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The Politics of Scheduling: Vaccination as Infrastructure, Spectacle, and Market in West Africa, 1960s–1980s

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Abstract

Vaccination schedules negotiate the timing of interactions among bodies, vaccines, and pathogens. Yet they do more: they orchestrate the movement of vaccines through factories, business plans, injecting devices, fridges, vehicles, healthcare labour, kinship relations, policy models, government budgets, and so on. This article approaches vaccine schedules as standards that synchronise the varying entities – and interests animating these – that make up vaccination infrastructures broadly defined. What unfolds is an examination of the politics of schedule-setting and implementation, set-out in three debates concerning vaccination in West Africa during a time of fitful, contested expansion in both the delivery of immunizing technologies and the development of basic healthcare infrastructure. The first debate concerns rhythms of vaccination during the US-led and funded West African Smallpox Eradication and Measles Control Program (SEMCP) in the latter 1960s, revealing tensions among this programme's technopolitical priorities. Two later debates, about the optimal age for measles vaccination, and the minimum total doses/visits required for full immunization, reflect broader contests, from the late 1970s to the late 1980s, over the ultimate goals of the 'Expanded Programme on Immunization' (EPI). These three debates provide insight into how multiple actors vied for control over how routine childhood vaccination was to be enacted and imagined in West Africa.

Keywords

vaccination; critical global health, West Africa, infrastructure, health systems

Introduction

Immunization schedules specify the timing of vaccine administration: how many doses should be given, at what ages and intervals, and in what order and combinations (for multiple vaccines). The explicit function of vaccine scheduling is to synchronise immune-stimulating acts with bodies' capacity to form an immune response, sensitivity to adverse reactions and susceptibility or exposure to pathogens – all of which may vary by age (or season, as in the case of influenza). Yet as illustrated by recent debates and national divergence regarding Covid-19 vaccination policies – concerning, for example, the value of delaying second doses under conditions of limited supply or of vaccinating children – scheduling decisions usually entail more-than-epidemiological considerations. The effects of scheduling depend on the properties of the vaccines being used – there may be several options, entailing different costs, potencies, modes of

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administration or needs for refrigeration, for each pathogen – as well as available or possible modes of delivery. Scheduling decisions therefore connect a wide range of actors and factors, and are hinged to broader struggles over what technologies, activities, and capacities to invest in, which may in turn rest on pursuits of institutional alliances, market capture or national sovereignty, or the solidification of socio-material manufacturing and procurement arrangements (on 'lock in', see Blume 2005). Vaccine schedules thus negotiate much more than interactions among bodies, vaccines, and pathogens. They also orchestrate the movement of vaccines through factories, business plans, injecting devices, fridges, vehicles, healthcare labour, kinship relations, policy models, government budgets, and so on. Because they both shape and entail judgments about relations among these, vaccination schedules are always political.

In this article, I explore the politics of schedule-setting in West Africa during the 1960s to the 1980s. This was a time of substantial but fitful expansion of vaccination programmes and infrastructures of 'basic' healthcare. My first case study is of the US-led and funded 'Smallpox Eradication and Measles Control Program' (SEMCP), which operated across West and Central Africa from 1967 to 1971. Experts in and around this programme widely predicted, early on, that it would fail to durably prevent measles, and attributed this failure to insufficiently frequent vaccination campaigns. Discussions of the programme's inadequate and ideal rhythms of measles vaccination illuminate how the programme's actors defined and negotiated among its competing techno-political goals. In the mid-1970s, attention turned from time-limited, disease-specific immunization efforts such as the SEMCP, to the establishment of permanent multi-vaccine programmes in accordance with the WHO's Expanded Programme on Immunization (EPI), adopted in 1974. Varying models and components for EPI – particularly for the timing and mode of vaccine delivery – were tested and promoted in the latter 1970s and 1980s. As a second case study, I examine how the dilemma arising around the minimal age of measles vaccination in highly endemic settings – where vaccinating too early and too late both entailed risks and uncertainty – was handled during this period. My third case is the promotion, during the same period, of 'simplified' schedules (requiring fewer doses and visits for full immunization) as a means of 'accelerating' vaccine provision despite sparse healthcare infrastructures.

The aforementioned case studies are about vaccine-scheduling in different senses: SEMCP experts debated the implications of time-intervals between repeated mass-distributions of mainly smallpox and measles vaccines by mobile teams; the issue of age-of-vaccination for measles concerned one component of multi-antigen, multi-dose EPI schedules; while the 'simplified' EPI proposed a minimal set of doses and associated age-ranges for full vaccination that was suited to mobile vaccine delivery – therefore set out as vaccinator visits to communities, rather than individual visits to fixed immunization sites, as assumed in standard schedules. Yet in all cases, the question of optimal and feasible timing of vaccine delivery was tied to broader considerations of, and conflicts over, the ultimate goals of immunization as a public health intervention, what should and could be done to achieve these, and how success might be defined and demonstrated. As they debated when – how often and at what ages – they should vaccinate West Africans, national health authorities and international experts from the WHO, UNICEF, CDC, USAID, and NGOs, also negotiated the selection and prioritization of immunization programme components, investments, and target outcomes, as well as the role of vaccination within broader health policies. Was vaccination meant to alter future epidemiological patterns, to (re)distribute access to vaccines or to broader-based health services in the medium term, or to display immediate commitments to child wellbeing and survival? While these

goals overlapped to some extent, they entailed choices about how much to invest in which specific vaccination technologies (antigenic substances, injectors), how much in what kind of capacity for their delivery (clinics, staff, fridges, vehicles), and how much in what strategies to justify and promote immunization.

Scheduling debates were animated by considerations and calculations of the gains – commercial, political, epidemiological, embodied – that immunization might obtain. These calculations were made within broader, changing regimes of value concerning West African health and its protection, from post-war internationalism, co-existing, sometimes uneasily, with late colonial and national development (Pearson 2018), to the emergence of global health. While post-war public health was governed by state institutions – national and international – and the articulation of health as a right of citizenship, global health is associated with an ideology of health as an apolitical and economic good that can be calculated and maximized on a global scale, which was driven by a growing involvement of financial and private actors in the 1990s (Brown, Cueto, and Fee 2006; Packard 2016). Yet historians have shown that these models do not map cleanly onto a neat periodization. Elements of each – such as the preference, in colonial and international public health, for technology-driven mass, mobile 'vertical' campaigns (targeting a single or limited set of diseases); or the insistence, in nationalist and internationalist models, on health as a right of citizenship; or global health's emphasis on calculating the cost of saving lives as the basis for making decisions about funding – persist over time, and often emerge before they become dominant, and therefore coexist within specific practices and moments (e.g. Runcie 2017; Velmet 2020; Beaudevin et al. 2020).

The values attached to vaccination illuminate both shifts and overlaps among different institutional actors' engagements with African health. The cheapness, portability and collective preventive efficacy of vaccines appealed to late-colonial administrations, CDC experts, new African states, the idealistic WHO of the late-1970s, and the World Bank in the 1980s, but did so for different reasons, and as part of different visions of public health under conditions of scarce public resources, sparse infrastructure, as well as epidemiological intensity, and uncertainty. Debates about vaccine-scheduling reveal subtle tensions and compromises among proponents of different models for healthcare delivery:

1) 'Vertical' interventions targeting the control or eradication of selected diseases, which formed the cornerstone of late-colonial and internationalist public health
2) Broader-reaching basic 'horizontal' capacity to maintain health and provide care, exemplified by the ideal of 'primary health care' (PHC) promoted by the WHO from the 1970s, and
3) Counter-proposals for a hybrid model of 'selective' PHC that became dominant in the 1980s, which focused on a limited number of highly cost-effective interventions.

