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Putting public health infrastructures to the test: introducing HPV vaccination in Austria and the Netherlands

Katharina T. Paul¹, Iris Wallenburg² and Roland Bal²

¹*Department of Political Science, University of Vienna, Austria*

²*Institute of Health Policy & Management (iBMG), Erasmus University, Rotterdam, The Netherlands*

Abstract This article presents two cases of policymaking concerning the vaccine against Human Papilloma Virus (HPV), which is sexually transmitted and carcinogenic. Our analysis focuses on its introduction in Austria and the Netherlands. In both contexts, we find prevention and screening to be at once complementary and competing public health logics and we draw on the concept of ‘infrastructure’ to understand their roles in shaping the reception of the vaccine. We reveal how the HPV vaccine had to be made ‘good enough’, much like the Pap smear (Casper and Clarke 1998), by means of diverse tinkering practices that transformed both the technology and the infrastructures in which they emerged. At the same time, it was important that the vaccine would not come to problematise Pap smear-based screening. The article points to the contextually contingent nature of policymaking around new medical technologies, and the skillful care with which public health infrastructures such as immunisation and screening programmes are handled and tinkered with.

Keywords: governance, immunisation, public health, women’s health, comparative methods, policy analysis

Introduction

Much like screening (Armstrong and Eborall 2012), preventive technologies appeal to policy-makers, medical professionals and public health authorities, yet they are often received critically by target groups (Hobson-West 2007, Reich 2016). The vaccine against Human Papilloma Virus (HPV), which is sexually transmitted and widespread, is a case in point: First, in the early 2000s, medical researchers saw the development of a vaccine against some strains of the carcinogenic virus as a real breakthrough, heralding it as the ‘first vaccine against cancer’ (Gericke 2008, cited in Paul 2016: 193). Yet these hopes were not only premature but highly contested, as sociologists have documented extensively (cf. Casper and Carpenter 2008, Epstein 2010). Second, the vaccine unsettled established ways of cancer-screening using the Pap smear, which now came to be reconsidered in light of a newly emerging HPV-based paradigm – for over 90 per cent of cervical cancer was found to be causally related to strains of HPV. The vaccine thus had to make room for a new role as a preventive tool among current

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concepts of public health and related professional as well as institutional traditions. In this paper, we ask: How did the HPV vaccine put extant public health programmes to the test and with what effect?

To our knowledge, the competing logics (e.g. Mol 2008) – or, as we view them, ‘infrastructures’ (Star and Ruhleder 1996) – of screening and prevention have not been addressed in the state of the art on HPV policy. Extant scholarship either focuses on issues of gender, sexuality (or, rather, its exclusion), and pharmaceutical interests (Casper and Carpenter 2008, Mamo and Epstein 2014, Wailoo *et al.* 2010), while the emergence of HPV-based screening has mainly been studied in the context of a wider trend of ‘molecularisation’ (Hogarth *et al.* 2012). For sociologists of immunisation, on the other hand, HPV has not been a focus as their research typically addresses resistance against ‘regular’ childhood vaccines (Blume 2006, Hobson-West 2007, Reich 2016).

This disconnect between studies of HPV prevention and HPV-based screening is puzzling given the impact of the vaccine on, if not conflict with, public health programmes across countries (Paul 2016): Not only did the HPV vaccine have to match legal, social, and technical requirements of national immunisation programmes (NIPs) grappling with recurrent waves of vaccine hesitancy (Reich 2016); it also had to be integrated alongside historically established screening programmes. The success of screening had been celebrated as key milestones in women’s health (Casper and Clarke 1998), yet now HPV vaccination was making similar promises to revolutionise women’s health. These promises and potentials produce divergent interpretations, concerns and policies across countries. In the study of such diversity (Aarden *et al.* 2011), the prominent ‘coproduction’ paradigm (Jasanoff 2004) has been immensely instructive in cross-national analyses, yet it pays little attention to conflict and negotiation, unlike critical policy studies (Wagenaar 2014). Inversely, critical policy scholars have yet to refine conceptual understandings of (emergent) technologies (cf. Uttley 1991).

In view of these gaps, this paper presents a comparative qualitative analysis of the emergence of the HPV vaccine in two countries, Austria and the Netherlands. Both countries feature a publicly funded health care system with voluntary, and tax-funded participation in vaccination as well as screening, and universal coverage based on the principle of equal access. Yet the HPV vaccine emerged at different time points and was backed by different implementation strategies – for example, target groups of HPV vaccination differed by gender and age. To understand these differences, we explore how HPV-based technologies came to be integrated into existing public health infrastructures and how they exposed their shortcomings at the same time. In this sense, our comparative approach cuts across two axes of difference: first, country-based differences, and second, infrastructural differences within those cases (i.e. screening and prevention). Based on desk research, interviews ($n = 21$, see appendix online), and secondary analysis of earlier observations, our analysis documents the ‘infrastructural frictions’ that occurred, first, between the novel vaccine and national immunisation programmes (NIP), and, second, the friction – and eventual realignment – between NIP and screening infrastructures already in place. The next section explicates our object of analysis and discusses the extant literature, while the third section begins to unfold what we label an ‘infrastructural approach’. The fourth section presents the two country-based cases, and the fifth section discusses the findings in light of our comparative approach and our contribution to the extant literature.

