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ROI IN PUBLIC HEALTH POLICY

Supporting Decision Making

Subhash Pokhrel, Lesley Owen, Kathryn Coyle and Doug Coyle

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Dedicated to colleagues and stakeholders from whom we have learnt a great deal.

Preface

It was a mere coincidence that brought four of us together—several years ago we needed to contribute to an exciting National Institute for Health and Care Excellence (NICE) project that looked at the possibility of developing a decision support tool to help local policymakers build their business cases for tobacco control. At the time, each of us was at different career paths, and none of us realised this collaboration would eventually lead to a book of this nature. We believe that return on investment (ROI) analyses can be useful in supporting public health decisions, but more needs to be written to make them accessible to readers.

As the use of economic evidence in policymaking increased, thanks to the work persistently done by national health watchdogs like NICE in England, this development required health researchers, including health economists, to take more responsibility to find ways in which evidence is produced and communicated to decision makers: in more iterative, engaging and meaningful ways than ever before. This process made the task of engaging with stakeholders (that included decision makers alongside other colleagues) in the buildup to, during and in the aftermath of a "research project" a desired goal within our professional circles. We soon discovered the trajectory between what we as the researchers find (knowledge) and what end users will use (translation) is not always linear; in fact it seldom is. This is the discovery (at least on our part) around "knowledge translation" that has inspired us in writing this book. We hope a health economic book of this kind would be a nice addition to the contemporary market.

Our approach to writing this book has been somewhat different from many other books that are written on similar topics. We always had end users—policy/decision makers, academics and researchers, service commissioners and providers, health advocates, patient groups, service users, and so on—in mind and we hope we have made the book accessible to all types of audience. We also hope that the book offers a nifty balance between theoretical details and pragmatic considerations as one wants to learn, and potentially design and conduct, ROI analyses. Chapter 5 is relatively more technical as it introduces the concepts around economic modelling that underlie the NICE Tobacco Control ROI tool and Chap. 7 is a step-by-step guide that we hope will enable the readers to use the NICE ROI tools. Issues related to decision making and wider than economics are featured throughout but can be found mostly in Chaps. 8 and 9. We start the book with a fictional story to set the scene so that readers can appreciate the challenging context of public health decision making. In the last chapter, this fictional story is revisited to enable readers to appreciate how ROI analyses can actually be useful. We look forward to hearing readers' feedback on our endeavour.

Throughout the book, we have provided several case studies where a core concept needed to be illustrated, many of which are based on our own work around public health ROI tools. We hope our storytelling approach will be valuable to the readers, particularly those for whom the ROI concepts are relatively new. Although the book revolves around mainly the UK context (where most of our own work in this area is located), attempts have been made to make the book as relevant as possible to a wider audience by drawing on some European and global evidence/examples.

Many people have helped us in this undertaking, directly and indirectly. Indirect inputs came from several stakeholders and colleagues particularly the research advisors and collaborators of the EQUIPT study (http://equipt.eu). Glenn Stewart contributed to writing up Chap. 2. Derek Ward and Tessa Lindfield's helpful contribution to Chap. 1 in understanding the use of cost-effectiveness/ROI evidence in policymaking is gratefully acknowledged, and so are the constructive comments from Robert West, Adam Lester-George, Stephen Hanney, Annette Boaz and Nana Anokye. Several institutions—NICE, the European Commission, Tobacco Free Futures, Smokefree SouthWest and Fresh NorthEast—supported our ROI work at various stages. Needless to say, the incredible support received

from our respective families in the form of their "forgone evenings and weekends" (with us) deserves a special mention here.

Uxbridge, UK — Subhash Pokhrel

London, UK — Lesley Owen

Uxbridge, UK — Kathryn Coyle

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Contributor Bio

Doug Coyle is a health economist and professor in the School of Epidemiology and Public Health, University of Ottawa, and in the Health Economics Research Group, Brunel University London. He has taught graduate courses in health economics for over 20 years and authored over 200 research papers.

Kathryn Coyle has 15 years of experience as an academic health economist originally at the University of Ottawa. In addition to being the principal economic modeller for the EQUIPT ROI tool, she has conducted numerous economic evaluations for multiple funders, including the National Institute for Health and Care Excellence.

Lesley Owen is a technical adviser in health economics in the Centre for Guidelines at the National Institute for Health and Care Excellence London. Owen's main responsibilities are to provide advice and leadership on the health economic analyses underpinning the development of public health guidelines and more recently social care guidelines. Owen has led the development of five return on investment tools for NICE.

Subhash Pokhrel PhD, is a reader in health economics and Director, Division of Health Sciences in the College of Health and Life Sciences at Brunel University London. He led the development of NICE Tobacco Control ROI tool in England and its roll out into other European jurisdictions via the EQUIPT study. He has authored several research articles on

behavioural health issues including tobacco control, physical activity, breastfeeding and medical care utilisation.

Glenn Stewart FFPH is a Consultant in Public Health and the Assistant Director of Public Health at the London Borough of Enfield. He has an MSc in Exercise and Health from St. Mary's University, Twickenham, and an MPH from the University of London, UK. He was awarded the Brunel University London Vice Chancellor's prize for doctoral research for his DrPH study.

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CHAPTER 1

Diary of a Policymaker

Abstract Policymakers are in search of evidence that resonates to their local needs (real-world practice). Often what is available is not in the format desired. This is particularly the case for economic evidence, where the traditional metric (cost/QALY (quality adjusted life year)) is seen as "abstract" in the context of real-world decision making by many. This chapter introduces return on investment (ROI) analyses that offer information on the costs and benefits of alternative policy actions. ROI information should usually be presented as a single, simplified metric making it easy for decision makers to relate it to their local contexts.

Keywords Decision making • Return on investment • ROI • Cost • QALY

"Tomorrow's a DH funding meeting, George. You are expected to present your business case for the 'Bio' programme", read the new email that had just landed in George's inbox. This was from his secretary, Elaine, who always preferred to send a "gentle" reminder to her boss what she thought needed George's careful attention and probably some focused time preparing for.

Elaine had been George's secretary for the last five years and he was used to her gentle reminders. However, on this occasion, the "gentle" reminder did not sound "gentle" in any way as despite Elaine's and other

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colleagues' best efforts, he had not been able to collect the sort of information he was after for the next day's meeting. Besides, he was just coming back from chairing a local strategy meeting, had another meeting scheduled for late afternoon and, above all, he and his team had been very busy for the last few months working out efficiency savings that they needed to deliver next year. Thanks to the current austere climate, his job had never been this hard!

"This meeting might turn out to be fiercely competitive, who knows?" thought George looking at the meeting agenda and the list of attendees, "without robust data, and more importantly, without showing economic returns in the short to medium terms, our plan is unlikely to get funded".

George always liked his role as the Director of Public Health for the New Maryland local authority (LA). New Maryland is characterised by its beautiful woods, several small but stunning lakes and lovely residents. The population health status was better than the national average, thanks to the abundance of small and medium enterprises (SMEs) that served as the backbone of the local economy.