As Jean-Paul Gaudillière and Camille Gasnier (2020) have pointed out, these models implied not just different scales and targets of investment but also different modes of 'triage' for weighing the value of potential interventions and epidemiological outcomes, one privileging political, the other economic, considerations.

I approach schedules as standards, but not primarily as norms demanding compliance and uniformity; I focus instead on how they served to synchronise the varying entities – and interests animating these – that make up vaccination infrastructures. In a rare historical study of vaccine schedules, Gaëtan

Thomas (2020) argues that they were designed, in Euro-American settings, as tools of *simplification* rather than of standardisation. Their purpose was not to homogenize practices across health professionals or national systems. Instead, by ordering recommended shots into age-timed series, schedules were, Thomas shows, meant to persuade publics that vaccination remained easy and safe even as the number of vaccine types and doses proliferated in the mid-twentieth century. Simplicity, here, was deployed as a strategy for maintaining public trust. By the mid-1960s, in France, experts of the *Centre International de l'Enfance* ((CIE), an institution promoting 'social paediatrics' in France and beyond), worked to *rationalise* rather than to centralise or stabilise schedules: indeed, France had no national schedule until the 1980s. CIE experts legitimized schedules as anchored in the study and orchestration of interactions between antigens and babies' evolving immune systems. Rather than becoming fixed or universal, schedules required continuous adaptation to new vaccines and immunological knowledge, as well as to distinctive epidemiological and infrastructural settings, notably in Africa where the CIE also oversaw research in the 1970s (Thomas 2016).

While not analysing schedules *per se*, Elena Conis' (2015) account of shifts in American federal recommendations for hepatitis B vaccination can be taken as a case example of the politics of vaccine timing. In the early 1990s, these recommendations expanded from restricted 'high risk' groups (such as healthcare workers and gay men) to *all* new-born babies, and soon after that, to the additional vaccination of teenagers. Universalising hepatitis B vaccination in the US was about scheduling in the sense that a new vaccine was added to routine childhood schedules, but also in that it entailed decisions about which age-groups it would make the most sense – infrastructurally, economically, epidemiologically, culturally – to vaccinate. As Conis shows, this policy shift was underpinned by new federal resource allocations for vaccination; healthcare reforms emphasizing cost-effective spending; as well as public anxieties about the (infectious) risks entailed by teen 'lifestyles' and immigration. Thus, an emerging economic and cultural politics of disease facilitated the framing of hepatitis B as a serious and pervasive threat that justified universal baby and teen vaccination – albeit not without public opposition.

These are notable exceptions to a general lack of attention to immunization schedules among social scholars of health, despite a surge of interest in the situated techno-politics of vaccination and its intimate entanglement with national, imperial and Cold War alliances and modes of government (e.g., Velmet 2020; Vargha 2018; Brazelton 2019; Conis 2015; Reinhardt 2015; Millward 2019). Scheduling debates, I seek to show here, are particularly revealing of the contested stakes of immunization and its expansion in the global South from the 1960s to the 1980s. The case studies I examine here show how West Africa – particularly Senegal – was treated by international experts as both an experimental and exemplary site of epidemiological and infrastructural challenges to the expansion of immunization and rural health services. As new actors and vaccination programmes emerged in independent countries, they were faced with the ongoing legacies of colonial underinvestment in epidemiological research and clinical networks, as well as of systems – with their advocates, practical implications, and ideological underpinnings – previously developed to control disease through mass mobile campaigns. Debates about the rhythms and timing of vaccination evaluated mutual interactions between the power (and profitability, feasibility, and risks) of specific technologies, and the distributed capacities of the delivery systems needed to make them work, or, conversely, the infrastructural gaps that technological capacities might surmount. These debates thus provide new perspectives on old questions of resource allocation and target-setting, but also illuminate little-examined

dimensions of international and global health such as the performative political work of vaccination campaigns, or behind-the-scenes efforts to (re)shape vaccine markets.

Following the special issue theme 'Standards and their Containers', I seek, in particular, to examine how schedules allow vaccine delivery infrastructures to 'contain' techniques and technologies (including vaccines designed, for example, to work well despite lower levels of investment in staff, clinics, vehicles, or refrigeration, as well as the schedules adapted to these technologies) by calibrating – or rather, given the centrality of timing, by *synchronizing* – their respective actions to each other. Conversely, I also attend to how schedules 'contain' health infrastructures in the sense that they enable actual or anticipated infrastructural configurations to work, whether with minimal investment, or instead by mobilizing additional resources. As American institutions brought new vaccination technologies to West Africa in the 1960s, they relied heavily on pre-existing mobile disease control systems designed under French colonial rule to cover as much territory/population as cheaply as possible (Runcie 2017; Velmet 2020). This reliance entailed the adoption of vaccination rhythms that were widely acknowledged to be ill-suited to measles control, yet which made mobile infrastructures work for other purposes such as eradicating smallpox and visibly preventing (some) measles epidemics and deaths. By the late 1970s, some actors continued to focus on making sparse, largely mobile infrastructures adequate to the task of generating sufficient levels of collective immunity by developing and promoting 'simplified' schedules. Others instead argued that infrastructurally-demanding vaccines and schedules should drive the expansion of broader-based health services, thereby also serving the ideal of Primary Health Care (PHC).

Research for this article draws on a heterogeneous set of digital and paper archives. Information about the SEMCP (discussed in the first section of this article) comes mainly from three online collections of digital documents and oral history transcripts: USAID's 'Development Experience Clearinghouse' (USAID 2024), the Emory/CDC 'Global Health Chronicles' (GHC 2024) and David A. Henderson's 'Target Zero: Smallpox Eradication Archive', (2024). A notable gap here are the archives of regional infectious disease control organisations (Organisation de Coordination et de Coopération pour la Lutte Contre les Grandes Endémies (OCCGE) for West Africa, and Organisation de Coordination pour la Lutte Contre les Grandes Endémies en Afrique Centrale (OCEAC) for Equatorial Africa, although I draw on work by historians Marie Bérengère Jeannès (1996) and Sarah Runcie (2017) who consulted some of their reports. On the WHO-EPI's position on the optimal age of measles vaccination (discussed in the second section), I relied heavily on grey literature held by the WHO's online 'Institutional Repository for Information Sharing' (2024b) as well as paper archives from the WHO's EPI programme (collected and generously shared by the historian Laurence Monnais). Unpublished data on the development and use of simplified vaccination schedules in Africa/Senegal comes primarily from two sets of papers archives: the fonds on the Centre International de l'Enfance et de la Famille (CIDEF, formerly CIE) held at the University of Angers (collected and generously shared by the historian Gaëtan Thomas), and files on EPI in Senegal that I consulted in the WHO Archives in Geneva. The latter provide rare primary sources on health in Senegal during the 1980s, and particularly on the involvement of African state actors in international programmes. African health ministry archives are difficult to find and to access. In Senegal, they are not held by the National Archives (which mainly preserves colonial documents), while institutional documentation centres (such as the national office of the WHO) keep only recent reports. The 'grain' of my archives thus reflects the power and perspective of mostly

American, French or international WHO experts, only occasionally, often opaquely or indirectly marked by African positions, expert or lay.

