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Acting with 'facts' in order to re-model vaccination policies: The case of MMR-vaccine in the UK 1988

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Abstract

In October 1988, the MMR (measles, mumps and rubella) triple vaccine was introduced in the UK. This study analyses the process of gathering and communicating factual evidence to support the decision made in order to implement the triple vaccine and to renew the prevailing vaccination policy. The study shows that implementation of a new national vaccination strategy is a not single act of decision-making, but a heterogeneous process of *acting with facts*, which grounds the decision itself on a solid body of evidence. This study develops the concept '*acting with'* as a way to describe how facts are acted upon in the context of utilisation. In particular, the concept of *acting with* is refined as *enacting*, *interacting*, and *reacting* in the case of implementing the MMR triple vaccine in the UK (1987). These three modalities of *acting with facts* reveal the dynamic, practice-driven side of evidence. The study is based on archived documents held at the Health Protection Agency, Colindale.

Introduction

"Gracious in fact if not in word." Jane Austen, *Emma* (1815)[1]

Twenty years ago, in October 1988 the MMR (measles, mumps and rubella) triple vaccine was introduced to the UK national vaccination scheme. To implement a new national vaccination strategy seems like an act of a single decision, supported by well-established 'facts'. Yet, this decision and the preceding public health research have been largely forgotten since the rise of the media-maintained[2] speculation of the vaccine side effects. The focus of this paper is not, however, on the MMR

[1] Thanks to Mary Morgan for drawing my attention to this quotation. In general, the idea of "acting with facts" was inspired by theme of the EASST/4S08 conference: "Acting with Science, Technology and Medicine."

[2] Cf. Ben Goldacre's column in the Guardian, 30.8.2008 about the persistence of the MMR-controversy.

controversy. The implementation of a new vaccine is a way to look at how to build a bridge from knowledge production to its utilisation. This study leaves the closed worlds of laboratories behind and follows the process through which reliable pieces of information are gathered, circulated, re-interpreted and communicated within the domain of application. This phase is grounded on monitoring, and decision-making practices. So, the main ethos of this paper is to develop an account of the active side of facts, and how they are dealt with by practitioners, researchers, and policy-makers. The aim is to show how a commonly held view of facts as robust, detached pieces of reliable knowledge is complemented by the ways in which they are *acted with* throughout the processes of utilisation. Hence, the main contribution of this study is to discuss the various forms of active engagement with knowledge that will result as an accumulated body of evidence to support the decision-making process. In order to keep this perspective, the study develops a concept of *acting with* facts and elaborates in particular three modes that reflect either "acting on the basis of facts" or "doing things with facts"[3]. *Acting with* as a concept aligns with connotations, such as, making sense of, manipulating, "getting one's hands on" and considering a fact or a set of facts as a fixed point for further actions.

Through the story of the triple vaccine, this study reflects the concept of facts from a new perspective. What is actually the facts-evidence relation? Often, one might think that facts are the building block for evidence. Think of, for example, the evidence data-bases, such as the Cochrane collaboration: they "pile" facts from various scientific studies, classify them and produce numerical reports of evidence for a particular risk. It seems that as a collection of facts, evidence is detached from the

[3] I wish to thank Mary Morgan for a brief, stimulating discussion that clarified these aspects of *acting with*.

original context of production, and is regarded as universal and widely applicable. However, this study aims to open the 'black-box' of impersonal evidence and thus joins the choir of similar voices. Various studies have emphasised the rhetorical uses of evidence, the hidden but purposeful production processes or the relevance of the heterogeneity of evidence that helps to challenge the hierarchical view and provides a more concise understanding of the phenomena (e.g. Petticrew and Roberts, 2003, Lambert, 2006). Relating to these discussions and by focusing on facts as acts or deeds, this study, hence, explores how different actors engage with facts in the context of utilisation, i.e. in decision-making processes.

The article is structured in the following way. I shall, first, develop the conceptual framework that relates a fact to an action or deed: *acting with*, and introduce the research setting and materials. Secondly, the analysis of the three modes of *acting with* is presented in the context of the three vaccine-preventable MMR diseases (measles, mumps and rubella) in the UK. Finally, I shall discuss the broader indications of this actor-centred account of utilizing factual knowledge.

Acting With Facts

> Epidemiology at any given time is something more than the total of its established facts. It includes their *orderly arrangement into chains of inference*, which extends more or less beyond the bounds of direct observation. Such of those chains as are well and truly laid guide investigation to the facts of the future; those that are ill made fetter progress. (Wade Hampton Frost, emphasis added)

As it is often considered, a ‘fact is a fact is a fact’ – a solid piece of well tested knowledge. However, this study shows how our current understanding of ‘facts’ can be linked back to the earlier English use of the

word – that of an act. In other words, the analysis focuses on the ways in which facts about the MMR diseases were acted upon prior to the decision to implement the vaccine to the national vaccination scheme. The study develops three modes of *acting with* facts: *enacting*, *interacting* and *reacting*. All these modes re-interpret what Hampton Frost suggests in terms of an orderly arrangement of epidemiological facts into chains of inference. The three modes of acting with facts develop a perspective to understand how different actors, different techniques, different sources of data were brought together and worked upon, perhaps "hammered into signposts of evidence" over time (Daston, 1992). Hence, the aim is to develop an active account of utilisation of facts within public health policy-making processes.