A contested vaccine: towards a new approach

Cervical cancer is the second most common cause of cancer-related death in women worldwide (Boulet *et al.* 2008), despite the success of screening programmes employing the Pap

smear test, named after its designer Georgios Papanicolaou. The discovery of a causal link between some strains of HPV and cervical cancer in the 1990s led to diagnostic and preventive technology development, which culminated in the approval of two vaccines, in 2006 and 2007, respectively by the United States Food and Drug Administration (FDA) and the European Medicines Agency (EMA). Critical observers raised a variety of economic, ethical, and societal objections to the novel vaccine. The notion of immunising children against a sexually transmitted infection was received with some opposition both in North America and Europe (Connell and Hunt 2010, Epstein 2010). Conservatives feared that young girls could be 'sexualised' through the vaccine, and parents' beliefs often reflected this discourse (Reiter *et al.* 2009). Feminist critics questioned the gendered nature and impact of the vaccine on women's lives (Casper and Carpenter 2008, Mara 2010, Mishra and Graham 2012). Health economists embarked on complex modelling exercises in attempts to estimate the cost effectiveness of the new, and rather cost-intensive vaccine. When studies began to indicate that men could not only contract genital warts through HPV infection, but could also develop penile cancer, anal cancer, and cancer of the neck, gay activists in the US began to lobby for administering the HPV vaccine to men too (Epstein 2010) – as did scholars who objected to the gendered and heteronormative nature of HPV campaigns. Some experts, in turn, questioned the long-term effectiveness of the vaccine and warned against false feelings of safety and protection as the vaccine protects against certain HPV-types only (Adams *et al.* 2007); it could thus not replace Pap smear-based screening programmes. Finally, commentators accused the pharmaceutical industry of 'pushing too hard' for the endorsement of the vaccine in NIPs and concealing uncertainties regarding long-term effectiveness and side-effects. In sum, the HPV vaccine was not only promising that it could, for the first time, help prevent cancer, but was also highly contested.

The efforts we observed in HPV policymaking are reminiscent of historical efforts to make the Pap smear 'good enough' and 'the right tool for the job' (Casper and Clarke 1998, Paul 2016). This means that much like the Pap smear, the HPV vaccine did not only have to fulfil technical criteria, but also come to satisfy pertinent 'social worlds' to become embedded in them (Clarke and Star 2008, Paul 2016). In the case of the HPV vaccine, the social worlds of both cervical cancer screening and immunisation were involved, and included clinicians, policymakers, parents' groups, and women's health advocates. In adopting and adapting to these different social worlds, the HPV vaccine was reshaped to match historically contingent infrastructures of public health and simultaneously changed those very infrastructures. Given these conceptual premises, our research question then becomes: How did the HPV vaccine put extant public health programmes to the test and with what effect? Below, we further develop this conceptual argument in the context of an 'infrastructural approach' to policy, thus bringing together insights from critical policy analysis and science & technology studies (STS).

An infrastructural approach to vaccination policy

The renewed importance of virology and the uncertainties around the vaccine had implications not only for prognosis, but also for policy infrastructures that predated the HPV-paradigm. In line with STS, we propose that technologies are actively shaped and reshaped to 'fit' into a particular infrastructure and need to make room for themselves among prevailing concepts, institutions, and power relations (Löwy 2010). This entails conflict and negotiation, as documented in the establishment of the Pap smear (Casper and Clarke 1998). In this 'becoming good enough', technologies may undergo reshaping and reworking, and their deficits become concealed when they come to be temporarily stabilised (cf. Singleton 1998, Singleton and Michael 1993). This reshaping by and in context is, of course, contingent upon prevailing

institutions and practices at a given time, in a given place. Accordingly, in our situated comparative approach, we remain sensitive to the specificities of the two political contexts and their historically shaped, and contextually contingent public health policy infrastructures. Our study thus adds not only to our understanding of HPV policy, but to an appreciation of how new technologies ‘put infrastructures to the test’ across (national) contexts.

In our understanding of the impact of the HPV vaccine and its interaction with the NIP, the concept of infrastructures is key (e.g. Bowker and Star 2000). Infrastructures are commonly described as substrates: something upon which something else ‘runs’ or ‘operates’ (Schick and Winthereik 2016, Star and Ruhleder 1996). Thus they carry a more material and stable connotation than Mol’s (2008) notion of a ‘logic’. Yet STS scholars have highlighted the relational connotation of infrastructure, underscoring how infrastructures mediate exchange over distance, bringing different people, objects and spaces into interaction and forming the base on which to operate economic and social systems (Larkin 2013). Hence, infrastructures are informative objects of study, in the sense that they only become real in relation to practices (Star and Ruhleder 1996) – organisational or other.