One public health problem that George and his team were trying to address, however, was the extremely low breastfeeding rates in their local authority, much worse than the national average. Less than 0.1% of new mothers were breastfeeding at four months despite about 60% of all postpartum women in the local authority initiating breastfeeding post birth. The breastfeeding cessation curve for the borough looked odd: most mothers who initiated breastfeeding would turn to breastfeeding substitutes by the 6th week, and by the 12th week, less than 0.1% would be exclusively breastfeeding their babies.

George and colleagues wanted to do something meaningful to improve this situation. They realised that because of the strong local economy in the borough, most women were working in the SMEs. They loved their job and the income it provided. The borough has almost 90% home ownership and most working women hold full-time jobs. Thus, women were more likely to return to work immediately after six weeks of maternity leave. At that point, breastfeeding ceased and breast milk substitutes kicked in.

Having understood the root of the problem, George and his team consulted with women about how the local authority could help continue breastfeeding their babies for (at least) four months or longer. The consultation pointed to a couple of possible interventions George and his team could offer to women: a nursery/childcare closer to the workplace where

they can visit their babies and breastfeed and a workplace facility where the working women were able to express breast milk during working hours and safely store it. Having further consulted with the employers and after scrutiny of relevant literature around the possible health gains of continued breastfeeding, George and his team had come up with a plausible intervention, the "Bio". The acronym "Bio" stood for "Breastfeeding in Offices", and it was on George's list of new programmes that needed funding to start this year.

"We have worked so hard and worked together with women and employers to develop this intervention", George got nostalgic for a while but soon recovered, "it would be a shame if we were not able to build an economic case for it. I have just a few hours now…".

George gave a second thought on what had been a problem in relation to the economic case. "The evidence on the health benefits of exclusive breastfeeding for four months or longer is pretty strong", he consoled himself. "But the evidence on the cost-effectiveness of interventions is rather sparse and where those evidence exist it is hard for us to translate that to our own contexts", he seemed to be in two minds. "It's the 'format' in which the information appears that seems to be problematic here", he concluded.

Soon, his fingers were on the telephone. "Paul, would you like to pop in to my office, please? We need to discuss 'Bio'". On such anxious occasions, it was not uncommon for George to count on Paul, his public health analyst.

"You know George, I found a very interesting new report this morning when you were in the local strategy meeting", announced Paul after taking a seat at the round meeting table in George's office. "They talk about the scale of cost savings to the NHS … if breastfeeding rates in the UK were to increase" he said as he passed the report on to George.

"I think it does the trick for us", declared Paul. "Our new intervention 'Bio' would increase breast milk feeding and given this new evidence, we could calculate how much cost savings it would generate under different assumptions of breastfeeding rates. If we then compared the cost savings with the extra costs to us of implementing 'Bio', we would be able to present our business case, wouldn't we?"

Paul's suggestion based on this new evidence punched George. "Eureka!" he exclaimed as he struggled to push himself back in to his chair.

The next hour was perhaps the most productive time they spent together working out the business case for the "Bio". Once they realised

that the evidence was in the format they needed, it was not hard for them to estimate likely returns from the investment they would require to run the "Bio" under different assumptions across New Maryland.

When Elaine came to remind George of his next meeting in 15 minutes, George seemed very confident that he would be able to present a strong business case for "Bio" the next day.

"This meeting might turn out to be fiercely competitive but I may get the funding, who knows?" he said smiling at Elaine as he left his office.

Elaine knew her boss had got all the information in the format that he needed them.

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Why is George's story relevant here?

Evidence-based approaches to decision making have been on the forefront of public policy for a long time. What works, in what population and with what consequences are the three questions underlying the quest for evidence prior to or during the decision-making process. In the medical sector, the dominance of evidence-based medicine (EBM) as a supplement to traditional medical practice is well known. Clinical (micro-level) decision making is often heavily based on EBM approaches whilst reimbursement (macro-level) decision making involves EBM as just one component. EBM can be defined as "the conscientious, explicit, judicious and reasonable use of modern, best evidence in making decisions about the care of individual patients" [1]. This definition lends itself to a simple interpretation—in order to make evidence-based medical decisions, one has to rely on better (than what is used traditionally), high-quality research information that can be integrated into or with one's clinical experience and patient values. Judgement is inevitable in such decisions but that is expected to have been informed by reasonable use of "best evidence". Any evidence-based decision would then bring about the maximal benefit to a patient.

The principles of EBM have extended to public health policymaking too. However, there is one fundamental distinction between the two. Unlike in the world of medicine, the aim of public health is to move the interventional benefits from one patient to a large number of people (the population). Unlike a clinician's focus on improving health of a patient, public health professionals work towards achieving better health outcomes at the population level. How would best available evidence such as the effect size of an intervention coming out from an adequately powered randomised control trial (RCT) translate to public health decision making then?

A slight adaptation is needed to apply EBM approaches to public health. Moving away from individuals to populations, from diagnosis to prevention, from treatment to health promotion and from whole patient to whole community is necessary [2]. Medical care is thus no more the only policy goal; it extends beyond that to include interventions that could mitigate the underlying causes of the low levels of population health such as poor sanitation, environmental pollution, certain lifestyles and behaviours. Is the sort of research information that is needed for evidence-based public health essentially different from the ones needed to practice EBM? The following view articulated by Cairney and Oliver [3] may help answer this question:

> Evidence-based policymaking is not just about the need for policymakers to understand how evidence is produced and should be used. It is also about the need for academics to reflect on the assumptions they make about the best ways to gather evidence and put the results into practice, in a political environment where other people may not share, or even know about, their understanding of the world; and the difference between the identification of evidence on the success of an intervention, in one place and one point in time (or several such instances), and the political choice to roll it out, based on the assumption that national governments are best placed to spread that success throughout the country. [3]

Understanding what research information is helpful to make public health policymaking is therefore crucial. As the EBM principles suggest, the evidence should be robust, usually coming from more than a single study (e.g. from systematic reviews, meta-analyses and economic evaluations) and presented in a critical way to guide users to choose what is known as the "best available evidence". The Cochrane initiative uses stringent criteria to "gather and summarize the best evidence from research" [4] to aid the decision-making process. The evolution over time of national guideline development bodies, such as the National Institute for Health and Care Excellence (NICE) in England, has clarified the attributes of best available evidence [5]. The Health Technology Assessment (HTA) programme that aims to combine clinical effectiveness/health outcomes information with costs provides a framework upon which evidence needs to be developed, scrutinised and presented [6].

Increasingly, cost-effectiveness evidence, most of which is presented in the form of incremental cost per QALY (quality adjusted life year) gained—to reflect the additional cost of generating one extra year of full health at the population level—is being used to make treatment choices in the NHS and beyond, including public health interventions. NICE considers an intervention would provide good value for money if the cost per QALY is

preferably under £20,000 but not above £30,000. Health economists argue that presenting research information as explicitly as incremental cost per QALY is useful for decision makers because it helps them consider whether the benefits of a new treatment are worth the health displaced elsewhere by their decision to fund that treatment.