What are, then, facts or how they should be understood in this context? By a *fact* I refer to knowledge claims that are generally accepted within a community and that can be reliably used by and acted upon other communities, or in other contexts, once they are documented. This definition relies on Becker's (2007, p.12) "community approach" to facts: "[…] facts are only facts when they are accepted as such by the people to whom those facts are relevant." This account is vulnerable to criticism of its seemingly relativist position. Yet, the account can be read as a non-relativist, when facts are attributed *integrity*, which means that they carry a particular character or function in a particular role both within the community that produced them and that utilises them, as I have argued (Mansnerus, 2008). Facts have, for example, the potential of being resistant to interpretation and to remain the same despite the context, i.e. they are *stubborn* (cf. Daston, 1991; Mansnerus, 2008). Or, they are "sufficiently definitive to be taken as facts", as Morgan (2008) argues. The knowledge content, even though it is not subjected to propositional values, not considered to be true or false, creates integrity by being interpreted to

a sufficient extend similarly across the domains of production and utilisation. In other words, by integrity I mean that the different actors that enact, react or interact with facts about the MMR diseases recognise, identify and agree that these facts are solid, definitive and clearly pieces of reliable knowledge that ask to be *acted with*.

So, the study of implementing the new MMR-triple vaccine in the UK focuses on the micro-level of interactions with facts. This means that I will set aside the broader categorisations of science/policy relations (Cf. Berridge, 1999a,b), and rather provide a window through which the reader is able to see how multiple sources of facts, produced and gathered for different purposes, were brought together in order to be *acted with* in the decision-making process. In other words, process of the *orderly arrangement of facts into chains of evidence* is the main thread of this paper, which is complement to idea that facts could not leave their "spatio-temporal envelope of production", as Latour (1998, p.250) suggests. Whereas the main ethos in the social studies of science has been on the knowledge production processes, the unnecessary boundary between production and utilisation has been raised. This study challenges that and shows how *acting with* builds a bridge between the production and utilisation. This is articulated by elaborating the idea of "*orderly arrangement of facts into chains of inference*" through which *acting with* is seen as one manifestation. By conceptualising the three modes of acting with as *enacting*, *reacting* and *interacting* I will clarify how the "chains of inference" vary according to the initial set of facts that needed to be *acted with* and according to the actors involved in the process.

These three modes of "orderly arrangements" of facts echo what Sandra Jovchelovitch (2007, p. 3) argues in her study of social representations:

> Knowledge is plural, heterogeneous phenomenon that comprises of multiple rationalities, whose logics are not defined by a transcendental norm but relate to the pragmatics of contexts. [...] Different knowledges coexist, responding to different needs and fulfilling different functions in social life. Diversity of knowledge is an asset of all human communities and dialogue between different forms of knowing constitutes the difficult but necessary resource that can enlarge the boundaries of all knowledges.

What she shows of the plurality of knowledge is similar to my exploration of the facts. Something that is commonly held as a solitary piece of information is actually part of interactive processes – not only in its making but also in its utilisation. Acting with facts, hence, extends the idea of mutuality of practices, processes, techniques, actors that has long been in the centre of our understanding of knowledge production to the domain of utilisation and dissemination of facts (Cf. Latour & Woolgar 1982, Keating and Cambrosio 2003, Mansnerus 2008). *Acting with* facts also aligns with Timmermans and Berg's (2003) proposal of the flexibility of standards that allows actors to work creatively within the tendencies, for example, to standardise work practices.

Research materials and methods

This study is based on archived material[4] and documents (minutes from meetings, correspondence, scientific publications, policy recommendations) that are held at the Centre for Infections, Health Protection Agency, Colindale. Informal discussions with epidemiologists at the Department of Immunisations have been most helpful to gain broader understanding of immunisation campaigns, history of the three MMR

[4] Minutes from Working party meetings held between January-September 1987 (9 meetings). These minutes discussed in details the reasons for the change in the vaccination policy, questions related to the licensing and supply of the vaccine, educational programme related to the implementation and targets in the vaccination coverage. Correspondence covers 15 letters between Dr. M (HPA) and public health officials in England, Ireland and Australia between April-June 1987.

diseases and the need to renew the policies in the late 1980s. The analysis was guided by applying micro-sociological approach that invited me to focus on the particular and detect the changes in that. The study is informed by my previous research on modelling practices (Mattila, 2006) and it benefits from the "Introduction to infectious disease modelling" course held at the London School for Hygiene and Tropical Medicine in June 2006.