Likewise, the HPV vaccine becomes acutely real and meaningful – that is, of different meanings to different social worlds – when we try to place it in the infrastructural context of NIPs, the invested social worlds, and the practice of public health. Recent work in STS has emphasised that infrastructures, while purely technical in the public imagination (Bruun and Morita 2015: 82), are fundamentally social. Bruun and Morita (2015: 83) add that infrastructures are fluid and dynamic entities, that their components are subject to change, ‘but also the forms of politics, society and environment generated by these systems’. Infrastructures thus entail and produce new forms of politics, agency, and sociality (Bruun and Morita 2015). Immunisation programmes – including vaccination registries, surveillance, research, and street-level public health workers – are a case in point. Our theoretical argument is hence two-fold: first, when a new medical technology emerges, it is not only shaped by the institutional context in which it emerges, but *transforms* it at the same time. We capture this interaction between technology and context as one of ‘infrastructural friction’. Second, we conceptualise NIPs as infrastructures that at once represent particular sociotechnical orders and actively produce such orders.

We thus view infrastructures – here, that of the NIP and its counterpart, the cervical cancer screening programme – as dynamic, but sociomaterial entities composed of multiple components, including technologies and ways of doing things (e.g. vaccination plans, Pap smears). In this sense, public health infrastructures are contingent entities that hold and serve to both enable and protect technologies and tools that are ‘good enough’ (Casper and Clarke 1998) at certain spatial-temporal moments. Introducing new elements, in turn, causes ‘infrastructural friction’, and in our present case, transformation and realignment.

Research design

To examine how institutional friction plays out differently across the two contexts of Austria and the Netherlands, we draw on three sources. First, the infrastructural approach required desk research on professional responsibilities, institutional relations in public health, and documents such as vaccination plans and screening guidelines. Second, we conducted in-depth interviews ($n = 21$, see appendix online), with public health officials, clinicians, and researchers in both countries, using both the desk research to identify the experts and, subsequently, the snowball method. The Austrian case study, presented elsewhere in a different form (Paul 2016), was undertaken by author 1. The Dutch case was executed by all three authors. All interviews, which lasted one hour on average using individual interview guides, were recorded

and transcribed verbatim after permission from the respondents. We obtained narrative accounts of policymaking with a focus on practices, but also explored, for instance, the mutual positioning of social worlds, and what respondents perceived to be key events. Third, we draw on a secondary analysis of data collected in an earlier participatory ethnographic study of the introduction of HPV vaccination in the Netherlands in which we engaged in the assessment of HPV vaccination for the Dutch Immunisation Programme at the Centre for Infectious Disease Control (*Centrum Infectieziektebestrijding*, Cib), part of the National Institute for Public Health and the Environment (*Rijksinstituut voor Volksgezondheid en Milieuhygiëne*, RIVM) (Wallenburg and Bal 2008). We interviewed the respondents again (late 2014–early 2015) to gain insights concerning the emergence of the HPV vaccine over time. This diachronic approach allowed us to develop a particular ‘ethnographic sensitivity’ (Prainsack and Wahlberg 2013) to the role of political spaces (institutions, policies, online and offline media, school yards, public health centres) in the making and remaking of policy infrastructures. Accordingly, the analysis below presents an account of infrastructural interaction with the vaccine, rather than individual agents’ accounts.

New vaccines and old infrastructures: creating a ‘good enough fit’

Public health in Austria¹

In September 2007, the Supreme Health Council (OSR), an advisory committee to the Ministry of Health (MoH), released a non-binding recommendation of HPV vaccination for girls and boys in Austria. Shortly afterwards, a young girl died a few weeks after her HPV vaccination, and a debate began to emerge, featuring concerns of vaccine safety and calls to review the NIP prior to adding any new vaccines – for example, by improving data collection in vaccination registries. In what we interpret to be an attempt to depoliticise the emerging vaccination debate, the Minister of Health, Andrea Kdolsky, commissioned a health technology assessment (HTA) report, labelled as an ‘economic evaluation’ of the vaccine. The HTA report solidified the earlier ministerial stance that the safety and effectiveness of the vaccine had yet to be proven (Paul 2016). In addition, it recommended investing more heavily in improving the screening programme – responding in part to criticisms by women’s health advocates, but arguably equally so to concerns about safety, long-term effectiveness, and financing. The Minister decided not to include the vaccine in the NIP – quite in contrast to her European counterparts. What can we learn from this episode – which, as we shall see below, was only one of many moments of Austrian HPV policy – about Austria’s public health infrastructure?

To begin with, Austria features a federalist social health insurance system; vaccination in the NIP is voluntary and tax-funded. The aforementioned advisory committee (OSR) meets regularly and publishes annual updates, yet its *modus operandi* appears less transparent than its European counterparts. The cervical screening programme is institutionally separate, but opportunistic as much as the NIP is: it relies on individual patients’ initiative, rather than a call-recall system. Despite frequent criticism and known weaknesses in Pap smear reading (Singleton 1998), quality assurance is not compulsory (Rasky *et al.* 2013, Interviews 6 and 7). Notwithstanding Austria’s small size, its federal states share competencies with the federal government in public health. The NIP similarly features this intricacy, for implementation of the NIP is handled at the level of federal states (Paul 2016). A vaccination pass is stapled into the ‘mother child health pass’ (MCHP) – yet while completing particular antenatal and pediatric consultations documented in the latter is linked to receiving benefits, immunisation is not.