If this was that straightforward, what would explain the struggle for obtaining the right information in George's story?

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That question has haunted us for the last seven years!

In 2010, we started to look at the economic impact of tobacco use in local areas in England (the then Primary Care Trusts). The timing couldn't have been more interesting as the localism agenda had just started to show up high on the recently elected Coalition Government's White Paper [7]. As a result, the Health and Social Care Act 2012 later entrusted the local authorities (LAs) to provide public health provisions such as Stop Smoking Services [8]. Austerity being high on the agenda, service commissioners started to look for relevant "data" supporting their business cases, be it for continued or new investment or even disinvestment from existing services.

As practising public health economists, we didn't see any problem with that as we were convinced—based on the hard data—that most public health interventions actually provide good value for money. In fact, Lesley and her colleagues at NICE evaluated over 20 economic evaluation studies (comprising 200 cost-effectiveness estimates) underpinning the NICE Public Health Guidance published between 2006 and 2010. They found that in 15% of the cases, the intervention was more effective and cheaper than comparator and a whopping 85% of the 200 estimates were cost-effective at a threshold of £20,000 per QALY. On that basis, they confidently concluded: "the majority of public health interventions assessed are highly cost-effective" [9].

As we kept on engaging with key stakeholders in this area, the "resonance" issue started to pop up: that most evidence in public health was created to aid national-level decision making that may not necessarily resonate to the local needs. "Local population is different" (questioning whether national population averages were the best measure to make policies where "we as the LA are so different"); "local data for local decision making"; and "I want to know what economic returns this investment gives me in two years" were some of the concerns we heard consistently. Even the NICE guidance (cost/QALY) wasn't considered enough by some. It seemed to us that decision makers were in need of something different, something that is meaningful to them (not just meaningful to us as the researchers).

It was the time, we realised, for us to abandon our respective ivory towers of academia and go to the ground to understand what stakeholders actually needed.

Soon, some of us started engaging with a number of stakeholders as part of a study [10]. Of the 12 stakeholders with whom we interacted, 8 were from health institutions (4 with public health, 2 with primary care and 3 with finance roles) and 3 from local authorities. The feedback reasonably represented the viewpoint of an important cross section of the professionals who were engaged in tobacco control at the time.

By this time, we had completed an evidence review to establish the feasibility and underlying methods of an economic tool aimed to help local decision makers build their business cases for tobacco control. The variation that we found in both methods and resulting estimates across different published studies led to a clear conclusion: if we wanted to be helpful to local decision makers, we needed to ask them what types of impact from their investments they would like to see in the tool. Not being sensitive to their needs would only risk poor uptake and receptivity of the tool when rolled out.

The findings of our engagement with the 12 stakeholders representing an important cross section of professionals were very interesting (summarised in Box 1.1). The stakeholders felt that published economic tools at the time were somewhat disjointed from local decision-making frameworks; they did not provide estimates of cash-releasing cost savings, and they had very long time horizons which might be entirely appropriate for national-level policy debates but not for the context in which local public finance operated. Of particular note was the idea that the tool should be able to capture proxies of progress, for example, changes in prevalence, changes in the rates of new smokers (particularly in young people), hospital admissions by type (e.g. by lung cancer or coronary heart disease) and incidence of smoking-related diseases.

The stakeholders also felt that it was important to include productivity and employment losses to businesses due to smoking. Importantly, they felt that the economic tool should be populated with local authority data as default and include short-term impacts, typically proxies at one to two years and the medium-term (up to ten years) costs and benefits. Long-term benefits, usually the lifetime costs and benefits, were of less interest to stakeholders. This reflected the current austerity climate in which public finance operated. There was a very clear message regarding how the tool should be presented. They strongly preferred an economic tool presented as simple and user-friendly, allowing real-time analysis of

"what-if" scenarios. Graphical illustration of results would make it more attractive. The economic tool needed to be able to address different populations and include micro-level analyses.

Box 1.1 Summary Findings from Stakeholder Engagement Activities

- There is a demand for a well-designed economic analysis of smoking cessation and tobacco control, in particular for an economic tool that would help local service commissioners and tobacco control managers make their business cases.
- Focus of such tools should be on current smokers, uptake and passive smoking.
- Such tools need to reflect the needs of local decision makers. Identifying "cash-releasing" savings through reduced number of hospital admissions is an example.
- Important impacts to include in the models are short-term (two-year) impacts such as primary care visits, hospital admissions and productivity losses and medium term (ten-year) impacts such as treatment costs of new diseases caused by smoking.
- Productivity losses, extent of passive smoking, particularly in children, and uptake of smoking in young people are other impacts that need to be included for both short and medium terms.
- Long-term impacts such as QALYs may be less relevant to local decision making.
- Balancing robustness with transparency and ease of use is important; in particular ensure that the model has a short run time to allow for "what-if" analyses.

Much of our work in developing public health return on investment (ROI) tools, analyses and evidence particularly for tobacco control has since been informed by stakeholder feedback. Initially, we conducted this work for NICE, but together with other European colleagues we endeavoured to roll the NICE Tobacco ROI tool to other European countries through the European-study on Quantifying Utility of Investment in Protection from Tobacco, (EQUIPT) study [11]. This book is largely based on this experience.

Stakeholder engagement became a part of our study design by default. We just could not ignore George's story and his busy diary anymore. The two boxed items (Boxes 1.2 and 1.3) are reflections from real-world decision makers and serve to highlight some of the challenges in this area.

Box 1.2 Understanding Decision Contexts for ROI Analyses

Professor Derek Ward, Public Health Advisor to Derbyshire Clinical Commissioning Group (CCG).

Interview excerpts:

The vast majority of policy/decision making still relies on historical decisions. Most often commissioning decisions require savings made through recommissioning contracts; look at the contract details and change them if possible by following NICE guidance. However, where there is a significant problem or where a new service is believed to provide benefits (or harms), looking for details about the area, its effectiveness and efficiency data such as ROI evidence is more common practice. This is rather a pragmatic approach. Also, since the Health and Social Care Act 2012, organisational structures have changed and decision making often cuts across NHS England, Public Health England (PHE), local authorities and clinical commissioning groups. At times, it is driven by how much money is available and considering the budget line by line.

It is hard to say how much of decision making would involve looking for cost-effectiveness (CE)/ROI evidence, mainly due to the complexity of service commissioning. Core packages involving individual clinical interventions need to be commissioned. Sometimes, one could look at things on a case-by-case basis, but the middle ground would be to have ad hoc conversations with the local clinical decision-making team and decide what would be the best thing to do. However, when different funding scenarios are worked out, it is useful to have cost-effectiveness/ROI evidence to hand.