Spectacular Vaccination and the Impossible Rhythms of Measles Control

In 1967, the Centers for Disease Control (CDC)-run, United States Agency for International Development (USAID)-funded SEMCP was launched in nineteen countries across West and Central Africa (Reinhardt 2015). The programme was planned as a concrete expression of the US President's commitment, declared in 1965, to the global 'Smallpox Eradication Program' the WHO had launched in 1959. Debates about its practices must be set in the context of its broader objectives. The Cold War techno-politics of American involvement in smallpox control are well-studied. Historian Etienne Gosselin (2012) has described how the US CDC, eager to expand their global reach, invested in developing technology (notably jet injectors) and expertise (including epidemiological surveillance) for mass vaccination/eradication campaigns. CDC experts played a key role in persuading the US government that, with their help, the smallpox virus was eradicable. They thereby construed smallpox, as Bob Reinhardt (2015) has argued, as a prime target for demonstrating, on a global scale, the charisma and efficacy of technology-powered American liberalism over unruly, development-thwarting disease ecologies. Promoted as transcending Cold War divisions, American investment in smallpox eradication was, as historian Erez Manela (2010) shows, motivated by the conviction that vaccination would, in fact, help the US 'win' this war.

Measles was included in the SEMCP despite CDC objections. Measles immunization in West Africa was already, since 1961, a target of American investment and activity (Jeannès 1996). Indeed, Volta children (from Upper Volta, now Burkina Faso) were among the first worldwide to receive a vaccine manufactured by Merck, Sharpe and Dohme, even before it became the first measles vaccine authorised by the Food and Drug Administration (FDA) in 1963. These initial trials were run by the National Institutes of Health (NIH) using Merck-donated supplies. They were followed by one of the world's first mass measles vaccination campaign in Upper Volta, and then by a series of pilot campaigns in neighbouring countries. USAID provided materials and funding, and called in CDC experts for help, particularly with jet injectors. CDC experience with these campaigns, which were meant to be temporary 'one-shot' initiatives, did not foster optimism about measles vaccination. They struggled with technologies that were poorly suited to local weather and roads and came to see measles as a highly infectious virus that was unlikely to be controlled by time-limited interventions, which risked 'rais[ing] public expectations that cannot be fulfilled' (Ogden 1987, 23).

At USAID, however, 'public expectations' were precisely what made measles vaccine politically potent. A 1965 staff memorandum stated that American-led measles vaccination in Africa had 'express[ed, to Africans] U.S. interest in people, and [...] accrued considerable benefits for the U.S.' (USAID 1966). The memo recognised gaps in the knowledge base needed to predict the epidemiological efficacy of a measles campaign. Still, it argued for measle's inclusion in the SEMCP 'based on [...] the political impact of providing the benefit of a significant American scientific breakthrough with respect to a major African health problem' (ibid., 98). In other words, while CDC saw smallpox vaccination as a political-epidemiological technology, which rested on the virus' eradicability and the measurability of its results, USAID presented measles vaccine as a technology of immediate and visible political *performance*.

USAID's support for measles vaccination turned on its (presumed) popularity with African governments and citizens. Indeed, contemporary and historian accounts insist that both experimental and mass measles vaccination were actively sought out by 'African' health authorities, notably Upper Volta's Minister of Health Paul Lambin (e.g., Labusquière 1967; Ogden 1987, 21–22; Reinhardt 2015; Runcie 2017. And, for a critique, see Jeannès 1996). This demand stemmed, in these accounts, from the severity of measles in western Africa, which affected and often killed babies, and was a significant contributor to child mortality – a fact that had only recently been brought to the attention of experts like Lambin (ibid.). Measles vaccination thus appeared, as a CDC historian put it, as a good way for African states to 'demonstrate that independence would enhance the quality of life of their people' (Ogden 1987, 21).

This narrative of 'African demand' is complicated not only by continued presence and authority of European – often ex-colonial – experts, including Lambin, in post-independence African health ministries, schools of medicine and public health organisations (see Runcie 2017). 'Demand' was also entangled with, and instrumentalized by, American and French interests in Africa as a testing ground and a zone of political/expert influence. In an oral history interview, former CDC officer (and future director of EPI) Ralph Henderson described the 1963 Upper Volta campaign as:

> . . . a self-serving exercise, in that we, the United States, wanted to test the measles vaccine on a large scale. Here was an area . . . where kids were dying of this disease, and you would have had to have a very, very bad vaccine indeed, not to be ethically justified in doing a combined trial of the immunization and of the vaccine itself . . . .Well, the impact was absolutely astounding. (Henderson and Harden 2006).

Henderson added that USAID saw measles vaccination 'as an entryway into West Africa, where the French culture was dominant'. Merck's vaccine donations were also linked to marketing strategies. The company was concerned that its vaccine's high price and side effects (for which expensive immune globulins were recommended), combined with a widespread perception by American parents of measles as a mild disease (Conis 2015), would prevent its adoption. The severity of West African measles provided a dramatic setting to display, unequivocally, the new vaccine's advantageous risk/benefit ratio as well as its suitability for mass administration. An early 1960s film, co-produced by Merck and the US Public Health Service, included scenes from the Upper Volta campaign – of mothers flocking to the sound of drumbeats, and lining up to thrust skinny child arms under vaccine 'guns' – juxtaposed with images of reassuring American lab-coated experts and of worrying rash-faced blonde babies (Enders and Stokes c.1964). Meanwhile, a narrator told of the tragedy of a measles epidemic that killed all but two of a Volta village's children. Having used Africa to promote its product in the US (also suggested by Jeannès (1996, 184), Merck apparently turned, especially after a competing firm introduced a vaccine with fewer side effects, to USAID-supported African campaigns as a potential market. According to an internal CDC history of the SEMCP, 'several West African countries [. . .] encouraged by a vigorous sales campaign by the manufacturer' requested the Merck vaccine for the SEMCP' (Ogden 1987, 33). Not everyone agreed: academic researchers based in Senegal and Nigeria concluded, in trial reports, that the side-effects of the first-generation vaccine (called 'Edmonston B') were unacceptable, *especially* under African conditions that prevented careful medical monitoring. On this basis, Senegalese authorities refused to take part in the early 1960s NIH-run campaigns using the Merck vaccine, while earlier trials in Ouagadougou, Upper Volta, were surrounded by rumours about child deaths caused by

the vaccine. According to Jeannès, these dissenting views were marginalised and silenced by the American and French disease-control experts who ran the trials (1996, 284–292). By 1966, a USAID planning document stated that the Edmonston B vaccine had been deemed 'quite safe' in Francophone countries, but that health officials in Nigeria, Sierra Leone and Gambia were 'very concerned' about its propensity to cause high fevers. 'Politically,' the document states, 'it would be preferable if the country were given the option as to vaccine type.' (USAID 1966) In the end, the US Surgeon General recommended that only the new, further-attenuated vaccine type 'Schwartz' be used in the SEMCP (Ogden 1987, 33). While measles vaccination, especially with the safer strain, seems to have indeed been 'popular' with parents and health authorities alike, these points of friction suggest that the presentation of 'African demand' in historical documents and accounts was both simplified for and refracted through American diplomatic, commercial, and public health goals.