¹The discussion of the Austrian case draws strongly on Paul (2016).

The sociotechnical design of the MCHP does, however, invoke the notion of parental responsibility.

Vaccination rates, however, are comparatively low in Austria, with only 76 per cent of infants being immunised against MMR (OECD 2015). Opposition to vaccination is not limited to religious objections, but includes views of immunisation as an unnatural interference in the course of childhood, fears of ‘unnatural’ adjuvant substances, and prevalent beliefs that vaccination may cause allergies (OTS 2013, Interview 1, Paul 2016). Moreover, low vaccine uptake may be related to the fragmented immunisation infrastructure, where no call-and-recall system exists. Vaccines in the Austrian NIP are administered in multiple sites, including local health centres and schools, yet school doctors are not obliged to, nor insured for, vaccinating children in federal public schools (*Bundesschulen*). This once again reveals that the Austrian public health infrastructure strongly relies on individual efforts (i.e. those of parents, professionals, school directors), in contrast to the solidified, programmatic nature of Dutch public health infrastructures, where the state guides and directs public health action in a more rigid manner while maintaining the notion of choice, as we will point out in more detail below.

Adapting and adopting the vaccine in Austria

What implications did this fragmented infrastructure and politically sensitive nature of vaccination in Austria have for HPV policy? In early 2008, as mentioned above, the Minister of Health decided to reject the inclusion of the vaccine in the NIP based on financial arguments and concerns regarding safety. This speaks to a shift in public narratives where the risks of vaccines are seen to outweigh their benefits (Berezin and Eads 2016). Yet while vaccine developers continued to tinker with and study the HPV vaccine, room was made for it in Austria’s public health system, using a different path. First, HPV researchers broke new ground when results suggested promising effectiveness for the prevention of anal cancer, the incidence rates of which had been growing in both women and men who have sex with men. Similarly, head and neck squamous cell carcinoma, a disease previously largely attributed to environmental exposures, was now linked to infection with some strands of HPV. Clinical researchers at the Medical University of Vienna continued to disseminate this evidence and were themselves also involved in clinical trials (Interview 7, Paul 2016).

Second, regional policy experiments with subsidising the vaccine were initiated in 2007 and 2008 to enrol local support. These regions functioned as a testing bed for the societal response to the HPV vaccine, yet these policies also reaffirm the fragmented nature of the NIP. Third, the vaccine’s supporters – key MoH officials and clinical researchers – continued to actively collect and disseminate evidence in support of the HPV vaccine in relevant networks within a tightly knit policy community. Inviting experts from abroad to exclusive seminars at the MoH added to the notion that more ‘objective’ data was being collected in this phase. HPV policy was discursively managed as an expert debate, rather than one that required public debate. In our interviews, critics of the HPV vaccine, such as feminists, were positioned as anti-vaccinationists (*‘Impfgegner’*, Interviews 1, 2 and 7) or as insufficiently knowledgeable due to their lack of clinical expertise (Interview 7, Paul 2016).

In turn, key policy officials in charge of vaccination at the MoH sought to counter further problematisation of the NIP. Now headed by Minister Alois Stöger, considered generally in favour of HPV vaccination (Interview 1), the MoH strengthened the NIP by adding two notably less contentious vaccines in 2012, against pneumococcal and meningococcal infections. Policy officials also tinkered with the infrastructure by investing in a more visible construction of the importance of the HPV vaccine: statistical surveillance of HPV infections in Austria began to explicitly and equally refer to women and men, and all cancers caused by HPV (Paul 2016: 197). This meant that the vaccine was being discursively detached from women’s bodies

alone and helped construct a shared, rather than gendered need for the vaccine. Hence, the HPV vaccine served a much wider public, adding to the Pap-based screening instead of competing with it. While also other vaccines, such as MMR (Dew 1999) have relied on such visible constructions and quantifications, the gendered aspect of the HPV vaccine, we find, takes a particular kind of infrastructural tinkering. At the same time, the vaccine was being removed further from gynaecologists who, in media reports (Paul 2016, cf. Stöckl 2010), had been perceived as too entangled with the pharmaceutical industry.

Furthermore, evidence emerging in 2010 and onwards (Schiller *et al.* 2012) suggested that administering two, rather than three doses, offered adequate protection, making the vaccine less of an organisational and financial burden (Interview 7), and assuring the feasibility of school-based delivery (Interview 13). Furthermore, the cost of the vaccine decreased significantly, while its prophylactic range had grown and it had already been licensed for administration to children as young as 9 years old. Put differently, by 2013, the HPV vaccine had (been) turned into a product that was rather different from the vaccine discussed in 2007 (Paul 2016).