Looking for cost-effectiveness/ROI evidence when there is a need for it is really a "hit-and-miss". Where an intervention is safe or harmful, or it has no or significant clinical benefit or its cost is very high or very low, one would be required to look for evidence. The starting point would be the evidence hierarchy—look for NICE

guidelines and meta-analyses and then bring in clinical expertise. Consideration of cost is always important. However, consideration of CE or ROI is secondary to whether the intervention has been commissioned in the past and whether there is an expectation it should continue, for example, grommets. We needed strong clinical evidence and guidelines to stop doing lots of grommets! Also, costs/QALY is not obvious for CCGs and they often follow the "we just pay it" approach. However, all CCGs have a commissioning procedure that they follow. In the case of very high-cost or high-volume interventions, guidelines from the NHS England and/or NICE would (normally) be followed.

In order to use CE/ROI information more effectively, we need to move away from single-risk behaviour to more complex multiple behaviour/conditions to an integrated model of care. In relation to public health, a behaviour change package involving different aspects such as smoking, nutrition, cancer prevention, and so on, would be useful to think about. Then, various scenarios with different effects could be worked out and ROI analysis would be very helpful there.

Cost/QALY does not resonate very well in a local commissioning context. Rather, if that information is broken down to benefits in terms of actual savings (e.g. avoidable numbers of hospitalisations and GP visits or averted numbers of falls) as the result of interventions, that would make much more sense. Likewise, working out how many accidents and emergenices (A&E) repeat attenders or episodes of serious mental illnesses admissions that a package of interventions could avoid gives a real impetus to the local decision-making process. Here, the point is about avoided costs rather than ROI—unless the ROI can be demonstrated over a very short timeline—preferably in a year!

Granularity of information is vital as that can be applied locally more readily than the cost/QALY information. Public finance works with a very short time horizon. What can we do this year to reduce the incidence of major conditions to deliver cost savings for this or next year? This is what most commissioners ask. There is common acceptance that benefits, usually the morbidity and mortality benefits in terms of QALYs, from interventions accrue over a long period of time. However, there is also an acknowledgement that we need to balance the books. Therefore, showing any benefits that would accrue in the short to medium term is very helpful.

Box 1.3 Understanding the Use of Cost-Effectiveness Evidence in Local Policymaking

Tessa Lindfield, Director of Public Health at London Borough of Enfield

Interview excerpts:

Cost-effectiveness and ROI are one element of decision making alongside other elements including risk and practicalities. There are many elements in decision making, particularly in organisations with many stakeholders and working across and between sectors and organisational boundaries. CE/ROI is obviously important but they have to be balanced against other considerations. There is not enough CE/ROI evidence for local authorities. This is less of problem for the NHS where there is more evidence, but this is still not enough. In local authorities, evidence is sparse. About 10% of decision making currently involves looking for CE/ROI evidence.

We use different sources of evidence when there is a need for it; first we'd go to recognised sources such as Public Health England, the York Consortium, Sheffield, and so on. If evidence could not be found we'd go online and look for grey evidence. NICE evidence can be useful, but as noted above particularly in local authorities, there may be insufficient evidence.

Consideration of costs usually kick in at the beginning of the decision-making process. Clearly there are a number of considerations to any decision but costs are a pretty fundamental one and if the costs begin to mount without any foreseeable benefits the decision begins to be made for you.

We could improve the uptake of CE/ROI evidence in decision making by making the evidence more relevant to the decisions and organisations we are working for. Also, there is a very big gap in how much evidence there is. Evidence also needs to be made as accessible as possible so that it can be understood and therefore influential.

Key Points

- Public health policymakers are expected to apply evidence-based decision-making principles, similar to those of evidence-based medicine (EBM).
- In order to make evidence-based decisions, one has to rely on high-quality research information integrating clinical benefits with population values.
- In applying evidence to decision making, some form of judgement becomes necessary but such judgement should be informed by reasonable use of "best evidence".
- Policymakers are in search of evidence that resonates to their local needs (real-world practice). Often what is available is not in the format desired. This is particularly the case for economic evidence, where the traditional metric (cost/QALY) is seen as "abstract" in the context of real-world decision making by many.
- Return on investment (ROI) analyses could help real-world decision makers by offering information on the costs and benefits of alternative policy actions. ROI information should usually be presented as a single, simplified metric making it easy for decision makers to relate it to their local contexts.

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CHAPTER 2

The Scourge of Modern Lifestyles

(with Glenn Stewart)

Abstract Modern lifestyles/behaviours are complex to understand; more complex is how to modify them to improve population health status. This chapter provides an overview of these issues. Most public health interventions aimed at modifying lifestyles/behaviours are or have potential to be effective and cost-effective. However, the greatest challenge for contemporary public health policymakers is the "type" of evidence on which to base their decisions. It is unlikely for a single intervention to deliver a significant positive effect in modifying lifestyle behaviours in order to realise the health and wider benefits; rather, most effects come from a multifaceted approach in which several interventions are delivered concurrently as a "package". The evidence showing the value for money of such a multifaceted approach is sparse.

Keywords Lifestyle • Behaviour change • Return on investment • ROI • Public health

Much of the world has undergone demographic transition and thus moved from being characterised by high to low birth and death rates [1]. Consequently, the major challenges to health and healthcare systems have moved from the need for immediate, acute medical interventions to the prevention and management of long-term conditions (LTCs) or non-communicable diseases (NCDs). These conditions or diseases have no

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cure but may be managed: heart disease, stroke, cancer, chronic lung disease and diabetes. Their impact is considerable—they account for almost 70% of deaths worldwide as well as, for example, in the UK, 70% of the NHS budget [2], 50% of all GP appointments, 64% of all outpatient appointments and 70% of all inpatient bed days [3].

Some LTCs are also known as "lifestyle diseases"; that is they are associated with how people live their lives, for example, meeting recommendations on tobacco use, diet, alcohol consumption and physical activity (PA) [4]. These recommendations are sometimes known as MEDS—moving, eating, drinking, smoking. With increasing longevity in many ways modern health challenges are not so much to increase life expectancy but to increase healthy life expectancy, also referred to as the compression of morbidity [5].

Lifestyles are largely determined by the attributes of the society we live in: availability of goods and services, cultural norms and expectations, marketing and promotion, and urban design. This means that modern healthcare challenges are reflections of modern society. Given the global burden of mortality and morbidity attributable to LTCs, the challenge for public health researchers may therefore be to understand how to influence the behaviour-shaping decisions of those who design and implement the environment in which lifestyle behaviour takes place [6].

Looking at lifestyle behaviours through the lens of policymaking is therefore important. In this chapter, we will discuss three lifestyles/behaviours—tobacco use, physical activity and breastfeeding—as exemplars of public health challenges facing modern policymakers around the globe. Of course, the three examples presented here are just the tip of the iceberg of contemporary public health challenges. Nevertheless, they can provide a good steer in understanding the scale of associated economic and wider costs and the complexity of public health policies around them.

2.1 Tobacco Use

Ever since the seminal Doll and Hill study that examined the association between lung cancer and cigarette smoking [7], the evidence linking tobacco use and ill health has become incontrovertible. The 1964 Surgeon General's Report on Smoking and Health concluded that cigarette smoking is a cause of lung cancer and laryngeal cancer in men, a probable cause of lung cancer in women and the most important cause of chronic bronchitis [8].

