance, less than 2 per cent of mainstream newspapers' space was devoted to science-related topics such as technology,

environmental affairs and medicine/health (Van Rooyen, 2004). South Africa has a long record of defined science communication events bringing scientists and media together and highlighting the roles of science in society (Joubert, 2001). On the other hand, du Plessis (2017) cites the influence of politics in a society where a population divided by colonisation and the apartheid system muzzled the development, research and use of science communication in higher learning institutions. Despite such constraints, science communication is a topic of research in institutions of higher learning, like other disciplines. Science communication research in Africa has focused on the practice of science communication—for example, science cafés in Kenya (Mutheu and Wanjala, 2009); providing health information through the radio in Malawi (Nyirenda et al., 2016), use of internet for health education in South Africa (Coleman, 2012); communicating science subjects through musical shows in South Africa (Fish et al., 2016); and media coverage of science information as exemplified in the coverage of genetically modified (GM) crops in Kenya (DeRosier et al., 2015).

But this work (like all forms of research in Africa) is mainly the domain of research and academic institutions, and these have been hampered by lack of resources unless they have partnered with counterparts from the Western world in getting proposals funded.

4. Research, the media and public relations

Since the 1970s, an increasing amount of scientific research is conducted under private patronage, particularly by major companies; and researchers operate increasingly in a commercial climate, with the imperatives of reputation-management and securing market share guiding the development of knowledge products. This puts pressure on science communication. Science writing is less interested in public information and education as communication staff employed by research institutes, universities and companies focus on securing public attention for particular scientists, products, research groups and scientific institutions. The model of professional public relations for science, though nothing new, turns into a generalised and domineering practice.

Traditional modes of science communication, especially with the public, have been through print (newspapers), television, radio and science cafés, but the advent of social media platforms such as blogs, Twitter and Facebook has diminished resources to media organisations in their previously commercial model of engaging with the public. This increases the dual risks of: (a) 'scientific fraud' because of higher production pressures on scientists

(Cookson, 2009; van Noorden, 2011; Schulz, 2016); and (b) lower quality in the societal conversation of science, because of the publicity imperative for research and researchers (Nelkin, 1987).

One implication is that journalists have fewer resources to check their stories. In order not to turn into a festival of hyperbole and misinformation, science reporting requires the structures of a public sphere capable of scrutinising the process of knowledge production outside science itself and supporting the peer review process. For science communication, this amounts to a paradigm change (see Bauer, 2008). Where there is diminished public participation in discussions on health issues and challenges faced by populations, there is less likelihood that any negative factors or issues of supervision will be unearthed; and much less likelihood that sustained long-term solutions to health problems will be introduced.

The scientific communities' perspectives were reflected in the developing field of science journalism, a specialism among professional journalists that has grown in strength and presence alongside the broader field of science communication. Then, and to a large extent now, a background in the natural sciences was practically an entry requirement. With the gradual professionalisation of science communication, courses have proliferated in universities or as part of professional development. Until recently, most have been accommodated in science faculties or professional societies, targeted at science students, graduates or professionals, and often delivered by 'converted' scientists.

5. Public perceptions and the gap between researchers and their subjects

The current research environment can widen the gap between researchers and their subjects. Research can be a means to further a crystallised form of communication and has played a major role in the African scene in the quest for improved food production, better health practices and knowledge for informed decision-making. However, the research has been in the domain of researchers and academic institutions with little information given to the people on whom the research is being carried out. The people provide information and data to the researchers, but in few cases are the research outcomes provided to the people in a language or format that is comprehensible to them. Nor is their feedback sought on the research process and content. Some universities are an exception in providing research science

information, especially in South Africa (Stellenbosch and Rhodes universities) where rural communities have been involved in providing their perceptions of science research projects and science communication.

This gaping chasm between researchers and the public, and other structural and cultural issues, have been implicated in the failure to adopt programs after monies have been spent on the research. An example where the chasm caused problems is a community's interruption of a study in western Kenya where researchers were conducting a verbal autopsy, which involved asking the relatives of the deceased what had caused the deaths of their loved ones. The oral interviews with the villagers were accompanied by conducting an actual medical autopsy to match the answer given by the villagers (Interview, 2018). Unaware of the nature and the processes of the research, the villagers accused the researchers of harvesting organs from their dead relatives for rituals. These interruptions and general ignorance of the public (perhaps caused by the researchers not explaining what they were doing in the experiment) has motivated research funders to allocate a Public Engagement Fund to the consortia and the scientists that they are funding to conduct public and community engagement events to the public.