Despite the SEMCP's name, the programme was not – as contemporary reports explicitly acknowledge – designed to *control* measles. Its director stated, in 1969, that what was known about measles in 1965–6 'did not greatly influence [its immunization] plans' (Millar 1970, 165). This was not simply a matter of putting smallpox eradication above measles vaccination: the latter activity attracted a substantial 40 per cent of the programme's budget (Ogden 1987, 28). This suggests a *qualitatively* different aim, one I suggest depended on vaccination's spectacular (Velmet 2020) rather than its epidemiological effects, and on its being (presumably) valued as such by African states and citizens, and therefore also by USAID. By 1966 (before the SEMCP was launched), it was clear that measles cases would bounce back after one-time mass vaccination: this was already happening in Upper Volta, as René Labusquière reported (1967). Labusquière, a French, ex-colonial military doctor who had served as director of Upper Volta's disease control service during the pilot campaigns, proposed that long-term control of measles would require repeated vaccination, twice a year in cities and annually in the countryside. By 1965–1966, Labusquière was appointed Secretary General of OCEAC (the regional disease control service in formerly French central Africa, twin of the West African OCCGE), and lobbied for the SEMCP to operate through the mobile disease-control infrastructure overseen by these organisations (Runcie 2017). To 'mesh' with the well-established tour schedules of existing mobile units (Millar 1970, 165), the SEMCP adopted a baseline rhythm of triannual vaccination campaigns. This was adequate for getting smallpox under control but not – as experts were aware from the outset – for any lasting prevention of measles outbreaks. Mid-programme strategy innovations to achieve smallpox eradication, such as the famous method of vaccinating around outbreaks and the adoption of the bifurcated needle, created further incompatibility with measles control (Reinhardt 2015).

The '*grandes endémies*' (major endemic diseases) system, comprising the regional OCCGE and OCEAC, and each member country's *Service des Grandes Endémies* (SGE), was a colonial legacy and an enduring site of French financial and scientific influence over post-independence public health action in Africa (Runcie 2017). Use of its infrastructure by the SEMCP in 'francophone' countries (and some of its principles in others) was both a practical choice, providing access to staff, habits, and expertise, and a political one, leveraging the influence in African ministries of experts like Lambin (who briefly headed the OCCGE) and Labusquière. In the report of his late-1965 tour of West Africa, a CDC official observed 'reluctance on the part of the Directors [of the SGEs] to modify [their] program' (Gelfand 1966). Noting that

many of these were 'expatriate Frenchmen', he concluded, in planning the SEMCP, 'we shall have to adapt our program to theirs' (Gelfand 1966).

This mobile infrastructure was initially designed to control sleeping sickness during the Interwar period, and later adapted to deliver mass immunization, diagnostic screening, and treatment for a range of conditions such as smallpox, yaws/syphilis, tuberculosis, yellow fever, and leprosy (Bado 1996). The principles remained the same: space was subdivided into sectors, which mobile teams covered through well-worn routes and routines, with all the supplies needed to gather, examine, and inject bodies that were conceptualised both as collective 'reservoirs' of pathogens and as sources of labour. As Sarah Runcie (2017) has shown for Cameroon/OCEAC, Labusquière and his Cameroonian colleague Jean-Claude Happi seized the SEMCP – as their predecessors had done with the global malaria eradication programme – as an opportunity to strengthen and display the enduring relevance of this 'French' model of disease control (see also Labusquière 1967).

Unlike the conceptualisation of schedules in the global North as 'structur[ing] the pace of [individual] medical consultations' (Thomas 2020, 437), a mobile disease control infrastructure 'scheduled' vaccination by setting intervals (and, in some cases, age-ranges) between the repeated passage of teams, technologies and immunizing substances through space and aggregate bodies (Thomas 2016). This system was anchored in an ethos of collective action, fiercely defended by its champions, that privileged spatial and biological *reach* over individual effects and interactions (Tousignant 2012; Jafflin 2013; Lachenal 2014). Its mode of operation, entailing speed, centralised authority, and standard protocols, was prone, as Guillaume Lachenal (ibid.) has shown, to provoking iatrogenic 'accidents'. Yet appeals to its ethical and pragmatic principles of mass action justified downplaying such harm as the unfortunate cost of saving many lives. It is unsurprising that *grandes endémies* experts such as Labusquière judged the Merck vaccine, despite reports of serious reactions, to be acceptable for use in mass campaigns (Jeannès 1996).[1]

The epidemiological need for shorter measles vaccination cycles was quickly confirmed by SEMCP staff and their collaborators. At a 1969 symposium in Lagos, presenters described how quickly non-immune individuals were born or migrated into cities like Dakar and Douala (Millar 1970). On the basis of computer modelling, a fortuitous experience in The Gambia (a country so tiny it was entirely vaccinated within a year, and measles declared eliminated there) and studies in Ibadan, SEMCP director Donald Millar echoed Labusquière's earlier suggestion that cities should be visited twice a year, with rural areas covered annually – possibly less in more remote regions (ibid.). Another study, conducted in Lagos, also suggested a need for more precise age targets than the SEMCP's wide range of six months to four years, noting that some babies failed to be protected when they were vaccinated before nine months of age – due to the persistence of maternal antibodies) (Smith et al. 1969). Ideally, Millar concluded, babies would be vaccinated continuously, as soon as they reached the optimal age; alternatively, serial campaigns would selectively target only those

[1] As Jeannès (1996) points out, and as is suggested in USAID planning documents, experts who rejected the use of Edmonston B vaccine (the strain on which the first Merck vaccine was based) were academic (expat) researchers who were influential in health ministries in Senegal and Nigeria.

not covered by the previous round (rather than vaccinating everyone within an age-range). It was theoretically possible to 'speed up' mobile mass vaccination, albeit with 'radical increase in inputs' as a 1969 audit report noted (USAID 1970). Continuous vaccination was, Millar cautioned, 'precluded' in Africa due to its sparse health infrastructure, while, he warned, more selective targeting 'may demand [. . .] new techniques of information [. . .] and possibly even changes in the basic concepts of mobile field immunization operations' (Millar 1970, 138).

American funders did not envisage investing either in an 'accelerated' mobile system or in new forms of vaccination infrastructure. The 1969 audit recommended, tersely, that the aim of measles vaccination be 're-evaluated' (USAID 1970). In a 1970 memorandum, a USAID administrator admitted that 'total control of measles was never intended and will not be achieved on the basis of the present rate and cycling of vaccination'. (ibid., 1970; North 1970, 4259). The 1970 report also encouraged African countries to consider 'what ha[d] been accomplished' by measles vaccination under rubrics such as averted deaths and disability, publics educated about preventive medicine, administrative capability and 'the value to the government in preventing social unrest'. (ibid., annex 2). A 1971 consultation, contracted by USAID to the American Public Health Association (APHA), concluded in the same vein: that measles vaccination had failed as an epidemiological project – in part due to inadequate rhythms of vaccination – but succeeded as a political one (Buck et al. 1971). The risks of ineffective immunization were also, they warned, political: 'growing unwillingness to participate not only in a measles project but eventually in any other vaccination program' (ibid.).

By the turn of the 1970s, USAID investment was confirmed to be inadequate for 'measles control' and it was predicted that disease incidence would bounce back after the imminent end of American funding, since it was expected that African states would not be able to afford to continue large-scale vaccination. At this juncture, these reports expressed hope that African authorities would share their authors' assessment of the programme's legacies: not of future epidemiological alteration and infrastructural investment, but of the political effects, manifesting as trust in preventive medicine, technologies, and government, of a spectacular saving of lives and of bodily integrity. It is difficult to surmise how African political and health authorities assessed the SEMCP; that 'Africans are far more interested in the measles and the smallpox vaccinations' was reiterated in the 1970 report, yet as the end of USAID funding loomed, this 'demand' was of little concrete relevance for future planning. So was the question of optimal measles vaccination age and rhythms, which, as the APHA report noted, called for further study. That the answer to this question remained uncertain as the SEMCP ended indicates a continuing lack of concern, among programme staff and assessors, that the programme's mode of operation – notably its timing of vaccination rounds – was not suited to achieving measles control. This highlights the extent to which the programme's practices were shaped by the epidemiological politics of smallpox eradication as well as the infrastructural politics of maintaining the legacy (and authority) of colonial-era disease control systems. Still, measles vaccination was not just a lesser priority of the SEMCP; its goals were different from those of smallpox vaccination, not so much epidemiological – measurable by disease surveillance – as they were performative, manifesting as spectacular efficacy and trust in American and African governments.