Nicotine is the addictive agent in tobacco and there are a number of delivery systems for such. These include roll-your-own cigarettes, cigars, bidis (tobacco wrapped in a leaf), kreteks (tobacco, cloves, flavouring) and

waterpipes (shisha) [9]. Recent developments have included the increasing popularity of electronic nicotine delivery systems (ENDS) mostly in the form of e-cigarettes in which typically a liquid containing nicotine is heated into a vapour for inhalation. However, manufactured cigarettes account for some 92.3% of global tobacco consumption [9] and it is cigarettes upon which this section will focus.

2.1.1 Prevalence of Tobacco Use

Smoking has claimed over 5 million lives every year since 1990 with this burden expected to grow, especially in lower-income countries. Globally, 1 in 4 (precisely, between 24.2% and 25.7%) men smoked daily in 2015 as did 1 in 20 women (precisely, between 5.1% and 5.7%) [10]. Of these, 933 million smokers (63.6%) lived in just three countries—China, India and Indonesia [10].

As measured by the Opinions and Lifestyles Survey (OPN), in Great Britain smoking prevalence has fallen steadily since 1974 when 46% of adults (aged 16 and over) smoked an average of 16 cigarettes a day to 19% of adults smoking an average of 11 cigarettes a day in 2014 [11]. Further data (Fig. 2.1) from the Annual Population Survey (APS) estimates that 15.8% of adults (aged 18 and above) smoked cigarettes in 2016 [12] whilst the OPN estimates 15.5% [13].

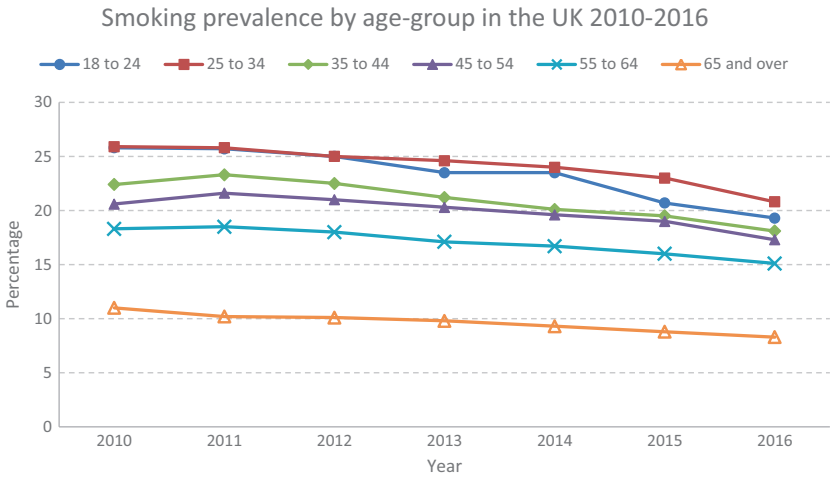


Fig. 2.1 Trend in smoking prevalence in the UK [12]

A note of caution is necessary here. Both the above surveys are self-report surveys which may be subject to either self-report or social desirability bias. There are a number of reports that indicate differences between subjective and objective measures of lifestyle [14, 15], highlighting a need to validate reports. However, it is widely accepted in the policymaking and research circle that the UK smoking prevalence has declined over time to close to 15% now.

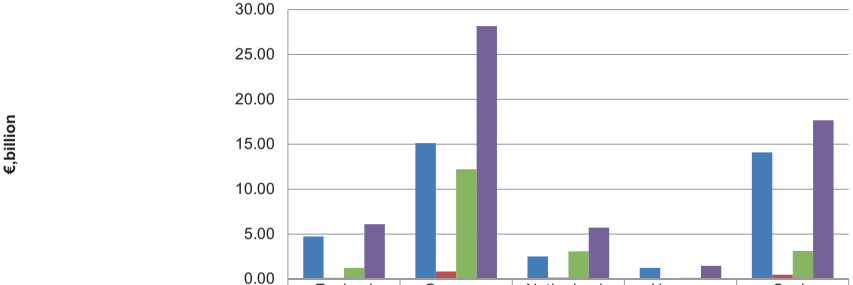
2.1.2 Health Consequences of Tobacco Use

It is estimated that 12% of all adult deaths (>30 years of age and older) can be attributed to tobacco use, some 6 million deaths of which approximately 600,000 (1% of global mortality) result from second-hand smoke (SHS) [9]. This includes 14% of deaths from non-communicable diseases (NCDs). Ten per cent of all adult deaths from cardiovascular disease, 22% of all adult cancer deaths and 71% of adult lung cancer deaths are attributable to smoking. Five per cent of all adult deaths from communicable disease, in which 7% of all deaths due to tuberculosis (TB) and 12% of deaths due to lower respiratory infections, are attributed to tobacco use [9].

Whilst UK smoking prevalence may have fallen to less than half of that in 1974, the health consequences are still severe. Smoking is the greatest cause of preventable death and disease in the UK causing approximately 80% of deaths from lung cancer, 80% of deaths from bronchitis and emphysema and 14% of deaths from heart disease [16]. More than a quarter of cancer deaths are linked to smoking and it is estimated that approximately half of all smokers will die prematurely. On average a smoker will die ten years earlier than a non-smoker [16].

Premature mortality does not include all the health costs of smoking though. Rather, smoking both causes and exacerbates NCDs. Together these account for 70% of the NHS budget (2). Smokers are more likely to require treatment in hospital [17], acquire surgical site infection [18], die after surgery [19] and require care from social services at an annual cost of £1.4 billion [20]. The costs are wider and include the treatment costs in primary care (where the majority of healthcare in the UK takes place) and the compromised quality of life of the smoker before death including potential loss of earnings through early retirement or the wider costs to society through the need to provide both formal and informal care.

A recent study [21] provides a useful comparison of economic burden of tobacco across five European nations (Fig. 2.2). The economic loss to



	England	Germany	Netherlands	Hungary	Spain
Direct healthcare costs	4.73	15.12	2.50	1.24	14.09
Second hand smoke healthcare costs	0.13	0.83	0.15	0.08	0.47
Productivity losses	1.24	12.21	3.08	0.14	3.11
Total	6.10	28.16	5.73	1.47	17.67

Fig. 2.2 Economic cost of tobacco use in selected European jurisdictions [22]

tobacco use is substantial and varies widely across the jurisdictions—from €1.5 billion in Hungary (smoking prevalence: 31.2%) to €28 billion in Germany (smoking prevalence: 24.4%) in 2015/2016. Although England had the lowest smoking prevalence (18% at the time of this study), tobacco use cost the NHS a staggering €4.8 billion in 2015/2016. It is interesting to see that productivity losses contribute significantly to the total cost even after accounting for direct medical care.