Enacting Measles in Models

> October 1988 sees the start of a major new initiative in preventive medicine – the introduction of measles/mumps/rubella (MMR) vaccine for routine childhood immunisation in place of single antigen measles vaccine. The objective of the new programme is the elimination of measles, mumps and rubella and the congenital rubella syndrome in the UK." (Miller, 1988)

As this optimistic quotation shows, the 20th anniversary of the implementation of the triple vaccine could have become a triumph of the elimination of the MMR disease. Yet, this is not the case. Current statistics show record high levels of measles cases in England and Wales[5]. The reasons for this peak in the number of the cases are various (and their closer analysis is beyond the scope of this paper). Yet uncovering the process which initially grounded the implementation is a step towards uncovering the rationale that lay behind deciding against vaccination, despite recommendations. Furthermore, this study invites us to look more closely at the actions behind the decision to implement the vaccine. These actions are conceptualised as acting with the various sources of data,

[5] Walsh in BBC News online 28.11.2008; HPA Press Release 28.11.2008.

information gathered via personal communication and the technical methods.

Acting with facts expresses the idea of doing things with facts. In my previous study on predicting the potential course of outbreaks caused by *Haemophilus influenzae type b* bacteria in Finland, I showed the need to develop particular modelling methods to re-interpret available data and to complement the scarcity of data (Mattila, 2006). Often the available data may not be easily communicated to or interpreted by different actors involved in the decision-making processes. Doing things with facts develops the idea of how to utilise available data in order to "stay one step ahead" with infectious outbreaks. This section analyses how facts about measles were enacted in models in order to utilise the existing information. What is it, then, in measles that causes the public health concern?

Measles is a highly infectious, life-threatening disease. Its main complications are encephalitis, pneumonia and bronchitis. It has long been a nuisance and a research challenge for the public health authorities. It was originally identified and distinguished from smallpox in the 10th C CE. As mentioned, it is a highly contagious, and follows a seasonal cycle affecting nearly every person in a given population in the absence of immunisation programme. The primary transmission happens via respiratory routes. At the 20th anniversary of the implementation of the MMR campaign, it is still unfortunately common: especially when one considers that the single measles vaccine was introduced in 1968. Before that time, the number of annual notifications of disease cases varied from 160,000 to 800,000. As the following figure shows, the vaccine reduced significantly the number of deaths caused by measles.

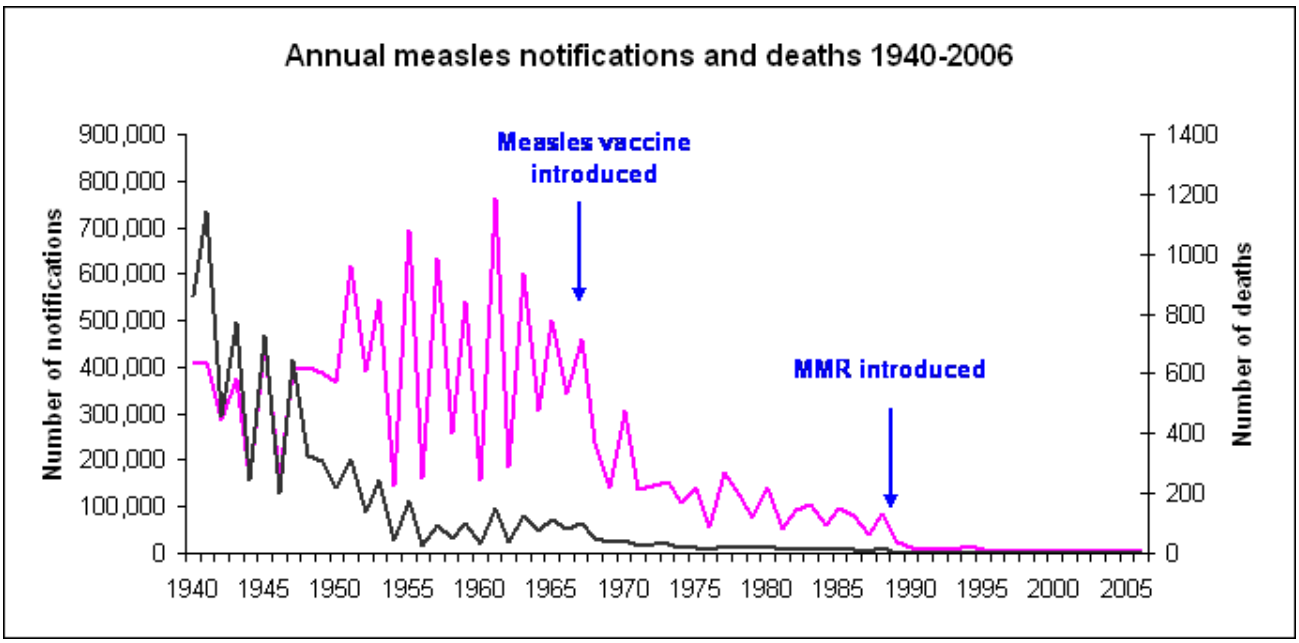

Figure 1: Annual measles notifications and deaths 1940-2006. Courtesy of Health Protection Agency.
http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733756107

