Public Health Systems Analysis – Understanding and Handling Complexity – Part One

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ABSTRACT

Over recent decades public health practitioners have developed a better understanding of the complex relationship that links a wide range of social, economic, environmental and genetic factors to health outcomes. But, despite this better understanding, public health responses have remained distinctly mono-causal – focussing separately on individual lifestyle behaviours, social conditions or genetic combinations and their respective links to specific diseases. In this paper we will consider the potential of a new meta-discipline – *public health systems analysis*. Public health systems analysis draws upon emerging techniques of operational research/systems analysis to provide better representations of public health systems thereby enabling complexity to be retained and appropriate policy responses to be derived. The paper also considers the more sophisticated approaches to evaluation required to monitor the impact of complex public health interventions and to understand the political structures that are needed to underpin them.

THE COMPLEXITY OF PUBLIC HEALTH SYSTEMS

Our understanding of the relationship between health and health determinants has changed dramatically over recent decades. The shift in thinking that we have seen has been a global phenomenon. Indeed, elsewhere I have argued that developed countries have in a number of significant aspects lagged behind their developing counterparts (Thunhurst, 2012 and 2013). However, in this article I will focus on the way that this change has been manifested in the United Kingdom, a country which provides exemplary illustration of these more global shifts. As with other apparent innovations in scientific understanding the emergence of Public Health, as we now know it, had its roots in thinking and actions that preceded it – sometimes by as much as one hundred years. In that classic text of Social Medicine, *The Role of Medicine*, (initially written in the mid-1960s as *Medicine in Modern Society*) McKeown (1965 and 1979) demonstrated how the putative achievements of modern medicine frequently depended upon social and environmental actions that had significantly pre-dated medical advances. Taking tuberculosis as a prime example, McKeown illustrated the decline in mortality that had preceded the introduction of preventive and curative therapies, rather in the main being attributable to improved housing condition and better nutritional status that were consequent upon the Public Health Movement of the 1870s. Alongside Social Medicine the disciplines of Community Medicine and latterly Public Health Medicine explored these connections further. Particularly catalytic, in drawing the historical message of McKeown into contemporary policy formation was the work of the Unit for the Study of Health Policy at Guy's Hospital led by Peter Draper which produced a number of seminal analyses during the 1970s looking at the health impact of employment, unemployment and economic policies more generally. (Draper, Best and Dennis, 1977).

But the major breakthrough for a new understanding came right at the end of the 1970s with the publication of *The Black Report*. (Townsend and Davidson, 1982) This report (so-titled as the report of a committee chaired by Sir Douglas Black) systematically chronicled and

analysed the existence and the persistence of inequality in the health experience of the population of the United Kingdom. It could be argued that the report shook the British academic community and British policy makers out of a complacency – a complacency born of the misconception that the founding of a National Health Service, undoubtedly a most significant achievement, had levelled the playing field, providing equality of health opportunity to all. The Black Report found this not to have been the case. Going beyond mere presentation of the continuingly unequal nature of health outcome the Committee took the bold (and subsequently controversial) step of analysing the causes of health inequality. The Committee differentiated between two broad causal influences – what it termed *materialist or structuralist explanations* and *cultural/behavioural explanations*. The former emphasised "the role of economic and associated socio-structural factors"; the latter emphasised "unthinking, reckless or irresponsible behaviour" of individuals.

The report was highly formative in the creation of what was subsequently termed *The New Public Health* (Ashton and Seymour, 1988) and launched what was frequently referred to as a *New Public Health Movement* – consciously acknowledging historical continuity with the Victorian public health movement the importance of which had been highlighted by McKeown. For many years the representational banner of the movement was a diagram prepared by Dahlgren and Whitehead (1991). This offered a layered categorisation that developed two-causal presentation of the Black Report. It distinguished: *general socio-economic, cultural, environmental actions*; *education, food production, water &sanitation, health care services*; *social and community factors*; *individual lifestyle factors*. By the end of the century rarely was a paper presented at a public health conference that was not introduced by reference to the Dahlgren and Whitehead model. Some analysts developed the basic model – most significantly to include more detailed coverage of natural and built environments and of the global eco-system.