In August 2013, the Minister of Health announced: ‘We have expanded the free children’s vaccination programme step by step. I am certain that, with the inclusion of the vaccine against HPV, we will be offering an essential contribution to the health of our children. We will save lives.’ (BMG 2013; cited in Paul 2016: 197). Enhancing the effectiveness of this statement, the decision was presented as beneficial to all. To underscore the general support of public health, the inclusion of the HPV vaccine was announced by three key public health players: the Minister of Health; Pamela Rendi-Wagner, the director of public health at the MoH and immunologist by training; and the President of the patient association *Krebshilfe*, Paul Sevelda, who also practices gynaecology. The vaccine would be offered to all children as young as 9 years old and the minister highlighted the innovative, gender-neutral nature of Austrian HPV policy. This newly invoked understanding of the HPV vaccine as a ‘regular’ childhood immunisation also implied that professionals typically considered trustworthy – pediatricians – could deliver the vaccine. Thus, not only was the vaccine desexualised, but its infrastructure (i.e. the designated administrators of the vaccine) had been transformed, too. Gynaecologists were no longer in charge of HPV vaccination (Paul 2016).

The HPV vaccine is now administered in schools or in private practices by pediatricians and GPs. Direct parental consultation can largely be by-passed in school-based vaccination, or at least formalised in standardised health status questionnaires and a parental consent form. Yet any questions or concerns children may have regarding HPV and sexual transmission are compartmentalised to a professional pediatric setting, much like the Pap smear is in gynaecological practices (Paul 2016). Turning the HPV vaccine into a regular vaccine made it ‘good enough’ for public health in Austria.

At the same time, the fragmented nature of the NIP was left intact, and the renewed vaccination policy discourse focused on maximising vaccine uptake and providing information, or, as in the recent campaign for the MMR vaccine, with fear-inducing slogans. This way, opposition to HPV vaccination was easily sidelined as irrational, including that of experts in the field, such as the HTA community, and those public health experts calling for structural reforms to the NIP prior to any additions. Likewise, the cervical cancer screening programme was left unreformed, screening continues to be opportunistic, and – a number of dispersed quality improvement projects aside – quality assurance of the Pap smear remains a matter of professional associations, in line with the high degree of professional autonomy in Austria. Nonetheless, the gender-neutral approach of its HPV policy enabled policy officials to label the Austrian NIP as a ‘European frontrunner’ in HPV policy – concealing the experienced difficulties in making the vaccine ‘good enough’ over a period of seven years, as well as the fragmented nature of the NIP and screening infrastructures.

Public health in the Netherlands

Given the highly institutionalised role of the youth health services and the programmatic approach of vaccine policies, most parents perceive immunisation as something quasi-compulsory in the Netherlands. Likewise, the Dutch cervical cancer screening programme is based on a call-recall system, and cervical cancer is less common in the Netherlands than in most other countries (Gezondheidsraad 2011).

Vaccine uptake is comparatively high, with 96 per cent of infants being vaccinated against MMR (OECD 2015; cf. RIVM 2006) despite its voluntary nature, and to public health officials, protecting this high uptake is of utmost importance. Nonetheless, also here, a small, yet identifiable segment of the general population opts not to have their children vaccinated. First, traditional orthodox Protestant communities, and second, a more recent movement of so-called ‘critical parents’ refusing vaccination out of fear for side effects and adverse reactions, or the belief that vaccination may impair the developing immune system (Blume 2006, Streefland 2001). These parents are typically associated with higher levels of education (Veldwijk *et al.* 2015). While often labelled irrational in our interviews with policymakers (interviews 10 and 15) and observations of scientific deliberations, this subcommunity is nonetheless included in the NIP: anthroposophical health centres cater to their wishes for alternative vaccination schedules (Interview 16; Geelen *et al.* 2016, cf. Cunha and Durand 2013). This exemplifies the highly programmatic and thoroughly organised nature of the Dutch NIP – unlike its opportunistic and loosely organised counterpart in Austria.

We propose to understand this feature of the Dutch NIP as one of ‘organised diversity’, which is likely to increase vaccine uptake as it embeds deviance from the norm in governmental practice. Second, we propose that the underlying infrastructures, which have been treated largely empirically, not theoretically, in the existing literature (Blume 2006, Geelen *et al.* 2016, Horstman 2013), are key biopolitical technologies that deserve greater attention. For instance, the vaccination registry *Praeventis* allows for individual level recording of vaccine uptake as well as epidemiological surveys of both vaccinated and non-vaccinated populations (van Lier *et al.* 2012). It thus not only enables the prediction of likely outbreaks in regions where, due to for example, religious affiliation with Christian orthodoxy, vaccination uptake is low, but also makes it virtually impossible to ‘avoid’ the NIP, unlike in our Austrian case. Below, we highlight the similarly programmatic character of Dutch HPV policy and cervical cancer screening.