It is important at this point to acknowledge an important limitation of the studies that have attempted to estimate the economic costs of tobacco use. Estimated costs depend on what health outcomes one considers within and beyond the NHS and how modelling assumptions are constructed. A recent systematic review [23] found that 50% of the 18 studies included in the review used a 1992 reference to estimate medical costs and 56% used a 1996 study to estimate quality adjusted life years (QALYs). This led to concluding that many studies may not have taken into account either advances in the treatment of smoking-related diseases or more recent research into smoking effects [23]. Although updated economic models of smoking addressing these limitations would be useful, it is, nevertheless, clear that the economic cost of tobacco use is indeed substantial however it is measured.

2.1.3 Tobacco Control Policies

Ever since the link between smoking and ill health was established, tobacco control has been a conflict between manufacturers and those that sought to mitigate the effects of the tobacco industry. It is claimed that "the cigarette is the deadliest artefact in the history of human civilisation" [24] from which cigarette manufacturers make approximately one cent for every cigarette sold, for example, every smoker is worth circa $10,000 to the manufacturer [25]. The World Health Organization (WHO) has set a target of reducing smoking prevalence in those aged 15 and over by 30% by 2025 [26]. The WHO European region has the highest global prevalence of smoking where 41% of males and 22% of females aged 15 and over smoke [27]. The most significant policy framework to reduce this prevalence has been the WHO Framework Convention on Tobacco Control (FCTC) which aims to make tobacco a "thing from the past" [27].

The FCTC includes measures to tackle all causes of the tobacco epidemic including trade liberalisation, foreign investment, tobacco advertising, cross-border promotion and sponsorship and tackling the illicit trade

of tobacco products. However, signatories to the framework have been inconsistent in its implementation. In 2013, the Tobacco Control Study (TCS) found that whilst the UK, Ireland, Iceland and Norway had implemented most measures, 24 of 27 countries failed to score even 50% for adoption [27]. At least part of this might have been due to strong lobbying by Phillip Morris International which spent €1.25 million to influence the Tobacco Products Directive (TPD) with possible subsequent changes to the size of health label warnings, the four-year derogation of the ban of menthol flavouring, dropping the ban on slim cigarettes and only tracking the legal rather than illicit supply chain [27]. To date, it remains unclear exactly what effects this influence might have had and what might enable countries to commit more fully to the FCTC.

Despite the above, there is evidence that tobacco control policies have affected smoking prevalence so that countries with stronger legislative frameworks for tobacco control also have lower smoking rates, at least in adolescents aged 15–16 [28]. Where implementation of the FCTC varies by country, it is also possible to analyse the potential effect of different measures. Large pictorial warnings are associated with a 11.0% (precisely, between 3% and 19%) lower cigarette smoking prevalence in adults with either no formal education or less than secondary education. No effect was found in those with at least a secondary education [29].

As mentioned above, the FCTC needs to be implemented by national governments. Others therefore have sought to understand the effect of this implementation. Smoke-free legislation is associated with a 4.3% drop in regular smoking by 15-year-old girls with positive but non-significant effects found in 13-year-old girls, boys and 15-year-old boys [30]. However, it is also noted that the effects may have been influenced by other measures such as raising the age at which cigarettes could be legally purchased.

The USA is a signatory to but has not ratified the FCTC. This though has not prevented national or state legislation in relation to tobacco control. Similar effects to those found in Europe have also been found where cities have implemented legislation on smoking in the workplace. Smoking frequency and quantity fell in college students whilst the number of binge drinking episodes (commonly associated with smoking behaviour) remained stable [31]. Between 1999 and 2013, adolescent (aged 14 to 18) smoking in the USA fell from 35.3% to 13.9% with the strongest effects being found in younger adolescents (aged 14 and 15) in 43 states that implemented an increase in cigarette tax. In this age group every dollar

increase in tax per packet was associated with a drop in prevalence of between 1.6% and 2.1%. Smoke-free legislation was found to have a similar but lesser effect (1.1% drop) but across all ages [32]. The effect of taxes on older smokers (aged 50 and over) has been modelled to suggest an inelastic demand for cigarettes, with an implied 3.8% to 5.2% reduction in the number of cigarettes smoked [33]. The USA has a strong history of tobacco legislation and control, and Levy and colleagues (2015) assessed the effect of all policies to reduce tobacco use since the Surgeon-General's report of 1964 [34]. The cumulative impact of taxes, smoke-free legislation, anti-smoking advertising, tobacco control campaigns, health warnings, smoking cessation programmes and the restriction of access to tobacco was found to be a reduction in prevalence of 55% by 2014 and the avoidance of 2 million smoking-attributable deaths [34].

The policies above perhaps illustrate some of the ironies of tobacco control. There seems to be a strong view that environmental and societal attitudinal change would be more effective in reducing smoking prevalence than interventions aimed at individuals [35]. It has been estimated that public health measures to reduce tobacco usage could prevent some 70,000 deaths over ten years [36]. The WHO provides detailed guidance on the implementation of effective tobacco control measures including taxation, advertising bans, smoke-free policies and protection against the tobacco industry [37]. The UK is seen as one of the leading countries in the implementation of tobacco control policies. The national plan was to reduce smoking prevalence yet in the UK £130 million is spent on tobacco-related disease research and just £5 million on tobacco prevention [38]. In comparison, cigarette companies spent $8.49 billion on cigarette advertising in 2014 [39]. In their annual report of 2016, British-American Tobacco detailed their market leadership, geographical diversity, market share growth and £5.2 billion profit from the sale of 665 billion cigarettes.

Whilst this may go some way towards explaining the persistence of smoking it may also hold lessons for tackling other public health issues. Vested interests in food and alcohol industries have been shown to use the same strategies and tactics employed by the tobacco industry to penetrate new markets [37]. Therefore, whilst there are gaps in understanding the economic effects of smoking it would seem more urgent to understand which measures would be most effective in reducing smoking prevalence in which population groups over what time period. Allied to this, it would be useful to understand what the barriers to action for policymakers are and how these could be overcome.

2.1.4 Tobacco Control: Looking Forward

Tobacco has killed more than 100 million people; more than that died in the First and Second World Wars combined (38). Current trends predict that at some point in the twenty-first century this toll will pass 1 billion [40]. Considerable work has been undertaken to reduce prevalence with evidence to show effect. In many countries, smoking has moved from the "glamour" of the 1940s and 1950s to present-day "stigma" [41]. Despite this, there are research gaps relating to the financial justifications for investing, and investing more, in the currently available evidence-based interventions. Useful future research would also be needed to understand the influences and barriers to evidence-based policy implementation.

2.2 Physical Activity

Physical activity (PA) is essential for maximal health [42]. "Progress" is in many ways the story of how human energy has been replaced by electrical, mechanical and other forms of labour-saving devices. As noted by Jerry Morris, author of the seminal bus conductor's study [43], "now, the first time in human history the mass of the population has deliberately got to take exercise" [44].

Physical inactivity is one of the ten leading risk factors for global mortality [45] with numerous studies confirming a clear inverse relationship between inactivity and all-cause mortality and a large number of conditions. These include cardio-respiratory health, metabolic health including type 2 diabetes, muscle mass and function, breast and colon cancer and poor mental health including depression and cognitive decline with further effects on weight loss, musculo-skeletal health including hip and vertebrae fracture and osteoporosis. Its health effects are considerable and similar in scale to that of smoking— 5.3 million of the 57 million deaths in 2008 were attributed to physical inactivity and 5 million deaths attributed to smoking in 2000 [46].