However, due to the cyclical nature of measles outbreaks, the disease triggered studies on the predictive measures to “foresee” the outbreaks. One of the pioneering studies was presented by Hamer in 1906. His contribution could be read as a predecessor for the later development of modelling methods as a part of the public-health research tool-kit. What was, then, Hamer’s major contribution? His study of measles outbreaks in London exemplifies the short-term periodic waves that are typical for infectious diseases. The measles epidemic returned approximately every second year. According to Hamer's observations, the outbreak occurred when the number of susceptibles in the population had increased. He also noticed that the alterations in the age constitution, varying customs, and social conditions affected the cyclic occurrence of the outbreaks. Hamer's achievement was to mathematise his observations. In order to do that he

applied the “mass-action principle” that was formulated in physical chemistry. So, Hamer pioneered in mathematising, or, in our terms, *modelling* the epidemiological phenomena of recurring measles outbreaks. He *enacted* epidemiological facts in the mathematical domain by expressing the changes in the number of susceptibles (infecteds and immunes) as successive steps in time (Mattila 2008). By his study, Hamer not only contributed to the understanding of contagious processes related to seasonal cycles, but also showed how enacting facts in this way supports indirect observations made in the mathematised domain of models.

What, then, are these indirect observations that are of the interest of the public health researchers and practitioners? Or in other words: what is enacted in current models that aim at predicting measles outbreaks, and how was the enacting of facts about measles enforced by the decision-making process that eventually led to the implementation of the triple vaccine?

Modelling (which in the broad sense covers all computational work utilising mathematical algorithms and oftentimes the computational capacity of machines – though in the earlier times, only the mathematical formulas and algorithms were there) is a mode of doing things with facts, enacting facts. What do I mean by enacting? The OED definition describes enacting as a act of bringing something into activity, to work upon or actuate something or to represent a scene, to personate a character dramatically or even to perform, to bring into act and accomplish. All these various descriptions of the word point the way to see more clearly how facts of measles were enacted with modelling techniques.

Models allow organising, re-arranging, accumulating and extrapolating facts in new ways. In the case of measles, the context in which the new policy was introduced was an unfortunate one. In a way, the

decision to renew the vaccination campaign reflected the unarticulated fact that the previous policy (covering only measles and rubella, not mumps) had failed. As we know, the measles vaccine was primarily introduced in 1968 with a mass vaccination campaign. Because of the low vaccination coverage, the disease kept circulating in the population and there were no signs of its elimination. As a result of that, morbidity and mortality from measles occurred at an unacceptable level. To tackle these concerns, researchers at the Public Health Laboratory Services (PHLS)[6] developed two separate modelling approaches. Their aim was to apply modelling techniques to reconstruct the impact of vaccination in England and Wales from 1968 to the 1990s, and to evaluate the merits of future policy options. Hence, the target of modelling was to understand the past through reconstruction, and to predict the future. More precisely, the goal was to act with the past facts in order to define the optimal vaccination coverage, which would respond to the main target of the new vaccination programme: the elimination of measles in the UK.

Two separate modelling approaches were applied to enact with measles. The first approach built models to interpret the data that were previously collected by the PHLS serological surveillance programme.[7] The second approach built a dynamic model to simulate measles transmission. Both models summarise results using reproduction number R_0, which represents the number of secondary cases produced by a primary case. In other words, it is the rate of the spread of infection in a susceptible population. The reproduction number provides an exemplary case to discuss what Hampton Frost referred to as “their [facts] orderly arrangement into chains of inference, which extends more or less beyond

[6] Public Health Laboratory Service, nowadays the Health Protection Agency or HPA.
[7] A serological surveillance programme means that serum (blood) samples are collected and tested e.g. annually by Public Health Laboratory Services. The samples are analysed with microbiological and biochemical tests in order to detect infection-specific antibodies.

the bounds of direct observation". In epidemiology, the remaining challenge is to overcome "the bounds of direct observation." When the disease case is observed, someone is ill and affected; the rest of the population is at risk of acquiring the infection. Hence, to reach beyond these is valuable for public health research, monitoring and decision-making processes. One way of doing this is to estimate the reproductive rate. The rate is determined by the probability of transmission in a contact between an infected and a susceptible, the frequency and duration of contacts are also taken into account. And the proportion of the population that is already immune affects the reproductive rate. (Giesecke, 2002)

All these properties of the reproductive rate can be expressed in mathematical equations and hence they provide numerical estimates of the transmission dynamics in a population. This rate is usually determined by empirical data that are derived from previous epidemiological studies or, for example, from serological surveillance programmes. Why is the reproductive rate important and how could it be linked with the indirect observation? The reproductive rate shows the increase or decline rate of an infection. Any vaccination programme aimed at eliminating a disease, as the measles campaign was, must keep the reproductive rate as small as possible and certainly less than one. Interestingly though, the reproductive rate, as an *enacted fact*, draws together different sources of information that describe the "coordinates" of the spread of an epidemic. When it was established in the models at the PHLS, it gave a "horizon of action," the target for the vaccination coverage that should be reached with the new campaign.