What the Dahlgren and Whitehead model and its derivatives lacked was a sense of interaction between the determinants – leading to the danger of unduly focussing on isolated determinants and the subsequent search for 'magic bullets'. The growing realisation that "health in later life may be a result of complex combinations of circumstances taking place over time" (Bartley, 2004) gave birth to what has been called *The Life Course Approach*. By introducing 'complexity' the life course approach emphasised the interactional nature of health determinants, in the process also greatly complexifying the nature of policy responses which had previously sought to find solutions in individual domains – tackling health inequality separately through nutrition or housing or lifestyle changes, for example. The need for an advanced understanding of complexity has similarly informed the recent analysis of Rayner and Lang (2012) who introduced the concept of *ecological public health* and looked for the achievement of health improvement through a number of interacting 'transitions'.

The highest profile airing to our developing understanding of the complexities of health determinants was given by the WHO Commission on Social Determinants of Health chaired by Sir Michael Marmot. (WHO, 2008) The work of the Commission was based on a model drawing out the interactional nature of *structural determinants*, *intermediary determinants*, and *socioeconomic and political context*. This model, greatly influenced as it was by the life course approach, also provided the backbone for Sir Michael's subsequent review of health inequalities in England (Marmot 2010). In respect of policy response Marmot advocated the adoption of a *Whole Systems Approach*, explicitly eschewing policy responses rooted in an atomised understanding of the nature of health determinants. And central to such an approach was seen to be the full engagement of communities in policy formation. It is worth citing Marmot's conclusion on this in full:

> "Community engagement can serve as an important lever to reduce health inequalities by influencing service provision. This often operates best in small localities and the involvement of primary care services is critical. Benefits to the community extend beyond the initial intervention and through increased participation lead to greater confidence and competence among individual citizens and can bring many positive real-life changes" (Marmot, 2010)

It might also be worth noting that also in 2010, a little ahead of the publication of the Marmot Report, the National Institute for Health and Clinical Excellence (National Institute for Health and Clinical Excellence, 2010) issued a scoping brief for "preventing obesity using a 'whole system' approach at local and community level". Guidance on 'Obesity: working with local communities' subsequently appeared in November 2012. (National Institute for Health and Clinical Excellence, 2012) It adopted a "system-wide" approach with exhortations for more joined-up strategic leadership across sectors including "those involved in planning, transport, education and regeneration". It also called for greater community engagement, referring back to more detailed guidance issued in February 2008 on this topic (National Institute for Health and Clinical Excellence, 2008). It included comprehensive proposals for 'planning systems for monitoring and evaluation' though passed over the more difficult technical process of programme development which itself requires more sophisticated methods of garnering and analysing the wide range of often-conflicting 'evidences' submitted by the appropriately diverse set of players now drawn into the policy-making and programme-development processes.

Community engagement, towards which policy formers and policy implementers have traditionally provide an appropriate genuflection, has tended to be seen as a parallel focus of intervention (through community health initiatives) rather than integrated into policy response at the macro level. This has no doubt been influenced by the perceived and the real complexities of effective community engagement – well documented in the earlier NICE guidance (National Institute for Health and Clinical Excellence, 2008).

In summary, it might be said that our understanding of the complex interactional nature of health determinants has not been matched by the increased sophistication in policy formation and policy implementation which is needed to secure the desired health improvement. In the next section of this paper we will consider how methods of systems analysis can assist and underpin public health's increasing need and growing efforts to capture and re-present the complexities underlying health determination. In subsequent sections (which will appear in a later issue) we will consider how complex representations can be employed to illuminate policy responses and how complex interventions can subsequently be evaluated for their health impact.

RE-PRESENTING COMPLEX SYSTEMS

The models of public health that have evolved over the recent emergent period have relied strongly on graphic representations. Working at a very broad generic level this can provide for relatively simple diagrams. However, for purpose of policy formation at the macro level and even more for purpose of programme implementation at the micro (community) level, more detailed representations are needed. How large quantities of data – some of which will be a qualitative nature, some of which will be of a quantitative nature – are gathered, synthesised and re-presented is a major challenge. But it is one that is not totally unfamiliar to analysts of complex systems found within other contexts.