Precise effects are dependent upon the type, intensity and duration of activity as well as biological factors (e.g. age, gender or ethnicity) but risk reduction is approximately 30% for all-cause mortality. For individual conditions, risk reduction is 20–35% for cardiovascular disease, 30–40% for metabolic syndrome and type 2 diabetes, 36–68% for hip fracture, 22–83% for osteoarthritis, 30% for prevention/delay in decline of physical functional health, 30% for risk reduction of falls, 30% for colon cancer, 20% for breast cancer and 20–30% for depression and dementia [42].

2.2.1 *Prevalence of Physical Activity*

Whilst the health effects of PA are clearly established, actual prevalence of PA across populations is less so. At least this is partly due to the methodological difficulties of actually measuring PA in free-living adults at a population level. The World Health Organization (WHO) estimated that in 2010 23% of adults aged 18+ years were insufficiently active (men 20% and women 27%) with older adults being less active than younger adults and inactivity being more prevalent in higher-income countries [47]. This estimate though was made through the statistical combination of a number of surveys with different definitions of meeting PA guidelines [48].

In England, physical activity was measured through the Health Survey for England 2008 and again in 2012. PA guidelines for adults in England were updated in 2011 from a recommendation of 5×30 minutes PA a week in those aged 16+ to 150 minutes a week moderate activity in bouts of 10 minutes (or 75 minutes vigorous activity). Data from 2012 was also reanalysed for comparative purposes with 2008. In both surveys two-thirds of males and 55% women reported meeting PA recommendations [49]. These results, however, are self-report data and should be interpreted with caution. Objective measurements taken in the 2008 survey indicated only 6% of males and 4% females meeting (former) PA guidelines [14].

2.2.2 *Getting More People Moving and Moving More*

In addition to imprecision of measurement, there is a lack of evidence on how to increase the prevalence of physical activity at a population level. The accumulation of evidence is made difficult by two methodological difficulties. The first difficulty relates to the demonstration of the counterfactual: what would have happened without the intervention? The second difficulty relates to the substitution effect: would an increase in PA in one activity have been counterbalanced or offset by a fall in PA in other activities?

Sport and major sporting events including the hosting of the summer Olympic Games did not seem to have increased physical activity at a population level in Australia [50] or England [51] despite government policy and funding [52]. Rather, conflating sport and other activity may be skewing physical activity to those who can afford it through the purchase of sporting equipment, entrance or membership fees, and so on [53]. Others

have sought to understand how levels of PA may be increased through other means, principally active transport (walking or cycling) cited by the UK Chief Medical Officer as being the easiest and most acceptable means of integrating PA into everyday life.

Active travel (travel requiring physical effort to move across space) can include roller-skating, skateboarding and non-motorised wheelchairs but generally refers to walking or cycling [54]. Particularly in the UK walking is much more common than cycling and does not imply the same level of vulnerability to road traffic injuries as cycling [55]. Walking is practical, inexpensive, does not require specialised equipment or clothing and can be undertaken either socially or individually [56]. It has been described as a near-perfect exercise [57]. Walking at 5 km/hour (3 mile/hour) has been found to meet the definition of moderate PA [58] though it is not certain that this is always achieved in free-living adults [59]. Nonetheless, walking can constitute a useful means of meeting or contributing to PA recommendations.

There is limited but promising evidence that interventions to increase cycling may also have an effect. An increase in physical activity has been found following the implementation of more cycle-friendly infrastructure at three sites in England [60, 61]. The Department for Transport, the Department of Health-funded Cycling City and Town (CCT), has been found to have had a positive effect on both commuter cycling [62] and overall physical activity [63]. However, between-country variation in levels of commuter cycling even in developed countries may indicate how great is the potential to increase physical activity through active transport; commuter cycling prevalence in the Netherlands is at least ten times that of the UK and the USA [64]. More recent data, though unverified academically, would indicate that even greater disparities may exist where there has been a long and strong tradition of encouraging cycling for transport purposes [65].

As with cycling, evaluations of interventions to increase walking have focused on those that are easier to evaluate; interventions aimed at individuals, volunteer samples and over short-time periods therefore provide evidence of efficacy rather than effectiveness in improving population health. This is unfortunate and illustrates the inverse care law—we know least about those interventions that are most likely to increase the health of the most [66]. Nonetheless, there is evidence that walking can be increased at both the individual and the environmental level; at an individual level factors that seem to increase walking include targeting those

most sedentary and motivated to change [66], increasing self-efficacy rather than ego orientation [67] and encouraging walking through other means such as making friends/connectivity [68]. Environmental-level interventions include short commuting distance, high-street connectivity, living in an urban area and high road density [69].

Ultimately the decision to undertake active travel is an individual one. However, the built physical environment can have a substantial positive or negative impact upon this decision. Assuming a transport modal shift from motorised to active travel is achieved, active travel has positive implications for health beyond PA including improved air quality and reduced road traffic injuries. The synergy between active transport and liveable cities is increasingly being recognised through, for example, the recently released draft London Mayor's Transport Strategy which has an explicit focus on encouraging and promoting walking and cycling as part of "healthy streets" [70].

2.2.3 Policies to Address Physical Activity

In many ways, even where they exist, policies to increase PA lag far behind those to reduce smoking prevalence. This may reflect the simplicity of the smoking message (don't) and/or that PA guidance varies across population groups. Alternatively, as indicated above it may reflect a lack of a clear steer of what interventions will increase PA or indeed other factors. However, it is noticeable that whereas many countries have passed legislation and policy frameworks to reduce and restrict smoking policy documents there is at best confusion as to policy progress to increase PA. Hence it is reported that less than 40% of the 53 countries in the WHO European Region have developed national PA recommendations [71] but also that 80% of countries worldwide have national PA policies or plans even if these were only operating in approximately half [72]. However, given that global prevalence of PA is not rising, there is concern that even where policies exist they are insufficiently resourced, often reliant upon mass media campaigns and other ineffective measures [73].

There is some concern that policy in the UK may not have learnt the lessons of the past. In 2012 *The Lancet* ran its first series on PA explicitly stating that it was not about sport and it was more than exercise [74]. In 2015 "Sporting Future: a new strategy for an active nation" [75] was launched extending Sport England's remit to engage people as young as five to "help create a much healthier and more active nation". Similarly, in

2016 Sport England published "Towards an Active Nation" with the ambition of increasing the "number of people who engage in sport and activity, not for its own sake but for the wider benefits it can bring, in terms of physical and mental wellbeing" [76] (68). Despite this emphasis, PA undertaken as active transport has been excluded as a Sport England key performance indicator (KPI).