6. Access to public debates and the media is limited

In Kenya, research institutions were established in the 1970s as centres for knowledge generation and transfer, leading to Kenya hosting international research institutions such as the International Centre of Insect Physiology and Ecology (ICIPE), the World Agroforestry Centre—also known as the International Centre for Research in Agroforestry (ICRAF)—and the International Livestock Research Institute (ILRI). Some of the research in these institutions addressed GM crops; however, researchers limited their work to seeking people's perceptions and knowledge about such crops but not making the research findings available to the general public. While debates and dialogue in the west in the 1980s concerning healthy foods and GM crops were informed by research, in contrast public debate and decisions in Africa took place without the public having access to research findings. There was eventual passive acceptance of GM crops due to constraining factors of food shortages (see Kimenju, 2011, for related discussion).

Universities in the post-colonial era have played significant roles in science communication, where exchange of scholars and professors, conferences and publications have contributed to an exchange of knowledge that surpassed geographical boundaries. Science communication in Africa claims a universality that does not appreciate the inequalities that exist in society, which public relations creates. The notion of universality is based on the idea of the *public sphere*, which allows discussions and debate, and can influence public policy. It may be carried out in the media, social media or at meetings (see Butsch, 2007 and 2011 for discussions of the public sphere specifically relating to the media). However, full engagement of the public has been lacking due to a barrier between the public and scholars.

Social differences have barred certain individuals from accessing important conversation spaces. As an example, the Nations Leadership Forum organised by Nation Media Group, East and Central Africa's largest media house, is one of the few media-backed forums where scientists are invited as panellists in discussions touching on science-related issues, such as the Sustainable Development Goals, health, technology and food security. Invitations to panellists are not on merit but depend on a fee being paid to the corporate communication department of the media house (Interview, 16 October 2018). The topics selected are of interest to those capable of paying the fee, and includes the large funding agencies such as the Bill and Melinda Gates Foundation. Fraser (1992) argues that this public sphere's 'rational deliberation' is a bourgeois individualistic social practice where only the moneyed, privileged and educated in society meet to pursue their individualistic needs, but there is some evidence of governments attempting to include all concerned in the spirit of collectivism (*ujamaa*), as evidenced in Tanzania.

There could not have been a better time to talk about selected communication than now in Africa, when funding for science communication and journalism is derived from the very people that bankroll the research such as philanthropic organisations like the Bill and Melinda Gates Foundation (Bunce, 2016; Downie and Schudson, 2009; Wright et al., 2018). It is a fraction of the monies the Foundation invests into biomedical research and agriculture, but it is involved in Africa's media in training and funding the actual news production process. Kenya's *Daily Nation,* South Africa's *Bhekisisa* hosted in the *Mail and Guardian* are examples of such funding and dedicated centres of health journalism; and non-government organisations (NGOs) are also active in health communication.

Declining advertising, the biggest sources of revenue for media houses, has placed pressure on traditional media and provided an entry point for the foundations to finance journalism. In Africa, the Bill and Melinda Gates Foundation is quite visible in science journalism and communication. The money is not just for the actual production of science journalism but also capacity-building in African journalists through training and fellowships (Mayonzo, 2012) to ameliorate gaps in science journalism such as coverage that lacks depth or context (Ainslie, 1966); outright partisanship; lack of professionalism (Schiffrin, 2010); laziness (Owuor, 2008); and lack of ethics (Nyamnjoh, 2005). The capacity-building is offered by organisations like the International Centre for Journalists (ICFJ) as well as the Africa Science Desk, which is also funded by the Bill and Melinda Gates Foundation.

These activities are debated, because foundations have strong interests and fund activities and areas of communication of interest to them (Scott, Bunce and Wright, 2017):

> Private foundations that support media in order to change the world have views about how journalism can make the world a better place, what the world's problems are and, in some cases, what solutions should be implemented. By using journalism to promote coverage of health or governance or corruption or elections or criminal justice, these foundations are making decisions for all of us about what problems the public should know about and even pressure governments to fix. That involvement in agenda-setting and public policy affects everyone, regardless of where they live, and so it matters how donors and journalists negotiate and implement such agreements. (Schiffrin, 2017, p. 3)

In Kenya, as in other African countries, the education system focuses on science subjects, while institutes for agricultural skills produce graduates skilled in improving food production. Improving health care was through a trained health workforce, largely nurses and clinical officers and to a lesser extent physicians. Science communication therefore was available to a select group of students in institutions, with the ordinary people having less access to science communication. While certain sections of the population have been trained in science, there is still a chasm on effective communication with the ordinary citizens.