Measles and EPI's Nine-Month Compromise

Uncertainty about the minimal age of measles vaccination remained when, in 1974, WHO and African health officials met in Ghana to discuss the expansion of vaccination programmes. This question was, however, being posed alongside a new ideal – that of multi-antigen vaccination as delivered by permanent, broad-based health services – articulated around the creation of EPI, resolved by the World Health Assembly in 1974. As Bruce Cockburn, Director of the WHO Division of Communicable Diseases, put it at the Ghana seminar: 'Vaccination [is] a continuous, on-going programme [. . .] and as such [has] to become an integral part of a routine health programme [and part of] comprehensive health services' (WHO 1975, 1). This vision would modulate the stakes of schedule-setting. Yet seminar participants were unsure of its immediate applicability. They pointed to a lack of fixed health facilities, and thus a need to continue relying on mobile services that were, by design, specialized and discontinuous. They also flagged uncertainty about what constituted an optimal vaccination schedule, particularly around two questions:

- How many doses should a full schedule contain, at minimum?
- What was the earliest age for measles vaccination?

The latter posed, as delegates described it, a dilemma between two potential risks. Vaccinating too young might lead to a failure of immunization, due to interference from maternal antibodies (which would later be lost, leaving the child susceptible). Vaccinating too late exposed those babies who had already lost these antibodies to potentially severe measles disease. Babies in Africa, particularly West Africa, were known to be exposed to measles particularly early. Seminar participants in Ghana called for more studies, agreeing, provisionally, on a lower limit of six months.

By 1977, EPI's new director, Ralph Henderson, presented a different calculus of the measles vaccination age trade-off. In a memo to EPI officers, he confidently recommended a minimum age of nine months in areas of intense measles transmission and disease (Henderson 1977). 'Precise figures for benefits and losses' were, he admitted, still unavailable (ibid.). He was, however, clear about the priority guiding this decision: to avoid immunization failures, even at the cost of a 'small number of measles cases' in younger babies. The memo also advised against a two-dose schedule (six and then 12–15 months), arguing this would be no more effective, yet more expensive (ibid.).

In 2012, Peter Aaby, a prolific measles researcher, and his colleagues identified and critiqued the assumptions underlying EPI's nine-month compromise (Aaby et al. 2012). The decision was based, they argued, on the idea that vaccination failures would undermine the credibility of immunization programmes, particularly mothers' confidence in these, as well as on the expectation that two-dose schedules were unfeasible. This suggests that the nine-month decision was tied to EPI's prioritization of increased immunization *coverage*, a goal that depended on infrastructure-building and public trust. EPI goals were, in the latter 1970s, explicitly aligned with WHO's commitment to the principles of PHC and universal access, leading, in 1977, to the adoption of the target of 'Universal Childhood Immunization (UCI) by 1990' (2013). Kristen Jafflin (ibid.) argues that coverage was initially selected as a goal because it was easier to measure than mortality. It may also, initially, have been considered a better indicator of investment in permanent infrastructures, on which WHO-EPI officials increasingly insisted. Indeed, Aaby et al.'s main epistemological critique of the one-dose-nine-month policy is that it was based on immunological data (the age-distribution of maternal antibodies, obtained in a WHO-supported 1975–1979 study in Kenya), rather

than tested for impact on child *survival*. The authors also suggest that setting a definite age standard was meant to shore up confidence in measles vaccination, which, in the mid-'70s to mid-'80s, some health experts and donors questioned, arguing that 'weak' babies saved from measles would simply die from something else (Hendrickse 1975).

Citing the Kenyan data, the EPI's new Global Advisory Group (GAG) made the nine-month recommendation official in the early 1980s. While this position has endured,[2] many remained troubled by the compromise it entailed. Debate continued, in the early 1980s, as to how robust evidence for a nine-month limit was (e.g., Walsh 1983), and whether the sacrifice of babies who died from measles before the minimal vaccination age was too high. In some African cities, a quarter or more of measles cases occurred in babies too young to be vaccinated. Some African health authorities (as well as mothers and healthcare professionals) were reluctant to follow the nine-month rule, whether in policy or in practice (Heymann et al. 1983; Whittle et al. 1984). Responding to a CDC officer working in Kinshasa, Henderson acknowledged the 'difficult choices' involved. Yet he justified the nine-month policy based on 'fewer cases in vaccinees', while reiterating the high cost, inefficacy and risk of non-compliance associated with a two-dose schedule (Henderson 1984).

Unsurprisingly, research on strategies allowing for earlier vaccination attracted considerable interest. Besides a two-dose schedule, technological innovations such as intranasal administration and more potent ('high-titre' (HT)) vaccines were under study in the early 1980s. HT vaccines, particularly a version developed using the Yugoslav State Institute of Immunology's Edmonston-Zagreb (EZ) strain, showed promise for vaccinating at six or even four months (Whittle et al. 1984). EPI's initial response to high-titre vaccine research was cautious; in 1985, Henderson wrote noncommittally that EPI 'would not discourage efforts' in this direction (1985). That same year, the CDC organised a workshop on under-nine-month measles vaccination that was not co-sponsored by the WHO (WHO Archives 1985a). By 1987, however, Henderson wrote to an NIH researcher that they, at EPI, were 'excited by the prospect of things moving quickly in [this] area' (Henderson 1987). And, EPI, did indeed move swiftly. A WHO review of research on 'alternative measles vaccines' was initiated in 1987 (Clements et al. 1988), and in 1988, the WHO co-sponsored a meeting on preliminary trial results. By 1989, the GAG announced there was now sufficient data to recommend the HT-EZ vaccine at 6 months in areas of high early-age measles incidence (WHO and EPI 1990), which EPI and UNICEF announced as policy in 1990 (WHO et al., 1990).

Widespread unease, particularly among those working in Africa, with the compromise entailed by the nine-month policy explains this enthusiasm for a technology that would eliminate the catch-22 of vaccinating either too early or too late. Yet the prospect of reducing measles deaths in very young babies may also have become more attractive as EPI's target-setting strategy shifted. While vaccination *coverage* remained a core, and indeed an increasingly urgent priority as the 1990 deadline drew nearer, the EPI's GAG

[2] This remains official WHO advice for a first (albeit no longer as exclusive) dose in high transmission, high mortality epidemiological settings (WHO 2024a).

began, in 1985–1986, considering whether the programme should prioritize specific vaccine-preventable disease, including measles, and set mortality and morbidity reduction goals. By 1989, the WHA resolved a 90 per cent measles mortality reduction target by 1995. The GAG (WHO and EPI 1988) also discussed the growing body of evidence suggesting that measles infections had 'delayed' effects on child mortality, and thus that vaccination could have a bigger impact, the so-called 'non-specific effect', on overall mortality than expected from the calculation of acute fatalities it prevented (Aaby et al. 1995).