The best illustration of this challenge is provided by the (to date) most ambitious attempt in the UK to analyse a public health issue as a complex system. The Committee established under the UK Government's Foresight Programme to examine the question "how can we deliver a sustainable response to obesity over the next 40 years" (Foresight, 2007) adopted a

commendably strategic approach to its task. Drawing upon a wide range of evidence, which included some specially commissioned studies, the committee constructed a systems analysis of the primary determinants of obesity. These determinants spanned the full range of those articulated in the respective generic models: biology; early life and growth patterns; behaviour; the living environment; and, economic drivers. Needless to say, the depth of investigation was reflected in the morass of findings. To present these findings the committee prepared a systems map. The 'full generic map' contained within the committee's report (Foresight, 2007) has been likened to a plate of spaghetti (Map 5, Figure 5.2 page 85). It was so detailed that it could not be read with the naked eye until blown up to 400 per cent. The interconnections were so numerous that it was easier to identify dis-connected issues rather than focus on connected ones. This representation of such a complex systems was by no means unreasonable – though of limited use to the would-be policy formulator or programme implementer. To attempt to enhance this usefulness ('seeing the wood for the trees') the report identified some weighted causal linkages and a segmented map concentrating on the particular position of children within the full system. The fundamental systems map, described as the 'core systems engine' was also segmented into a number of clusters: physical activity environment cluster; food consumption cluster; food production cluster; individual psychology cluster; and, social psychology cluster. {We will return to the technical methods employed in their analysis in the second part of this article}.

The Committee had made a brave attempt to capture and to re-present the intricacies of a highly complex system. And the more that we endeavour to reflect the whole systems approach advocated by Marmot the more we will encounter similar complex systems. The Foresight Committee was after all looking at the complexity of a system with a single outcome variable – obesity. Consider the additional complexities faced, say, by a transport planner wishing to place a city's transport policy onto a health-promoting footing. We have at one level the variety of mobility-production systems – from pedestrian, cycling, motorcycle, car, taxi, through to various public transport systems, buses, trams, railways and to private carriers, vans and lorries. If the city is fortunate to have a canal system, the currently unexploited potential of this should also be considered. On the other side of the equation we have the myriad of health outcomes. Transport can be instrumental in the determination of heart disease, accidents, stress and associated conditions such as diabetes and various cancers. Obesity, the central focus of the Foresight investigations, would appear as just one (albeit a critical one) amongst several mediating factors. The full systems map would make the spaghetti diagram of the Foresight Report looked like a nouveau cuisine starter. Consider also that the Foresight Committee, working at a macro level, were in a position to draw evidence from systematic reviews of the literature. The transport planner operating at the micro level, whilst acknowledging and drawing in available secondary knowledge, would need to give even greater weight to primary evidence emanating from the community itself.

The NICE Guidance on 'Obesity: working with local communities' advocates the involvement of 'community champions and advocates'. (National Institute for Health and Clinical Excellence, 2012) In areas of particular local focus, specifically those that house communities with critical health needs, the creation of Community Health Networks composed of key informants with in depth knowledge of community needs, could prove a valuable investment. But it should not be presumed that there is a single homogenous community view.

Thus, the first major challenge confronting the health programme developer adopting a whole systems approach is collecting and synthesising data from a very broad range of sources with frequently conflicting views on the interventions required to gain maximum health advantage.

Systems mapping, (which we will return to more fully in the next section), can be a way of clarifying and explicitly drawing out areas of agreement and conflict.

As part of a recent investigation into the health implications of the options for waste management in the Republic of Ireland methods of policy analysis {Reich 1994 and 1996; Glassman 1999} were adopted and adapted to explore and to differentiate the substantive and the superficial areas of disagreement between protagonists in what was a highly controversial area of debate – given that at that time Ireland had not previously adopted incineration as a means of disposing of domestic waste, but that this option was under active consideration. The initial stage was to scope the problem area by positioning informants according to their relationship to the problem context (figure 1). Next a policy network map (figure 2) was developed to highlight critical interrelationships and an information flow diagram (figure 3) prepared based on the sources of information employed by and trusted by respective parties.

In the next stage of the analysis, simple methods of cognitive mapping were employed to aggregate individual cognitive maps into composite strategic maps (Figures 4 and 5) which were then used to identify thematic clusters which exposed root issues in the parties' perception of respective options and their health implications.