The two models built at PHLS to reconstruct the history of measles outbreaks and to predict the future ones were well grounded on data from England and Wales. These data included notifications of the disease cases, vaccination statistics and serological studies. Yet, these data built-in

a limitation to extrapolate from the modelled estimates the rate for Scotland. This limitation was acknowledged by the modellers, yet with the note that the epidemiology is broadly similar to England and Wales. Hence, the effective immunisation coverage that was derived by modelling – by enacting the available facts about measles outbreaks in the models – was 90-92%. This rate means that when 90% of the population is vaccinated, the disease is eliminated from the population. The modelling studies related this estimate to previous sero-conversion[8] studies.

On the basis of the analysis, I conclude that *enacting facts* in measles models shows one angle of the process through which facts turn into evidence. Enacting, which itself resonates as *doing things with facts*, seems to integrate a particular set of techniques required in order to "make sense of" the heterogeneous set of information available about the previous measles outbreaks and data gathered through surveillance programmes. However, this study shows that the functions[9] of models, which often related to the context of knowledge production, seem to occur also in the context of utilisation. These functions are: a capability to function as a storage space and a capacity to transmit facts across different communities of practitioners (cf. Mattila, 2006). These functions are not bound with the context of production, but expand to the domain of utilisation. So, by analysing how facts were *enacted* in models has also revealed something of their functions.

Interacting with Mumps

Acting on the basis of facts can be seen as a mode of interaction. The idea of interacting with facts counteracts the assumption that "facts speak for themselves": as if the body of evidence supporting the decision-making

[8] Sero-conversion studies are studies that detect antibodies in blood serum that are specific to an infection or result from immunisation.
[9] Morgan and Morrison (1999) pioneered in introducing the notion of functions of models.

process is enough and no further communication is needed. In a way, these assumptions are expressed in the current discourses of evidence as a monolithic body of objective knowledge (cf. Pettigrew and Roberts, 2003). However, acting with facts put the emphasis on interaction that preceded the decision-making process leading to the introduction of the mumps vaccine to the national vaccination scheme. As a concept, interacting emphasises the reciprocity of activity. It highlights how the public health researchers communicated with their colleagues and learned from their experiences in order to ground the decisions to be made. But why was it important to consider the mumps in the first place as a preventable disease that needs to be diminished by an intervention?

Even though mumps appears to be a seemingly mild childhood infection, it is still a disease worth preventing. A clinical description of mumps was provided by Hippocrates in the 5thC BCE. It is commonly known that mumps causes painful swelling of one or both parotid glands. Mumps is caused by paramyxovirus. The severity of mumps lies in the fact that it can cause viral meningitis and encephalitis. It occurs in cyclical and seasonal peaks and is often transmitted via droplets of saliva. (Parish, 1965).

At the time of introducing the MMR vaccine, in 1988, there was no vaccine available against mumps in the UK. Mumps was then a newcomer to the programme. I will discuss the implementation of mumps component as a part of the triple vaccine and the process of grounding the evidence for that decision as a process of *interacting with* mumps. What forms of interaction actually took place in that process?

Interaction with mumps and the reciprocity of the process might remain hidden. As it is commonly understood, evidence for decisions of this kind is or should be derived from scientific publications. However, interacting with facts reveals another angle of that story. Scientific

publications form only a part of the knowledge-base on which the decisions were grounded. The public health researchers, especially those who actively worked over the years to renew the policies, engaged in a vast network of communication with colleagues in other countries. Even though the vaccine was not a part of the British vaccination scheme, it was already in use in the USA and in Australia. Three years before the final decision, Dr. M. gathered via personal correspondence a large amount of information from public health experts in order to support the implementation plan in the UK. This correspondence includes references to epidemiological studies that were conducted, although not yet published, and observations from the implementation processes, experiences and potential hindrances during the campaign. The correspondence between Dr M. (UK) and Dr F. (Australia) during the autumn of 1985 shows how different aspects of the vaccine implementation were interwoven.

The main concern related to a vaccine campaign is how to reach the target level of coverage in the population. As I explained in relation to measles, the adequate level of vaccine coverage is essential for a successful vaccination campaign. One reason to include the mumps component into the triple vaccine was to provide a more cost-effective scheme and to increase the uptake. As Dr F. wrote to Dr M.: “I cannot give you accurate figures of these rates but the data on vaccine distribution shows that when the combined vaccine was introduced there was an increase in the number of doses distributed from 322,338 to 409,700.” In the same letter, Dr F. also emphasised the epidemiologically important reason: “The rationale for adding mumps vaccination depended on the published US data that the vaccine was effective and safer than natural infection.” In other words, the natural circulation of mumps was reduced significantly with the new vaccine. The artificially induced immunity against mumps is safer than to acquire the immunity naturally from the infection

itself. With the vaccine the unpleasant and potentially threatening conditions following mumps infection are avoided.