Apart from the aforementioned challenges of lacklustre coverage, science journalism has caused social change, especially in positive health-seeking behaviour (Westoff and Rodriguez, 1995).

7. Science communication against the backdrop of science events

During the late 1950s and early 1960s, African countries experienced a wave of historical events encompassing independence, economic, social and agricultural production as well as health care. These changes were reflected in the existing means of communication, largely radio and newspapers. Colleges and universities played a key role, and the three East African countries combined their resources to form joint higher learning institutions for sciences at the University of Nairobi in Kenya, economic studies at Makerere University in Uganda and law at Dar es Salaam University in Tanzania. However, there were no formal courses in science communications in these institutions. Kenya was to (later in the 1970s) develop an institute of mass communications for journalists reporting mainly for radio and newspapers.

Science communication in Africa has taken place against the backdrop of science events and advances in the Western world such as space exploration and computer development. The education system in Africa reflected those in the west where science subjects (mathematics, biology, physics and chemistry) were taught for a workforce to take on jobs in post-colonial countries. The focus on science became intense in Kenya where a number of institutes of science and technology were established in the 1970s with the aim of building a more informed population and providing skills needed to propel these post-colonial countries into the 21st century. In health, there was a need to inform populations and encourage positive health actions that would ameliorate low life-expectancy rates and causes of morbidity and mortality among vulnerable groups such as mothers and children. In order to address the need for health communication in Africa, there emerged a primary health care approach, following the Alma-Ata Declaration[1] of 1978. This declaration was adopted by African countries and led to the dissemination of health communication through trained community health volunteers who reached populations at the household level.

Secondary school performance in science in the 1960s reached a peak where high-performing schools were those that excelled in science subjects. In Kenya, Francis Carey, a British educationist was renowned for his science teaching skills and having been taught by him was viewed as a mark of excellence. While the focus on examination performance in science subjects reigned in

1 The Alma-Ata Declaration of 1978 emerged as a major milestone of the 20th century in the field of public health, and it identified primary health care as the key to the attainment of the goal of Health for All.

most secondary schools, the outcomes over the years in Kenya have been positive, where technology advancements in mobile money transfer and other practical phone applications for businesspeople and farmers has emerged and contributed globally to mobile technology.

The emergence of HIV and AIDS placed the health agenda at a different level, because this was a disease that appeared to affect not just a small population in a given geographical area but had global impact. The means of spread and the effect of HIV and AIDS on populations were devastating, pushing the need to share information in innovative and open ways that had not been previously experienced for a health issue. Counselling, testing and sharing one's HIV status required knowledge about the disease and open communication among health and non-health professionals.

Early HIV campaigns during the 1990s used the 'shock and fear' approach in attempting to change people's behaviour. Billboard and radio messages depicted thin and wasted 'victims' of the disease. However, this approach was counterproductive and only strengthened fear and stigma in communities and resulted in the isolation of AIDS patients. Rumours and misbeliefs abounded, regarding for example touching infected people, sharing eating utensils with them or being bitten by mosquitoes that were believed to transmit the HIV virus. With no impact on infection rates, high mortality rates and expensive treatment regimes, program interventions changed their approach to one of positive living, integration of affected and infected people, disclosure, counselling and stigma reduction. This approach was spearheaded by TASO (The AIDS Support Organisation) in Uganda and eventually adopted globally and by WHO as an effective approach to HIV and AIDS reduction.

In Africa, politics has played a significant role in the health of people. In elections of political leaders every five or so years, politicians become the communication media for health information and, depending on their agendas, can also be sources of science communication. The health issue of HIV and AIDS has been used by politicians to push their agendas for a healthy nation. They have demonstrated that HIV testing and counselling is an effective strategy to address the issue, through talks and speeches and by undergoing tests themselves to prove that they ascribe to the desired actions. With the emergence of democratic space, partly spurred on by the globalisation of information, there has been more tolerance resulting in freer communication.

8. Science communication and public sentiments

While the Western world debated nuclear power in the 1970s and recombinant DNA and GM crops in the 1980s, these issues emerged later in Africa, but only as research topics. The public were not engaged in debates as in the west. Economic development was a priority and any science information and technology that was perceived as being useful for this purpose was provided to government extension workers and volunteer community workers trained and motivated by NGOs. The model of science communication retained the two distinct groups—those that possessed the science, and those who were recipients of this information. With the emergence of a global world through a burst of communication channels, public opinion is now reflected in debates on the role of agriculture and the quest for an agricultural green revolution in Africa similar to that which dramatically changed crop production in Asia and Latin America. Public discourse using social media continues on topics such as climate change and global warming, drought, and the consequent demands for irrigation.