The analysis drew out a number of important features – some of a general nature, some relating to use of information, this having been seen as providing the essential framework for informed debate:

- Maps provided greater knowledge of the key actors in the public debate, the nature of the policy alliances formed and the sourcing and routing of information within the network of debate.
- Informants demonstrated little detailed epidemiological knowledge relying heavily on secondary sources.
- Information provided by the EPA, the WHO and agencies of the EC was viewed with credibility.
- Peer-reviewed articles in academic and medical journals were used by these agencies as a primary source, as well as studies undertaken or commissioned by themselves

In this illustrative analysis a number of techniques and approaches, now generally referred to as problem structuring methods were employed. We will discuss this further in the second half of this article as they will prove critical to the next stage of a whole systems approach to analysing public health issues – that is, developing an appropriate programme of intervention which retains the complexity of the problem at hand. We will then finally move on to consider the final, though much neglected final stage of the process, monitoring and evaluation, arguing strongly that this has to be built into programme development from the very outset rather than seen as a separate post hoc activity.
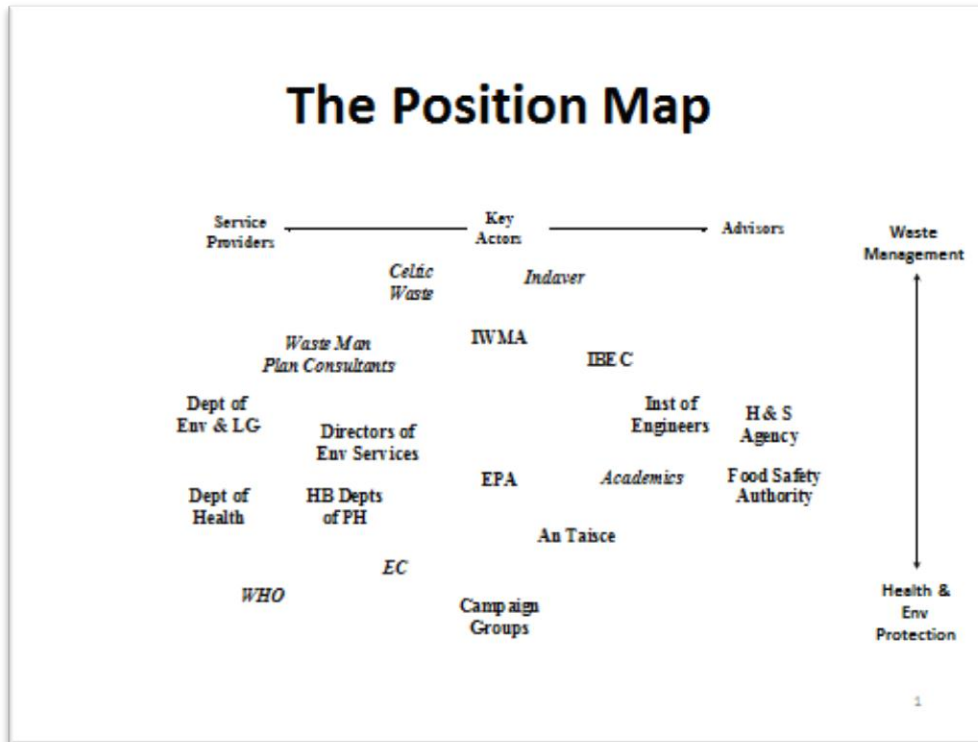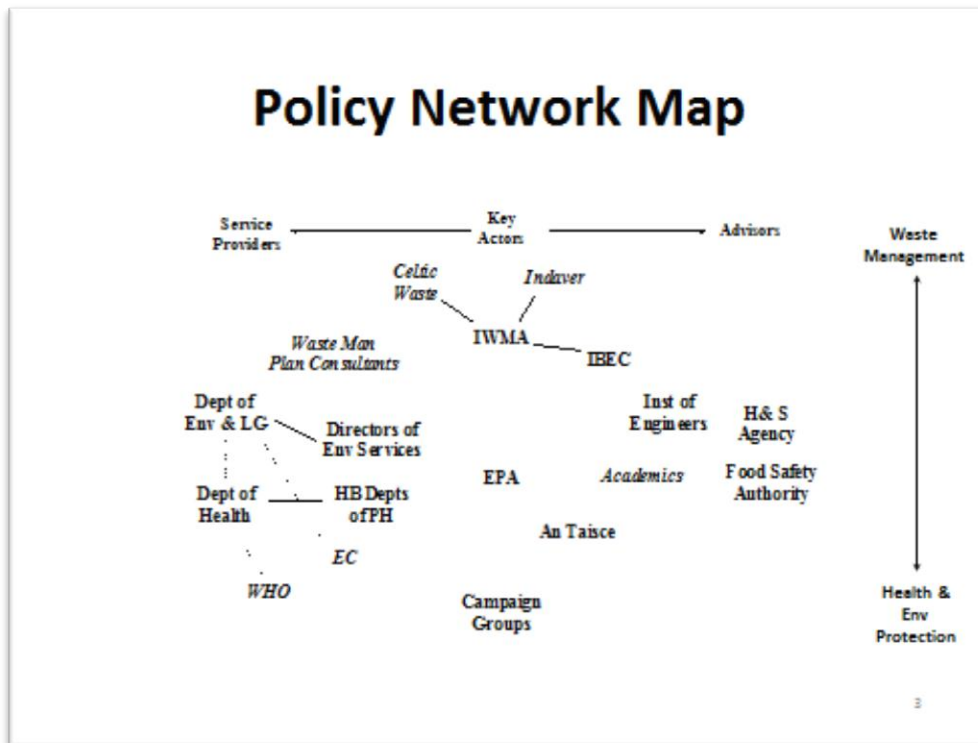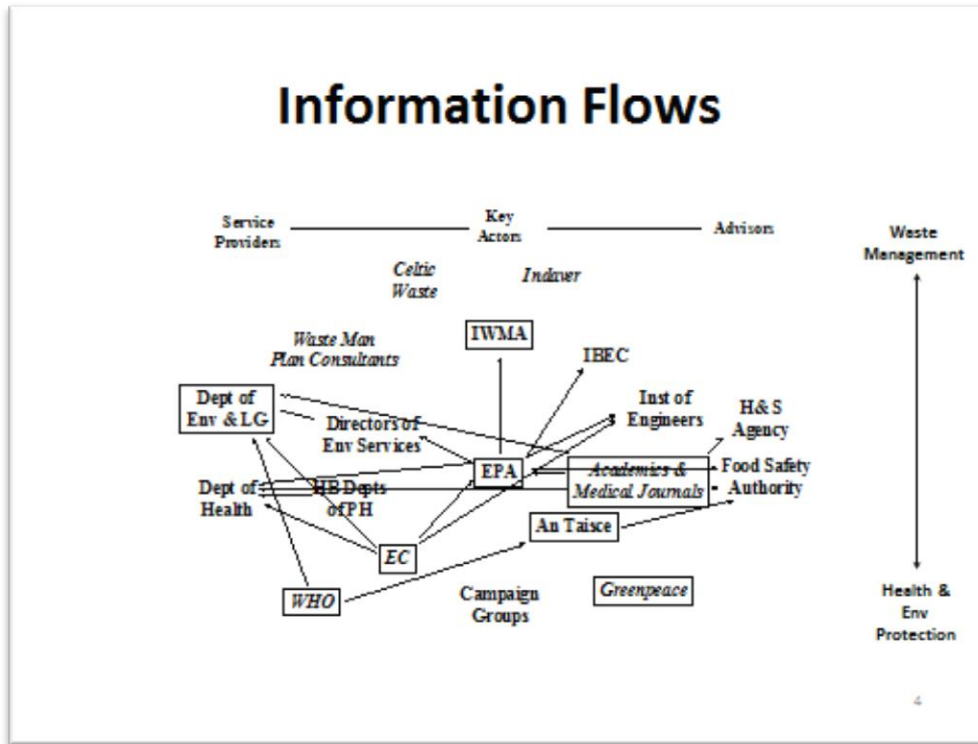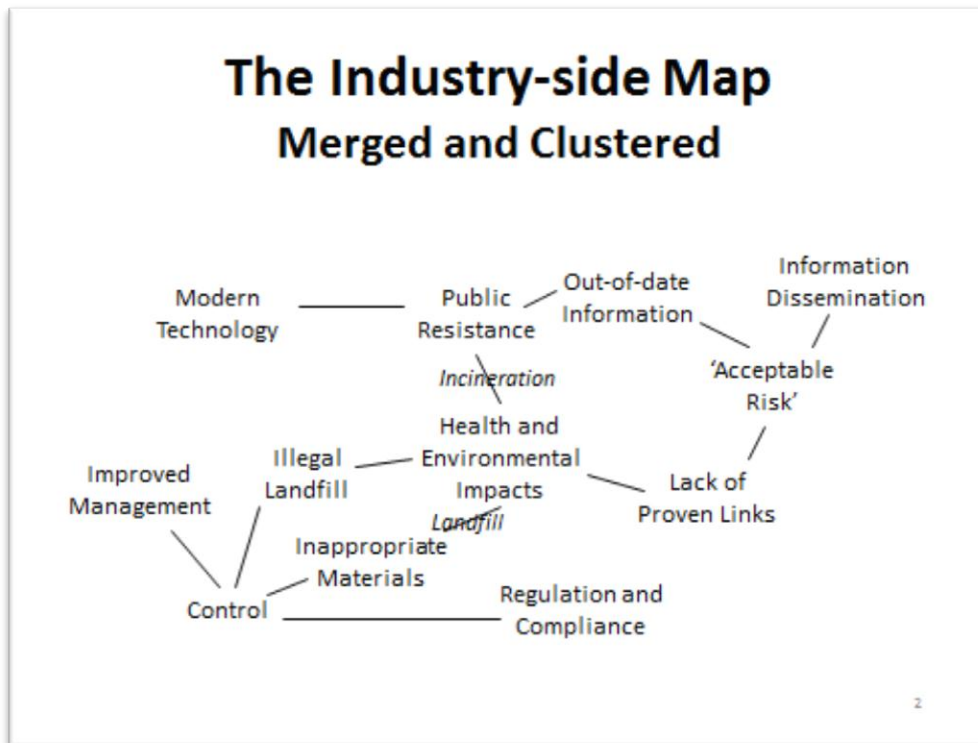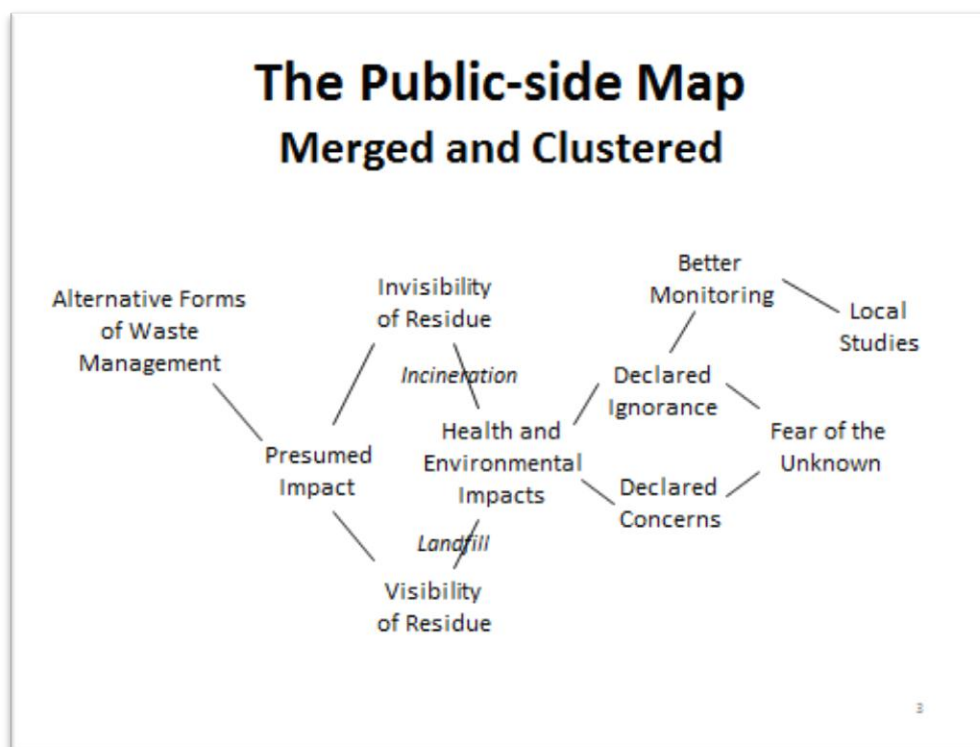
Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

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