However, the correspondence also reveals a growing concern related to the changes in the natural circulation of the virus in a population. Dr M. raised the voices of opposition against the mumps vaccine. She mentioned that the long term effects of the immunisation were pointed out and the issue of increase in the incidence of orchitis in adult men was raised. Interestingly, this “prophesised doom,” as she vividly describes the risk, it was drawn from a “crystal ball” of modelling. This supports previous observations that modelling enables indirect inference based on the given information. Furthermore, Dr M. reflected on the parallels between the British and Australian debates related to the MMR. There were similarities in the way in which the two countries managed their vaccination schemes. She also emphasised that including the mumps component to the scheme helps overcome the “philosophical argument about giving a vaccine to boys who really do not need it” (referring to mass campaign with rubella vaccine).

Through this window of correspondence I showed the reciprocity that is interwoven to the mode of acting with facts. The public health authorities, who prepared the MMR campaign in the UK, did not only ground their decision on published facts or modelled results. They engaged with their colleagues, gathered facts from their experiences and discussed how to interact with, interpret and understand those facts in series of meetings. One mode of the correspondence was also to communicate with the three Primary Care Trusts (PCTs) that had implemented as an “experiment” the triple vaccine. These PCTs were asked to “pre-run” the vaccination campaign, monitor the possible side-effects and report the feedback from parents. These results ranged from general observations of how willingly parents engaged with the new vaccination campaign to letters from the

general practitioners (GPs) asking for further advice or reporting adverse effects of the vaccine. The analysis also shows the following reasons to add mumps component into the national scheme: the economic drive to increase the cost-effectiveness of the campaign; the epidemiological rationale to reduce the circulation of the virus in the population, and the persuasive “selling-point” to smooth the attitudes of the parents of boys, since rubella was a threat to women in child-bearing age. These reasons enrich my argument that acting with facts in the context of utilisation is a heterogeneous net of interactions, interpretations and negotiations, yet grounded in evidence and strengthening the degree of facticity of the decisions made.

Reacting to Rubella

Whereas *enacting* and *interacting* with facts emphasised the mode of *doing things with* facts, *reacting* focuses on the mode of *acting on the basis of*. These are complementary. *Reacting* means to act in return or upon some agent of influence. It also incorporates the idea of displaying some form of energy in response to a stimulus. *Reacting to rubella,* then, captures the urge to respond to the increase in the incidence of congenital rubella syndrome.

Rubella, although known as a mild childhood pox, is capable of causing devastating effects on a foetus if encountered during a pregnancy. What was then the main concern that urged the public health officials to react to rubella? The researchers and officials reacted to surveillance data, which is summarised in the following figure:

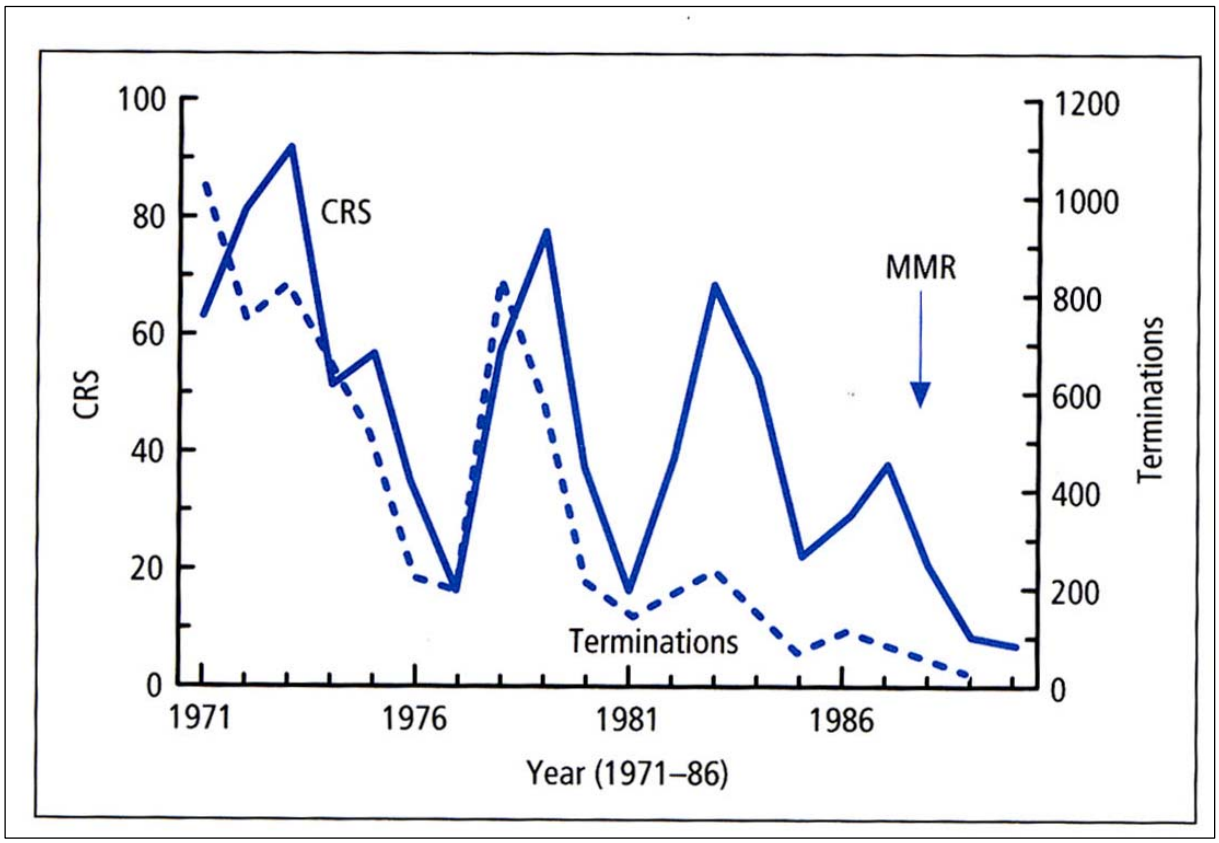

Figure 2: Numbers of terminations of pregnancies and births with congenital rubella syndrome. (Farmer and Lawrenson 2004, p. 122):

This figure shows that there was a constant fluctuation in the number of cases of congenital rubella syndrome (CRS) despite the ongoing target group vaccination strategy. In other words, during the years prior to 1988, rubella vaccine was given to girls aged 11-13. Why did this strategy fail to prevent the increase in CRS cases? Perhaps a part of the challenge to prevent CRS could be answered by a brief glimpse to its history.

Pioneering observations of congenital rubella syndrome were made in 1941, when Norman McAlister Gregg, an Australian ophthalmologist published a report that linked congenital cataracts to maternal rubella. He had noticed an unusual number of infants with cataracts, who were brought

to him for medical care. He detected case histories of maternal rubella that occurred at the time of the Australian outbreak in 1940. However, it took twenty years before the breakthrough in isolating the virulent agent. In 1962, American researchers were able to isolate the rubella virus. At the same time, in the mid-60s a pandemic of rubella started in Europe and soon thereafter reached the US. During this pandemic, thousands of pregnancies were affected, leaving behind “a wake of abnormal infants and terminated pregnancies” (Miller, 1988, p. 317). However, the pandemic had two effects on the further development of the biomedical studies. Firstly, an expanded congenital rubella syndrome was recognised, with disorders related to CRS included deafness, cataracts, heart disease, encephalitis, and mental retardation. Secondly, from the public health perspective it became obvious that a vaccine was needed and it was developed for commercial use by the end of the decade. What was the major impact of the attempts to prevent a similar kind of large scale outbreaks of rubella with the new vaccine?

The mid-60s epidemic worldwide epidemic waves showed the serious effects of rubella in pregnancy. For example, in the USA, approximately 20 000 infants were born with CRS. The resulting human suffering was immeasurable. The reaction to prevent this devastation from re-appearing was to introduce rubella vaccine for girls aged 11-14, in 1970 and for sero-negative women of childbearing age in 1974. In 1983, the aim of the vaccination policy was defined as “the control and ultimate elimination of congenital rubella infection and therefore of all rubella defects” (Miller, 1988, p. 317). Neither the reduction of natural rubella, nor the development of herd immunity was part of the early strategy.

However, these pre-1988 vaccination schemes did not succeed in effectively protecting the public health. Each year, 100-200 infections in pregnancy were reported from the laboratories in England and Wales.

Many of those women were infected during the early pregnancy, which meant that the infection caused the highest risk of foetal damage resulting in therapeutic abortion. Around the time of the renewal of the vaccination campaign, approximately 20 cases of CRS were reported annually (Miller, 1990). Correspondingly, in 1988, the measles vaccine had been in use for 20 years. In that particular year, 85,000 children suffered from measles and there were 11 cases of death. But the vaccine uptake was alarmingly low, at only 74%, reflecting a failure to appreciate the dangers of the disease and the concerns related to vaccine safety.

So, these were the facts that required *acting with* in 1988. Facts from surveillance reports that underlined the insufficiency of the selective, target group policy of rubella that failed to reach all within its target group and left the disease uncontrolled in the child population. Facts reporting the "unacceptable level" of mortality and morbidity from measles cases. And facts that notified the adverse effects of mumps – 1200 children admitted to hospital, and mumps virus being the most common cause of laboratory-confirmed meningitis.

Let us take a closer look at the facts that required action and how they were clustered together from different sources of information, which of them were considered as a driving force in the process of re-evaluating the policies, and what kind of technical tools were implemented to synthesise evidence and produce short-term predictive ("what would happen if…?") scenarios. In the re-evaluation of the existing vaccination policies, the main focus was on rubella and measles, partly because of the constant concern they caused for the public health, and partly because there were vaccination schemes covering them. However, the process of re-assessing the policies also introduced the idea of implementing the triple vaccine that was now available on the market. So collecting facts to act with mumps and the process of justifying it as a part of the new scheme became