Growing emphasis on the lives saved by (measles) vaccination may have reflected the growing influence over EPI policy of the 'child survival movement' that emerged during the 1980s. In 1982, UNICEF's executive director, James Grant, declared a 'child survival revolution', which was anchored in the principle of prioritizing a small number of health interventions – growth-monitoring, oral rehydration, breast-feeding, and immunization (known as GOBI) – that would prevent the most child deaths, as soon and as cheaply as possible.[3] These principles of 'selective' PHC put Grant in conflict with WHO's commitment to immunization as integrated with, and indeed a driver of, a more open-ended and expansive version of PHC (Cueto, Brown, and Fee 2019, 185). By 1984, however, the WHO entered a coalition with UNICEF, the World Bank, UNDP, and the Rockefeller Foundation as part of the Task Force for Child Survival (TFSC). The TFSC's objectives were to prevent child deaths, promote vaccination and stimulate donor funding – goals that all its members could agree on (Foege 2018; Cueto, Brown, and Fee 2019, 192). The TFCS, as will be seen in the following section, also advocated for technological innovation as a solution to (infrastructural) problems of access and efficacy. One of the TFCS's first research contracts was for a trial of HT vaccines in Senegal (Garenne 2018).

Results from this trial showed unexpected excess mortality among girls in the HT-EZ group, revealed by data analysis in 1990, *after* the WHO/UNICEF recommendation had been released. Michel Garenne (ibid.), a lead scientist on the trial – and self-identified victim of the controversy that resulted from it – claims that the WHO's rush to make the recommendation, and subsequent slowness in retracting it, stemmed from its political commitment to broadening the geography of vaccine production toward the East (Yugoslavia) and South (Mexican and Indian manufacturers were licensed to produce EZ).[4] This is certainly plausible, although not discussed in the EPI documents or archives I consulted, which, on the contrary, emphasize the challenge of securing an adequate and reasonably priced supply of EZ vaccines. What does seem clear is that enthusiasm for HT at the WHO arose at a time when the definition and measurement of vaccination outcomes was shifting and as the 'child survival' movement grew in influence in the late 1980s, thereby also modulating the stakes of scheduling. Their influence went beyond the pursuit of HT as a technical solution to scheduling dilemmas: in the late 1980s, WHO experts also began reconsidering the

[3] Other major actors included USAID, which was allocated a substantial 'child survival' funding envelope in 1985.
[4] And therefore away, he implies, from the North, where, as Blume (2017) has described, vaccine innovation and production were increasingly concentrated in large private corporations.

feasibility of two-dose measles vaccination schedules as a way of meeting mortality-reduction targets despite ongoing concerns about cost and compliance (WHO and EPI 1988; Clements et al. 1988).[5]

A 'Simplified EPI' in West African Test Zones

As was already evident in the proceedings of the 1974 WHO seminar in Ghana, the ideal of vaccination as part and parcel of expanding health services was countered with proposals to adapt to postcolonial infrastructural legacies and constraints. Tensions between the prioritization of long-term infrastructural investments and the adoption of short-term strategies to expand immunization coverage recurred in debates in and around the EPI in the latter 1970s and 1980s. These tensions played out around the prospect of a 'simplified' EPI schedule, in which the six EPI antigens (diphtheria, pertussis, tetanus – combined as DTP – polio, BCG and measles) were to be delivered in fewer doses and visits than the standard WHO-recommended schedule. In this section, I describe how the development and deployment of a 'simplified EPI' drew together diverse political (and, perhaps, commercial) interests in expanding vaccination in the global South, especially in (West) Africa, and played a pivotal, albeit temporary, role in the consolidation of the 'child survival' movement.

The project to develop a 'simplified EPI' for Africa was spearheaded by the French NGO *Association pour la Promotion de la Médecine Préventive* (APMP). Founded in 1976, the APMP succeeded the AMP, created in 1972 by the philanthropic branches of France's main vaccine manufacturers Mérieux and Pasteur to advise African governments on public health, particularly vaccination. Still funded mainly by the Mérieux Foundation, and directed by Mérieux epidemiologist Philippe Stoeckel, the APMP joined forces with the *Centre International de l'Enfance* (CIE), which provided its headquarters and whose members served on its board. CIE experts had long worked on the immunological basis and implications of vaccine schedules in France (Thomas 2020). Starting in 1970, the CIE also conducted studies in African countries, initially at the behest of none other than OCEAC Director René Labusquière (Thomas 2016). These studies explicitly sought to adapt, by simplifying, vaccine schedules to both the epidemiological and infrastructural specificities of African settings, notably to support the expansion of vaccination with minimal investment in new facilities, staff, and equipment. Notably, CIE and later also APMP experts, sought to configure schedules to work with the mobile system of the *grandes endémies* services, which, into the 1980s, was still widely used by fledgling EPI programmes across formerly French- administered Africa (Jafflin 2013).

Less explicitly, the APMP's simplified schedule project arose from efforts to secure a strong position for French vaccine experts and products in African health programmes. While Stoeckel vigorously defended the commercial and political neutrality of the APMP – whose stated mission was to guide and liaise between governments, donors and vaccine suppliers (AUAL 1976) – he described its founding aim, in a confidential letter, in the diplomatic terms of presenting a 'united front for French vaccinology' (Stoeckel 1982). As

[5] As an EPI consultant wrote to a CDC officer about two-dose schedules as a potential alternative 'in case the E-Z vaccine turns out not to be the magic bullet we are all hoping for' (Hayden 1987).

historian Jennifer Lynn Pearson (2018, 114) describes, the CIE was founded in 1950 with the aim of 'carv[ing] out a global sphere of influence for French medicine in the postwar world', and in particular to promote – by organising meetings, training programmes and research – cumulative *colonial* know-how, especially in Africa, against the mobile expertise and internationalist values channelled through the UN system. The CIE continued to work in Africa after independence, and to 'stake a claim' for, and maintain ties with, French experts (Pearson 2018, 168–169). Stoeckel's statement clearly situate the APMP, and its alliance with the CIE, within this lineage. Commercial motivations for the APMP's activities, which joined the philanthropic foundations of rival vaccine firms, are less clear. In the same confidential letter, Stoeckel explains that, initially, setting aside commercial competition to form this philanthropic alliance was easy, in that it concerned 'very poor developing countries [that are] not exactly a 'market''. Yet in 1982, Stoeckel noted that 'fierce competition' was emerging between the two firms on the ground while, as we will see, the vaccination schedule developed by the APMP – which it promoted to donors such as USAID and UNICEF for implementation in African nations – was tied to specific Mérieux (and one Pasteur) products. Whether or not the APMP was meant to help open markets for both firms, or to gain a market advantage for Mérieux (whose foundation provided much of its resources), and regardless of whether it promoted African immunization programmes as a potential source of profit, its activities demonstrated that investing in African public health could be compatible with a private French vaccine industry.

The development of a simplified schedule was intertwined with the development of an 'enhanced' version of the inactivated polio vaccine (IPV), originally introduced in the mid-1950s and credited to the American scientist Jonas Salk. By the 1960s, IPV had been largely displaced, in national policies and industrial manufacturing worldwide, by the 'Sabin' live-virus oral polio vaccine (OPV). As Stuart Blume (2005) has argued, the shift from IPV to OPV was 'locked in' by a large-scale reconfiguration of global vaccine production capacity, even as concerns about the safety of OPV – as a potential source of polio infection – (re)emerged. Salk actively promoted debate about OPV risks, first in the 1960s, then again from the early 1970s (Jacobs 2015).[6] In parallel, he approached Charles Mérieux, head of the eponymous firm, as a potential supplier of IPV should a shift in US policy stimulate demand. The Rijksinstituut voor Volksgezondheid (RIV), the Dutch Public Health Institute, was another rare manufacturer that still produced IPV, and had innovated a process that could boost antigen potency. Salk saw a more potent, or 'enhanced' IPV (eIPV) as key to its 'rehabilitation' (ibid.), particularly as a technology suited to 'tropical' settings. OPV, while clearly advantaged by its cheapness and ease of administration, was known to be highly sensitive to heat. IPV use required less investment in refrigeration, while a more potent IPV – if effective with fewer doses – could reduce the overall cost of vaccine delivery.