From ‘rolling out’ to ‘weaving in’

In the Austrian case, early HPV policy rejected the vaccine because of its novel, uncertain, costly, and politically sensitive character – in short: it was seen as a vaccine different from others. Yet in the Netherlands, early HPV policy did not highlight its different character, but rather treated it as a vaccine just like any other that could be effectively ‘rolled out’ in the well-established and programmatic public health infrastructure. This public health infrastructure largely focuses on the effectiveness of public health measures – both in terms of biomedical effects (‘protection’ and ‘health improvement’) and cost-effectiveness. To this end, a robust policy infrastructure has been established: It includes, first, a scientific advisory committee at the Health Council (providing ‘state of the art’ scientific advice on biomedical effectiveness and cost-effectiveness) and second, a research and executive agency in the form of the Centre for Infectious Disease Control (*Centrum Infectieziektebestrijding*, CIB) at the RIVM that, in collaboration with the Health Council, advises the MoH on (the adaption of) vaccines for the NIP, and monitors vaccine uptake and effectiveness. The assumption underlying this infrastructure is that if (cost) effectiveness is proven and the NIP is scientifically monitored and robust, citizens will trust expert advice and partake in the programme. This programmatic

approach also becomes apparent in the administration of vaccines: infants (age 0–4 years) are vaccinated during regular health and development check-ups. Parents are invited to these visits, and in case of a no show, receive a reminder, and/or a house visit. Other age groups are immunised in cohorts at local sports halls, making vaccination a public and collective event, quite in contrast to the private and individual nature of the choice for vaccination.

In line with this programmatic approach, Ab Klink, then Minister of Health, commissioned a vaccine assessment from the Dutch Health Council for HPV vaccination. Simultaneously, the Clb was commissioned to assess the possibility of introducing HPV vaccine in the NIP in 2006. Our participant observations of the committee tasked with identifying the appropriate criteria to assess the HPV vaccine at the Clb (2006–2007) showed that concerns regarding societal responses and its uncertain long-term effectiveness played a role, too, besides anticipated costs and effectiveness (Boot *et al.* 2008). Moreover, the committee was careful to, on the one hand, consider the HPV vaccine as a new way of protecting against cervical cancer, while, on the other hand, avoiding a problematisation of the screening programme. Both NIP and screening programme were considered well-functioning public health programmes with high levels of trust presumed. Similarly, the Health Council used established criteria to evaluate the vaccine for the NIP, reflecting a very programmatic approach: severity and extent of the disease, effectiveness, acceptability, effectiveness, and priority of the vaccine (Gezondheidsraad 2008). This procedure underscores the expert-based paradigm underlying the Dutch NIP. For instance, the Health Council as well as the Clb committee discussed the target group of the vaccine (girls, boys, age groups), organisation of vaccination (schools or local public health providers), the possible need for booster vaccination, the desirability of a catch-up programme, and the impact of the vaccine on participation in the national screening programme for cervical cancer (Boot *et al.* 2007). Following deliberations of nearly one year, the Health Council published a 200-page report in favour of HPV vaccination (Gezondheidsraad 2008). The MoH, which had already announced it was to follow the Council's recommendation (Interview 21), quickly adopted the advice and included the HPV-vaccine for girls of 12. In addition, a catch-up programme was announced for girls 13–16 years old to enable a higher protection rate.

How do these assessment practices compare to the Austrian case? The Dutch Health Council regularly publishes lengthy reports on its activities and assessments, displaying its transparency regarding vaccination policies – quite in contrast to its Austrian counterpart. Furthermore, in the case of HPV, representatives of the pharmaceutical industry but also a representative of the 'critical parents' movement mentioned above (*Nederlandse Vereniging Kritisch Prikken*, NVKP) were invited to attend parts of the deliberation and to provide input. Beyond its participatory quality, this policy practice, we propose, once again points to the anticipatory mode of vaccination policy in the Dutch context. At the same time, it brings to the fore a rather technocratic practice in which a mechanism for voicing (Hirschman 1970) was introduced to not only hear, but, perhaps to manage the anticipated opposition, as is regular practice in the Council (Bijker *et al.* 2009). Finally, as witnessed in our observations in 2006–7, among HPV advocates, there was 'always a consensus that the vaccine was good in itself' (Interview 21) even prior to formal evaluations, given its potential to 'save 200 lives per year, which is a relatively high number for an infectious disease' (Interview 21). This indicates the dominant causal framing of cervical cancer and HPV, the meaning of the vaccine as a tool to prevent an infectious disease, and finally, the idea that the vaccine was 'good enough'.

With the vaccine considered 'good enough' early on, what kind of work needed to be done in Dutch HPV policy? While Austrian HPV policy invested – over a period of seven years – in tinkering with the vaccine, largely leaving the extant infrastructure untouched – Dutch HPV policy was not to invest in making the vaccine good enough, but rather to prevent

'infrastructural friction' with the NIP. This second phase of HPV policy consisted of institutional tinkering: HPV vaccination was moved to the general public health system in charge of prevention, the Public Health Services (PHS), thus setting HPV apart from the NIP, which is designed for children up to the age of 9 years. Policy officials were hesitant to review or even amend a well-functioning NIP as not to risk losing public trust and the comparatively high uptake of vaccinations in general (Interviews 17 and 18). Overall, the two cases thus feature opposing tinkering strategies: ultimately, Austrian policy transformed the vaccine into a regular vaccine, and Dutch policymakers accentuated its difference while trying to anticipate and soothe opposition in quasi-participatory practices.