important. The re-evaluation of the vaccination scheme was characteristic for measles and rubella vaccines; but with the mumps vaccine, the question was more of introducing a new vaccine to the overall national scheme. This process of assessing the immunisation policy happened in meetings with public health researchers and officials. In June, the aim of the meeting was, generally speaking, “to consider the scientific evidence concerning the effectiveness of current rubella vaccination policy in the control of congenital rubella. To consider whether on scientific and practical grounds on any changes or additions should be made to current UK policy and to make recommendations.” The meeting itself was initiated by Dr M. at the Central Public Health Laboratory.[10] She took the effort of gathering facts from other countries through personal communication with other public health officials in countries that had already implemented the triple vaccine, such as Australia, and the US. This preparatory work took place in 1985. A major part of this personal communication focused on gathering information and experiences of implementing mumps vaccine as a part of the scheme. When the preparatory work began, two alternative vaccination strategies were discussed. These two vaccination strategies were: immunisation of all infants of both sexes to eliminate the risk of exposure of pregnant women to rubella by interrupting the transmission of infection among children. The second strategy involved selective immunisation of adolescent girls to eliminate the risk of rubella occurring in pregnancy. The second strategy did not aim to interrupt the transmission of infection within the population; indeed, it built on the acquisition of natural immunity during childhood and allowed for the boosting of vaccine-induced antibody by circulating virus. This approach did not alter the pattern of infection in the community. Dr M. summarised the current problems with the vaccination policy in the UK:

[10] Currently the Health Protection Agency.

> Vaccination of schoolgirls and women before and after pregnancy had reduced the level of susceptibility to about 3% but it is unlikely that it will fall further. When rubella is prevalent, infection in pregnancy occurs in over 2% of non-immune women resulting in an unacceptable number of cases. During rubella outbreaks, which will continue as long as our vaccination policy is selective, the demands for diagnostic and contact testing will recur on a large scale.

It was clear that the *reaction* to rubella was needed and that reaction resulted as the mass vaccination campaign of children of both sexes. However, *reacting to*, as a concept might suggest a straightforward, almost slightly panicky way of dealing with facts – as if the public health officials did not digest the facts, but, shocked by the increase in CRS cases, came up with the idea of revising the strategy. This was not the case. As I discussed in the case of both measles and mumps, the evidence for CRS cases and the suggested, more effective intervention on rubella were well-grounded. The particular meeting condensed the discussions, interactions, various sources of data and hence gave support for the process of reforming the whole of the vaccination intervention. Reacting to, hence combines, to some extend the two angles of the notion of acting with. Reacting to rubella, i.e. to the increase in the number of CRS cases, implied that there was a need to act on the basis of and to do things with facts. It was not enough to just acknowledge the increase, but something needed to be done and as a result of that a new policy was to be implemented in order to protect the public health.

Concluding Remarks

This study followed the footsteps of Wade Hampton Frost by analysing the "orderly arrangement of facts into chains of inference." Acting with facts and the three modalities: enacting, interacting and reacting were

represented the different forms of “orderly arrangement.” *Enacting* showed how facts about measles were translated into evidence to support revised vaccination policies with modelling techniques. These techniques reach beyond direct observations; they facilitate the scarcity of available data and create the predictive horizon for vaccination planning. Interestingly, enacting measles facts in models also built the bridge towards the historical studies of measles outbreaks that initiated the mathematical expressions and their adaptation to epidemiology (e.g. the law of mass-action in Hamer). So, as discussed, acting with carries two connotations: acting on the basis of and doing things with: Enacting measles with modelling techniques implies the aspect of doing things with facts.

Interacting with mumps reveals the in-built process of mutual communication and interaction that complements the evidence gained from scientific publications. As is well known, scientific publications deliver facts with delay. Research is communicated in conferences and in mutual interaction well before the study itself is published. As mumps was introduced as a new component to the vaccination strategy, the interaction provided a valuable horizon to evaluate the benefits. Interacting with facts involves both aspects of acting with. The policy was renewed on the basis of the facts gathered via personal communication with other public health authorities, but the mumps vaccine itself and the need to include it within the new campaign has the flavour of doing things with facts.

Reacting to the unfortunate facts manifesting the failure of the target group vaccination strategy with rubella highlights how important the capability to flexibility is. Nationwide vaccination strategies are subject to change if they seem to fail. Reacting means not only doing something, acting in order to change something, but it also implies the capability to interpret, monitor, read and understand so that the subtle changes become visible and allow the process of change.

By reviving the connotation of an *act* as a part of the largely forgotten and neglected meaning of fact, I have shown that within the domain of utilisation, facts are *acted with* creatively. Not only, as suggested by Daston (1992), to anchor and strengthen evidence in order to increase its credibility; but also by returning to the domain of production, learning from facts when engaging with them actively in novel technical realms. In other words, the active engagement with facts also implies a continuous, diverse process of acting *with* them. In a way, facts are not “finished” or “finalised” when they are produced, nor when they leave their domain of production, nor when functioning in the domains of application or utilisation. This incomplete nature of facts leaves space for re-interpreting, further monitoring, studying, communicating and circulating them within and across various interest groups. In a way, this approach to factual knowledge echoes what Becker (2006) argues for artwork. Something that is commonly held as a finished piece of art, as we see it in exhibitions, is really still in the process of becoming, still *un*finished, since our interpretation of it is yet to be made. This study, hence, provided an alternative way of seeing facts by emphasising the centrality of active engagement with them through the processes in which facts travel well.

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