In 1976–1977, Salk and his allies created the Forum for the Advancement of Immunization Research to fine-tune and promote eIPV. Its members included the head of the RIV, which was content to produce the

[6] It should be noted that Salk had no financial interests in promoting IPV, which was not patented. While there were obviously implications for his reputation and prestige, he was also likely genuinely concerned about the risks of mass OPV use.

vaccine for national public use, and Mérieux, who, by contrast, had his eyes set on global markets (Blume 2005, 168). Stoeckel was also a member. The APMP's first project, in 1977, was to coordinate a trial in Mali, in collaboration with the OCCGE, to determine the optimal concentration of an eIPV formulation that was effective in two doses (AUAL 1977). The Institut Mérieux opened a facility to produce eIPV in 1978 (Jacobs 2015). According to French regulatory records, a Mérieux brand polio vaccine was approved as 'Immovax' in 1982, and a DPT-IPV combination vaccine as 'Tetracoq' in 1985.

Taking advantage of French bilateral funding for vaccination programmes in its former African colonies (AUAL 1978), the APMP set up a pilot zone in the southern Senegalese district of Kolda in 1978–1979. The site was selected by the OCCGE, recipient of the French funds, which sub-contracted the study to the APMP (it is unclear whether Senegalese health authorities lobbied for, or were enthusiastic about this selection). The Kolda project sought to demonstrate the efficacy and feasibility of a 'new type of EPI' (Schlumberger n.d.), which delivered full vaccination to children in two visits – as two annual passages of a mobile team – compared with the four or five required by a WHO standard schedule requiring three doses each of DTP and of OPV (Caudrelier n.d.). As dreamt of by some SEMCP staff, this system 'sped up' the rhythm of prior *grandes endémies* mobile campaigns, to vaccinate children more often and therefore within more precise age-ranges, thereby offering a credible substitute for clinic-based routine immunization services.

The new eIPV-DTP was key to making mobile vaccination in Kolda similarly effective as, yet cheaper than, fixed delivery. The other vaccines used in the pilot study were produced by Pasteur (BCG and yellow fever) and Mérieux (measles). A Mérieux jet injector, designed by the *grandes endémies* veteran Léon Lapeyssonie (Nau and Tréan 2000), was also a key technology, as it could be handled by non-medical team members, notably the 'driver-mechanic'. The Kolda system hinged these technologies to a parsimonious division of space and labour. A four-person team, headed by a nurse, included a (female) 'educator-animator' who opened each session (held, successively, at 144 assembly points across the sector) with a speech about vaccination, and closed it with a health talk ('*causerie*'). Sessions were announced by radio and local authorities, then again, on the day before, by the team's general labourer ('*manoeuvre*') who crisscrossed the area on motorbike, while the nurse met with authorities and the two others checked and sterilized the material. At sessions, babies were passed from the educator to the nurse to the driver for examination, paperwork, and injections. Besides fine-tuning the system, the pilot study generated data on its effectiveness – on immunological, epidemiological, and economic terms. While the eIPV's immunological potency enabled a 'simplified EPI', the Kolda system, conversely, justified its use on economic terms: although it cost significantly more than OPV, the difference was offset by the 'infrastructural' savings of a two-dose schedule, so that – as the Institut Mérieux's Vice-President of Sales and Marketing calculated – more children could be 'fully' vaccinated per dollar with the added benefit of

improved compliance (Martin 1984).[7] Whether or not these dollars would turn into profit for Mérieux, the case for eIPV rested on allocating a greater share of programme funds to vaccines, relative to staff or facilities, than alternatives.

Documents hint that EPI leaders such as Henderson, who urged the 'horizontal' integration of vaccination in PHC (Jafflin 2013), were initially hesitant about the brazenly vertical Kolda system. By the early 1980s, however, there was a growing openness among EPI advisors and leaders towards stand-alone activities – such as National Immunization Days (NIDs) – that would 'accelerate' a still-sluggish expansion of coverage to achieve the 1990 target. By 1983, a CIE vaccine expert, who was also a member of the EPI's GAG and the APMP Board, wrote to a Mérieux staff member that Henderson 'himself [was] keeping an eye on [the Kolda project]' (Fillastre 1983). Stoeckel too was happy to report, in early 1984, that Henderson now accepted the 'principle' of the two-dose schedule (AUAL 1984). Yet he had even more exciting news for the APMP Board: a recent meeting, in New York City, among influential players in international health had 'originated from an interest in [their] work', signalling that a 'shift in favour' of the new IPV seemed to have (finally) begun. In response, a fellow board member 'applauded the global impact of the APMP's simplified vaccination programme' (ibid.).

The New York meeting had been attended by Stoeckel and Salk, as well as by the WHO's Director-General, the Rockefeller Foundation's Ken Warren, the Word Bank's Director Robert McNamara, and UNICEF Director Jim Grant (Cueto, Brown, and Fee 2019, 192). According to Rafe Henderson (cited by Foege 2018, 22), Salk's lobbying for the eIPV's use in global vaccine programmes – which he did armed with results from the APMP studies – was the driving force behind this meeting. Its focus was on strategies to demonstrate the urgency and feasibility of 'accelerating' the rollout of EPI. The meeting concluded with plans for a bigger meeting at the Rockefeller's centre in Bellagio, and the tentative selection of Senegal, India, and Columbia as sites for model 'acceleration' programmes, on the logic that, as Salk put it, 'if dramatic results occurred [...] the campaign would sell itself' (USAID 1983).

Stoeckel presented the Kolda project at the 1984 Bellagio meeting, which was attended by Senegal's Minister of Health, Mamadou Diop, and Mady Oury Sylla, its Director of Public Health. Back in Senegal, Sylla, with Stoeckel, drafted an action plan for a 'Bellagio EPI' (Sylla c.1984).[8] The APMP also contracted consultants to sound out donor responses to this plan, and contributed to an assessment of Senegal's EPI (Emmet, Niane, and APMP 1984; Ministry of Public Health, WHO, and APMP 1984). While Sylla insisted that this 'Bellagio EPI' was 'neither horizontal nor vertical but [...] diagonal [*oblique*]', the plan's content – which proposed to extend the Kolda system on a national scale – was vertical and specialized (Sylla c.1984;

[7] Martin, apparently a Mérieux sales and marketing executive, calculated, using a projected vaccine price of $0.45 USD per Mérieux-brand IPV dose, that an IPV-based series of doses would cost $1.30 per child, versus $0.50 for OPV, but that cutting down on visits would reduce non-vaccine costs by about 30 per cent, nearly halving the cost of fully immunizing a given number of children.

[8] Whether or not Senegalese health authorities backed the Kolda project from 1979, they clearly worked closely with Stoeckel by 1984.