In some southern African countries, governments attempted to involve farmers in increasing food production. Towards this end, governments provided subsidies to farmers consisting of seeds and digging implements accompanied by widely disseminated information on farming practices through radio, newspapers and by government agricultural extension workers. While food production increased temporarily, dependency of farmers on government subsidies also increased during the same period. With other factors of unpredictable rainfall, price fluctuations and long-held beliefs on farming practices such as timing of planting and which family member should plant their field first before other family members, farming practices did not change over time, resulting in late planting and poor harvests.

Science communication has used traditional means such as radio, television and newspapers to communicate science information, with radio reaching the widest audience. The *baraza* or community meeting in East Africa has been a forum used by NGOs to educate and inform people on development initiatives that includes science information. This method is relevant to the intended rural audience since it promotes analysis of issues affecting communities and solutions. The *baraza*, a regular communal meeting presided over by community leaders, is an open forum for all members of the village to voice their opinions on priority issues that include health, social events and security. A *baraza* employs storytelling, proverbs and role-playing that highlight messages for community action, including science messages in a culturally acceptable manner.

A health issue in rural Kenya is the high numbers of babies delivered by unskilled people, leading to high mortality of mothers and babies. A solution is for mothers to reach hospitals in time for delivery by skilled health providers. In one *baraza* session in western Kenya, communities discussed how to assist pregnant women to reach a health facility in time for skilled delivery by health workers. However, in rural settings, transport to health facilities is largely unavailable when needed, or is unaffordable. Community members discussed the issue and agreed to train and enlist local motorcycle riders to transport mothers to hospitals for delivery. The *baraza* session used role plays to depict the late arrival of a mother to a health facility, reactions from the health providers, eventual safe delivery of the baby, and mother and baby riding back home safely.

Different emotions and reactions characterised the *baraza* session: humour and laughter during the role-play scene where the pregnant mother was arguing with the husband that the baby was due, while the husband disagreed because he had competing commitments; apprehension (will the pregnant woman arrive at the hospital in time, or will the baby be delivered by the roadside?); empathy with the situation; and the final happy resolution (role play of crying baby and women and husband smiling happily). The approach of using motorcycle riders to transport pregnant women to hospital was adopted by rural communities and led to more women delivering safely in hospitals, thus addressing one high cause of deaths of pregnant women and their babies.

For primary and secondary school children, visits to museums, animal reserves and animal orphanages in Kenya have served to provide science information to the youth.

9. Science communication through events and social media

South Africa is noted for holding science communication events. ScienceLink holds science communication events for international participants consisting of students, researchers and NGO workers as part of building a community of practice in science communication. Current science communication methods are blogs—for example, the South African SciBraai, which was initiated in 2013 as a means of social media communication and includes Facebook, Twitter and Instagram feeds and exists to promote science reporting and communication.

Most recently, with the advent of social media, science communication has taken on a new dimension in Africa. The Association of South African Women in Science and Engineering (SAWISE) has a public Facebook platform for science communication for those concerned with science activities and research. Online communication with readily available information—for example on HIV and AIDS and gender health issues—has enabled more people to be reached with science information and for people to voice their opinions and concerns while getting immediate feedback. Online communication has resulted in greater shared health information with a wider audience that has no geographical boundaries.

Some health issues that are sensitive to communities require diverse approaches—for example, issues of sexual and reproductive health that include female genital mutilation (FGM) or female circumcision require dialogue and in-depth discussions with those involved with the practice. The procedure of FGM is mostly carried out on girls in their babyhood to adolescence and before reaching the age of 15 years. In Kenya between 25 and 50 per cent of girls and women aged 15 to 49 years have undergone FGM (UNICEF, 2013). According to international standards and requirements, FGM violates the human rights of girls and women and is known to lead to health complications, some of which are extremely severe. FGM is performed for various sociocultural reasons including the need to be accepted and to conform to social norms, initiation into adulthood and marriage, notions of cleanliness after FGM, and the stand that a cultural practice is not to be argued against. Despite negative consequences, FGM is endorsed by local leaders and is carried out by respected community members who also have traditional roles such as serving as birth attendants. Through our continuous dialogue with a certain group of community members and leaders, their attitudes changed over time and by giving birth attendants alternative roles as birth companions who accompany pregnant women to hospital, they have ceased to perform FGM.