More specifically, we propose, this approach reflects an expectation that the extant infrastructure would do the adaptation work for them: Dutch HPV policy relies on a 'rolling out' approach, driven by a more general technocratic, expert-based policy approach. This approach typically relies on framing public concerns as lay perceptions of expert matters requiring either a technical fix, or science-based monitoring. Yet this 'rolling out' approach through regional public health providers within the PHS soon proved inadequate for the HPV vaccine. Two issues emerged, with unexpected consequences for HPV policy. First, the RIVM embarked on a strongly gendered HPV campaign that focused on girls and their mothers, with an underlying appeal to making the 'right' choice. This approach turned out not to fare well in a time where social media, particularly the Dutch platform *Hyves* – at that time a popular Dutch version of Facebook – emerged as a new communication technology among teenagers. For the first time, the NIP included a vaccine that was not only to be discussed with parents, but that formed a matter of concern among young girls and their parents. It was also discussed and contested offline, at kitchen tables and in schoolyards – and led to an unprecedented amount of girls refusing vaccination. In other words, the felt need for public engagement and the gendered nature of the RIVM campaign backfired.

A second issue in early Dutch HPV policy that amplified public hesitance, was its firmly expert-driven nature, and particularly the felt need for a scientific consensus in order to protect the robustness of the NIP. We understand this dominant status allocated to biomedical knowledge as a resource for depoliticisation – much like the economisation of the vaccine by means of a unique HTA report was in Austria. The Dutch consensus-driven approach, however, failed when dissenting experts publicly articulated doubts regarding the safety and long-term efficacy and effectiveness of the HPV vaccine in 2008 (de Kok *et al.* 2008). Individual experts, particularly clinical gynaecologists, publicly raised their voice against HPV vaccination, underscoring the vaccine's uncertainties and arguing for more effective and less costly measures against cervical cancer, like improving the existing cervical cancer screening programme (Interviews 20 and 21). This points to the friction that occurred between screening and vaccination infrastructures, in addition to infrastructural friction within each of those with the emergence of HPV diagnostics and prevention. The fact that these same critics were involved in screening infrastructures – not only as advocates, but as their active administrators – illustrates the friction between the two infrastructures particularly well.

What made these public appearances even more meaningful for HPV policy in the making was the membership of one of the scientists in the Health Council, albeit not on the cervical cancer committee itself, but as a member of the Council's Standing committee on Health law and ethics. She was publicly accused of harming public faith in the vaccine, and with that, trust in the NIP. In that sense, the dissenting experts' position can be understood as instances of what Michael (2012) discusses as 'overspilling' the political framing of an event, or as 'misbehaviour'; those activities or actions that do not make sense within the framing of the engagement event, but actually disturb the collective engagement – in this case, the creation of a shared understanding of the goodness of the vaccine for the NIP.

What consequences does such ‘misbehaviour’ (Michael 2012) generate in the pertinent infrastructure? In response to the public appearance of critical experts, leading public health officials criticised this group of scientists heavily, suggesting that they had broken a silent agreement to only voice dissent behind closed doors (Interviews 19 and 21). In Austria, policy officials had managed to silence opposition by marginalising their critique, and positioning it as ideological and scientifically unfounded. In the Dutch context, on the other hand, the very employment of the scientific method – publications in journals, employing numbers, performing expertise – helped to set the stage for not only a public, but also a scientific controversy.

Given the failure of the consensus-driven, rolling-out approach, how was the HPV vaccine accommodated eventually, and with what transformative effects on the pertinent infrastructures? Neither the NIP nor the screening programme remained unaffected by the HPV vaccine. First, the RIVM campaign shifted in its communication regarding HPV (Interviews 15, 16 and 18). Guided by consultants in this process – an unusual practice in this context – the RIVM campaign steered away from its focus on mothers’ and daughters’ choices and refers to ‘families’ as decision-makers regarding vaccinations instead. Furthermore, our respondents (Interviews 17 and 18) indicate that they had not anticipated the role of social media, as a result of which they were unable to steer public debate and could no longer solely rely on established science-based policy instruments. This led to an increased investment in risk communication skills and more attention paid to the role of social media (van Keulen *et al.* 2013). Once again, this points to a lasting transformative effect of the vaccine on the infrastructure.