USAID 1983). TFCS Secretary William Foege, who flew to Senegal just a month after Bellagio, also advised on the plan: he recommended that provision for the renovation of Senegal's only 71 maternal-child health centres be cut from the proposed budget, but did not oppose the purchase of Mérieux-brand DPT-eIPV (Sylla c.1984).[9]

Archived reports describe USAID and UNICEF reactions to the 1984 plan – representatives of the former worried that it would interfere with their efforts to institute basic rural health services – but provide little sense of Senegalese buy-in or reservations. Little concrete action followed, mainly a five-day mass vaccination campaign limited to regional capitals. A new plan was drawn up in 1986, heralding a 'withdrawal from the mobile team concept' (WHO Archives c.1986), instead proposed to invest in fixed facilities able to deliver other 'child survival components' such as oral rehydration therapy. A budget of approximately $5 million USD, channelled through UNICEF by Italian bilateral aid, would equip 650 rural clinics and purchase Mérieux's DTP-eIPV, the only brand-name product mentioned in documents. The two-visit schedule was to be offered only to those who lived far from fixed facilities, and in most cases to be implemented through outreach by clinic staff rather than dedicated mobile teams, which were slated for phasing out. Those able to reach clinics would be vaccinated according to a three-visit schedule, while a full standard schedule was maintained in the capital city of Dakar (Brenzel et al. 1987).

Senegal's five-month EPI acceleration phase was launched in late 1986, and given high profile shows of support by both the Senegalese President Abdou Diouf and UNICEF's Jim Grant. It was by all accounts a 'PR' success for the Senegalese state, whose ailing EPI had, prior to this influx of donor funds, 'not fared well' in a context of structural adjustment programmes mandating cuts in public health (WHO Archives 1985b). It was no less so for UNICEF, which promoted Senegal's vaccination programme in a glossy pamphlet as 'an example of how political commitments and intensive mobilisation of national resources can be used [in a challenging African context] for achieving the goal of UCI by 1990.' (Brenzel et al. 1987) The Diouf government's enthusiasm for accelerated vaccination during a time of public disinvestment from, and privatization of, healthcare (notably through the introduction of user fees in early USAID and World Bank experiments in Senegal), might be described as a *performance* of state care.[10] UNICEF assessments and public materials emphasize how intimately the President became involved in the campaign, and highlight the omnipresence of political, media and community messaging about EPI during this time. Communication radiated from every government ministry through local authorities, youth, and women's groups, to radio plays, sporting events and popstar posters. The accelerated EPI thus 'saturated' the media, 'mobilizing

[9] This does not mean that Foege or the TFCS sought to promote Mérieux products in particular, but does suggest, as indicated by their support of the high-titre measles vaccine, that they favoured technological solutions to infrastructural and system gaps in the pursuit of epidemiological goals.

[10] On the 'performance' of state care as a façade under structural adjustment, see Masquelier (2001). This use of vaccination as a strategy to maintain public trust in the state despite defunding of healthcare contrasts with suspicion of an energetic vaccination initiative in the absence of other forms of care in 1990s Cameroon, as described by Pamela Feldman-Savelsberg, Flavien T. Ndonko and Bergis Schmidt-Ehry (2000).

virtually every level of Senegal society', generating a 'high degree of national pride' and a 'groundswell of enthusiasm' (McLellan c.1987).

This success did not, however, consecrate the new eIPV or the Kolda system as key EPI technologies. In a confidential letter to Rafe Henderson, a local UNICEF officer wrote that he and colleagues were 'considered killjoys' for pointing out that 'only 55% [. . .] had the third DPT' during the acceleration phase (the target, proclaimed to have been reached, was 75 per cent) (Lapointe 1987). Initially, two doses of DTP were to be counted as a full course, but shortly after the campaign was launched, a third dose had been prescribed because:

> . . . we at UNICEF were not comfortable with the two pertussis immunizations. I might add we are not comfortable with the two inactivated polio shots, but that's another story. Nevertheless, in an argument that borders on sophistry, the Minister of Health personnel are now intimating that the third DPT was more of an unofficial addition, perhaps a sop to UNICEF [. . .] As is the case when technology meets politics, we cannot possibly refute [those] who have jumped on the successful EPI bandwagon.

This passage highlights a negotiation of – and challenge to – the terms for defining the success of vaccination (as technical or political performance), and their entanglement with decisions about vaccine scheduling. It also confirmed the demise of a strategy – the simplified EPI – for radically minimalizing infrastructural health investment. As the UNICEF rapid assessment observes, this addition of a third DPT dose was made possible by the increase in fixed vaccination facilities (Brenzel et al. 1987). In turn, this infrastructurally-enabled definition and implementation of full vaccination made both eIPV and a two-dose schedule obsolete.

UNICEF's initial support for IPV, 'both in the U.S. and in Dakar', had been based, the assessors wrote, on the Kolda 'mobile team strategy' (ibid.). Given a denser clinical network, IPV was no longer cheaper than OPV: purchasing the Mérieux product, consultants estimated, had increased the price of Senegal's acceleration phase by 20 per cent 'over a hypothetical case using DPT and OPV' (ibid.). By the end of the decade, the debate was closed.

Conclusion

These three debates were not just about fitting existing antigenic technologies to existing infrastructures of delivery. They were also animated by efforts to bring future infrastructural configurations into being – sped-up specialized mobile circuits, or a denser network of fixed clinics with a narrow or broad range of functions – that would make vaccines work and, in the case of more-antigenic measles and polio vaccines, *be made to work by them*. In the SEMCP, the thin, slow coverage of colonial disease control, and the decision to maintain its rhythms and infrastructure, were identified as obstacles to making measles vaccine work as an epidemiological tool. This was not defined as a major failure for the SEMCP, which had funded measles vaccination for its spectacular effects. Yet by the early 1970s, it kindled, among both American and African health experts, aspirations for infrastructures that would allow for more frequent, long-term interactions with vaccines. As projects to densify infrastructures of vaccination and primary care in Africa emerged starting in the latter 1970s, discussions about lowering the age of measles vaccination and the 'two-dose' schedule turned to how specific product innovations (HT-EZ and the enhanced IPV) could make specific

versions of EPI effective, amid contests over how efficacy should be defined, measured, and enacted. Vaccine-scheduling is about making future collective immunities. Yet here – and in general – it is also about building future public health infrastructures and vaccine markets, as well as future regimes of calculation and evaluation.

These debates also draw attention to how extensively African sites – particularly in West Africa – were implicated in the production of 'global' knowledge about vaccines and vaccination practices during the 1960s–1980s. This was not new: Aro Velmet (2020) shows how the French colonial administration gave the Institut Pasteur access to its disease control programmes to test and validate BCG and Yellow Fever vaccines as effective and cheap technological solutions for the world. The NIH (and Merck) came to Upper Volta in 1961 to generate data on the new measles vaccine in an epidemiologically intense environment – trials of this and other (Wellcome) vaccines in Nigeria and Senegal were motivated by the same logic (as were pioneering trials of hepatitis B vaccine in Senegal and The Gambia in the 1970s and 1980s). The HT-EZ vaccine was, in the latter 1980s, tested in Senegal, but also in other 'zones' of medical research in The Gambia and Guinea-Bissau, again as exemplary sites of early-age and frequent viral transmission. Pilot studies of specific vaccine protocols (model and 'simplified' EPIs), were conducted throughout the 1970s in Cameroon, Ghana, Mali, Senegal, Central African Republic, and Côte d'Ivoire by the CIE and APMP, as well as by the WHO and CDC/USAID, who treated these as sites of minimal infrastructure and of challenges to the expansion of health services. While seeking to generate knowledge of how to 'adapt' global vaccines to local epidemiological and infrastructural conditions, these various forms of experimentation were also designed to reveal the power of these technologies to prevent disease and death with minimal investment in other forms of care and protection such as access to food, environmental regulation, and broader health services. The knowledge they thus produced was both shaped by and continued to justify the infrastructural gaps bequeathed by colonial underinvestment and maintained by structural adjustment policies and international/global health strategies.

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