However, the spread of information has been hampered by poor internet and electricity connectivity and high costs of phone and laptop devices, particularly in rural and remote regions. While the Western world has experienced a vast expansion of communication channels and methods (such as science events), Africa has seen restricted information flow and is largely influenced by political systems where information is state-controlled and vetted for political correctness, and in cases where learning institutions and media houses have been under state control.

The issue of HIV exemplifies state-controlled information in instances where any information portrayed depicts the government in a negative light. During early 2000, when HIV treatment was not available in public facilities, health systems in sub-Saharan Africa were burdened with high treatment costs—for example, in South Africa and Uganda where the burden of the HIV infection and AIDS stretched health systems and services. In such contexts, governments controlled information made available to the public largely due to leaders' objectives of staying in favour with the populace. However when treatment became affordable, and governments demonstrated action to improve the lives of people by ensuring universal access to treatment, there was less information restriction and even over-exposure of government information about their actions to provide people with treatment and their global partnerships in ending the AIDS epidemic and contributing to Sustainable Development Goals.

While in the recent past, science communication has been restricted to providing information on science as opposed to inviting discussion and exchange of ideas, most recent communication in science has leveraged the emergence of the internet and social media. These have revolutionised how information is retrieved, shared and disseminated to intended audiences. Communication applications such as WhatsApp enable the teaching of science in a virtual manner, which is a shift from traditional classroom interaction or state-controlled media where the content was highly regulated and focused on the leadership rather than on information demanded or needed by the population.

The emergence of the internet and social media that includes Google and websites, Twitter, Instagram, Facebook and YouTube have had both positive and negative effects on science communication during a period of rapid expansion of global communication. On the positive side, more information is shared with a wider audience across different platforms. However, interaction is less personal and may be prone to misinterpretation. The emergence of 'fake news' and misinformation has diminished trust in this channel of information.

Some forms of science communication took place in the interface between researchers and users of technologies in the 1990s in Africa. This process did not reflect what communicators would term today as 'true' communication, since these were research contexts that often did not allow feedback on the process or content covered in a research study. For example, research on HIV and AIDS, family planning and malaria had outcomes that required behaviour change; however, communicating research findings in a manner that supports community behaviour change has had challenges due to the gap between researchers and end-users of the research findings.

People resisted scientific findings when they could not connect the science to their health conditions and where science ran against socioeconomic and sociocultural beliefs and practices. For example, using bed nets to prevent mosquito bites required the ability to afford insecticide-treated bed nets. In the case of HIV infection, the intervention of limiting sexual partners to one uninfected partner ran against the cultural requirement to inherit a woman whose husband had died of HIV infection in order to ensure social stability of the deceased's household. While progress has been made in improving positive health behaviour, impoverishment and cultural beliefs and practices persist, leading to preventable malaria and HIV infections in sub-Saharan Africa.

10. Sources of information for populations in Africa

In the post-independence period, radio became a versatile tool to communicate important issues of the day. It played a major role in reaching especially rural populations with scientific information. Literacy levels affect the reading population—for example, Kenya has 79 per cent literacy (and numeracy), and this influences any science communication in the print media. In the early 1970s, a program by a non-government organisation provided health information to remote villages through a radio program paraphrased as 'doctor health'. During the same period, the national radio station transmitted a weekly children's program that discussed health actions for children at home and school. Newspapers were second to radio in disseminating information with their special reports on health topics.

The country has moved from traditional means such as print, photography, radio and television broadcasts to embrace advancements in new media, social networks and videos (YouTube, Twitter, Skype, Facebook, Blogger, LinkedIn), where science information is readily available for those with access to phones and internet.

While most countries in sub-Saharan Africa have achieved improved health indicators, including life expectancy and education, challenges continue to emerge with emerging diseases and conditions that include climate change. However, Africa is a resilient continent and will continue to face future challenges in science communication, technologies and livelihoods as resolutely as in the past.

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Contributors

Dr Margaret Kaseje is a community health, health policy and public health specialist based in Kenya. She is Professor and Director of Research and Programmes, Tropical Institute of Community Health and Development, Kisumu, Kenya; and Visiting Professor for Health Policy and Planning and International Health at Université Libre des Pays des Grands Lacs, Goma DRC.

Verah Okeyo is a global health reporter from Kenya with seven years of experience at the region's largest media house. She has seven journalism awards, five from Kenya and two from the continent on health, environmental and gender reporting in East Africa.

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