Second, while efforts were made to keep debates on vaccination and screening apart, as to protect both programmes, HPV has been ‘weaved into’ the cervical cancer-screening programme more recently. Starting in 2017, the screening programme will operate on the basis of testing samples for the presence of high risk HPV in triage; only positive samples will then be examined for cell changes (RIVM 2015). In addition, in an aim to increase participation rates in the screening programme, the RIVM will offer self-sampling for high-risk HPV infections. The self-sampling test is targeted at women who do not participate in the regular programme (so-called ‘non-responders’) for, for example, religious or personal reasons. As a public health practice, self-sampling not only has the potential to increase the construction of evidence justifying HPV vaccination – it also speaks to the ability of Dutch public health infrastructures to accommodate different publics in its approach.

Overall, the screening programme was technically set apart from the HPV-screening debate, not only protecting the screening programme from the political upheaval, but also underscoring the technical approach of Dutch public health protection. Again, this speaks to the strong institutional efforts invested in public health here, which stand in stark contrast to the reliance on individual efforts in Austria. We shall explore the implications of these differences in our concluding section below, as well as the consequences for the co-existing approaches of combating cervical cancer: vaccination and screening.

Discussion and conclusions

Efforts to introduce the HPV vaccine against the backdrop of existing cervical cancer screening programmes are reminiscent of historical efforts to make the Pap smear ‘good enough’ (Casper and Clarke 1998). In this process, conflict and dissent becomes concealed, and a technology becomes embedded in social worlds. Our paper takes up conflict and negotiation as an object of analysis, and in doing so, mobilises the concept of ‘infrastructural friction’. With this concept, we bring together STS and critical policy studies and are able to trace and analyse the emergence of the HPV vaccine in Austria and the Netherlands.

We find two sets of frictions: first, the temporal, technical, and social alignment between two infrastructures – cervical cancer screening and primary prevention in national immunisation programmes – and, second, the infrastructural friction that occurred within NIPs when the novel vaccine did not easily match established assessment criteria and prevailing concepts. In Austria, policymakers invested strongly in tinkering with the vaccine, leaving the fragmented screening and prevention infrastructures in need of reform. Opposition to the HPV vaccine was continuously conflated with resistance to vaccination in general, and critics were rhetorically sidelined to avoid unlocking the kind of debate witnessed in the early phase of HPV policy (Paul 2016). By transforming the vaccine into a vaccine ‘just like any other’ over time, and having it administered by pediatricians, the vaccine was not only desexualised but also disentangled from cervical cancer screening. The two public health infrastructures were at once protected and kept apart. Our earlier observation that the two sets of emergent technologies are treated separately in sociological scholarship thus reflects strategies of creating institutional space for the new vaccine.

In the Netherlands, the early ‘rolling out’ approach and the reliance on biomedical knowledge as the sole legitimate input for policy failed to convince – and perhaps even encouraged – an increasingly critical citizenry. The HPV vaccine could not easily be embedded within the solid and programmatic NIP infrastructure, nor could the debate be captured as an exclusive expert matter. The ‘weaving in’ approach we observed, as well as the ‘inescapability’ of the public health surveillance infrastructure reveal the efforts of policymakers to regain ownership of both vaccination and screening matters while keeping the two apart. These efforts culminated in the creation of a separate infrastructure for HPV vaccination and increasing inclusion of social-scientific expertise in policymaking.

Beyond these specific findings, the loose nature of Austria’s public health programme and the programmatic and solid character of screening and prevention in the Netherlands have several implications. First, in Austria, the relative strength of public health infrastructures continues to rely on individual efforts – those of patients, parents and professionals. At the same time, the loose nature of public health also creates room for social, organisational, and regional diversity or even pilot projects – as in the 2007 and 2008 regional experiments with HPV vaccination – and thus enables the emergence of different kinds of contextual alignments between infrastructures and technologies. In contrast, the rather rigid nature of infrastructures in the Netherlands may imply that only innovations that ‘fit’ these infrastructures are able to emerge, even if those are then more quickly absorbed than in other contexts, such as Austria. This ought to be explored further in future comparative research. Third, the reliance on individual efforts in Austria also implies that women can seek specialist care if they feel concerned. This is virtually impossible in the Netherlands – where the programmatic nature of public health limits, if not forecloses, individual initiative (for additional Pap smears) despite a clear discursive trend towards personalised responsibility for health prevention and individual empowerment. Arguably, there is then a conflict between the biomedical statistics-based health policy and the individualism invoked in contemporary policy discourse (cf. Blume 2006).

We conclude that, despite considerable differences in the reception of the vaccine and its implementation across countries, neither infrastructure nor technology was left unchanged by its emergence in political contexts. Our mobilisation of the concept of ‘infrastructural friction’ is not only helpful in bringing together disciplines – or perhaps social worlds, those of sociology and critical policy studies. It also offers new tools in studying emerging technologies comparatively. Future research may then consider to what extent infrastructures ‘learn’ when new technologies become adapted and adopted, and how not only technologies but also additional social worlds (e.g. social scientists) become embedded in them.

Address for correspondence: Katharina Theresa Paul, University of Vienna, Faculty of Social Sciences - Department of Political Science, Vienna 1090, Austria.

E-mail: katharina.t.paul@univie.ac.at

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix: List of interviews.

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