2.2.4 Physical Activity: Looking Forward

Physical inactivity has been acknowledged as a public health problem. However, how the prevalence of physical activity might be increased at the population level is less understood. A more pragmatic policy question may therefore be "how policymakers could be enabled to promote interventions that will integrate PA into everyday life rather than focusing on activities that may be costly both in time and finance". If traditional approaches to increasing PA are to be continued albeit with an emphasis on encouraging those who are defined as inactive into activity as emphasised in the new Sport England "Towards an Active Nation strategy" [76], it would seem that these approaches will need to be evaluated both for their effects and costs. If it is accepted that Northern European examples of active travel-friendly infrastructure may be difficult to evaluate but may offer lessons applicable to other countries, it may be useful to understand exactly how those lessons might be applied in an alternative policy (provision and financing) context.

2.3 Breastfeeding

Breast milk is widely regarded as the best form of nourishment for infants, and its supply for the first few months of life is usually considered sufficient. Breastfeeding is found to be protective against several childhood diseases (gastrointestinal and lower respiratory tract infections (LRTI), acute otitis media, necrotising enterocolitis in preterm babies) and maternal breast cancer, thereby saving significant resources to the national health services [77, 78]. There are many other conditions (e.g. cognitive outcomes, sudden infant disease syndrome and childhood obesity) where breastfeeding may be protective too [79, 80]. Yet, exclusive breastfeeding rates at six months are low in many countries, highlighting the suboptimal breastfeeding behaviour. Improving breastfeeding rates is therefore an important contemporary public health challenge.

2.3.1 *Prevalence of Breastfeeding*

The proportion of infants exclusively breastfed for the first six months of life varies across the income levels. In the World Bank low-income countries, 47% of infants are exclusively breastfed for the first six months of life and in general this proportion reduces as the income of a country increases. Globally, only 36% of infants are exclusively breastfed for the first six months of life [81] (WHO 2015).

There is a substantial variation in breastfeeding behaviour across countries. Figure 2.3 depicts the exclusive breastfeeding rates at six months for a cross section of countries representing the entire income spectrum. Whilst many low-income countries still have high breastfeeding prevalence, suboptimal breastfeeding is prevalent in many high-income countries including the UK. The breastfeeding initiation in the UK has been between 64% (Northern Ireland) and 83% (England), but exclusive breastfeeding ceases rapidly with most mothers opting for breast milk substitutes by six weeks (23% UK mothers exclusively breastfeed at six weeks) [82] (Fig. 2.4). By six months, 1% or less infants are exclusively breastfed (compare this with lower-income countries like Nepal or Sri Lanka where 70% or more infants are exclusively breastfed at six months).

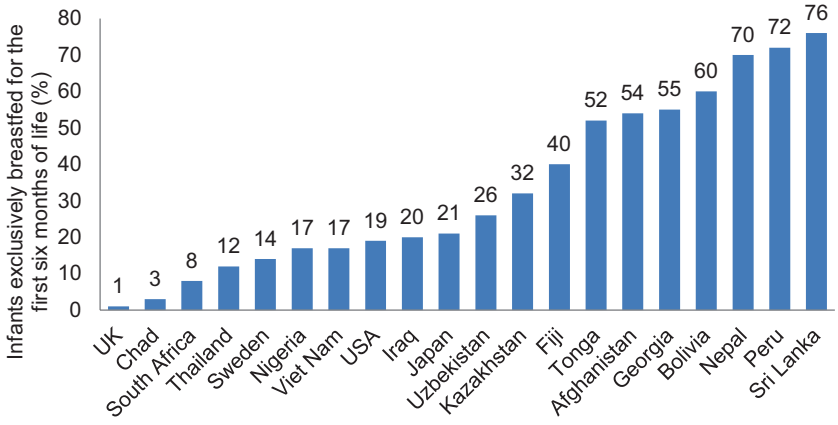


Fig. 2.3 Breastfeeding behaviour in a cross section of countries [81]

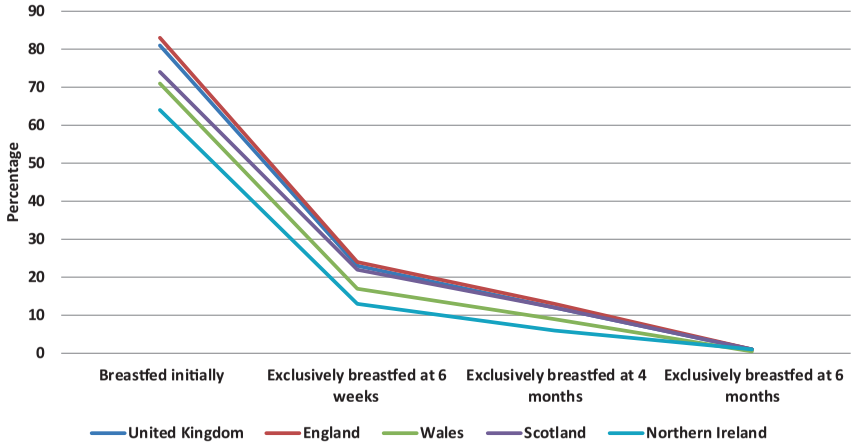


Fig. 2.4 Breastfeeding initiation and cessation in the UK and home countries [82]

2.3.2 *Economic Cost of Suboptimal Breastfeeding*

Suboptimal breastfeeding is associated with substantial costs to the national health services. The costs of suboptimal breastfeeding are essentially the costs of treating excess number of disease conditions such as gastrointestinal illnesses, lower respiratory tract infections and acute otitis media in infants, necrotising enterocolitis in preterm babies in neonatal units, maternal breast cancers in women and several other conditions where breastfeeding may have been protective. Renfrew and colleagues reviewed the published health economic literature and found that whilst the way many studies had reported economic impact of suboptimal breastfeeding differed, the evidence could not be stronger in highlighting suboptimal breastfeeding being a major contemporary public health challenge in the industrialised world [77, 78]. In particular, the impact that suboptimal breastfeeding has on health services finance and premature morality is substantial (Table 2.1).

2.3.3 *Breastfeeding Support Policies: Looking Forward*

From a policy perspective, working towards optimal breastfeeding is complex in at least two ways. First, the decision whether to breastfeed is ultimately an individual choice and it is clear from the breastfeeding prevalence data presented above (Fig. 2.4) that not every mother chooses to breastfeed her baby. Second, the extent to which breastfeeding provides health benefits depends on the duration and exclusivity. Despite high initiation rates, most women stop breastfeeding exclusively within the first six weeks or immediately after as seen in the case of the UK. Supporting women who choose to breastfeed thus seems an important policy goal.

Public health interventions are usually cost-effective. A study found that more than 80% of public health interventions were cost-effective at a threshold of £20,000 per QALY [97]. Unlike other areas of public health, the cost-effectiveness evidence on breastfeeding support interventions is sparse, however. Enhanced contact with specially trained staff providing education, support and a care plan for mothers [98] and proactive telephone support (i.e. a feeding support team calling women daily for one week after hospital discharge) [99] do increase or have the potential to increase breast milk feeding rates at less or reasonable costs compared to

Table 2.1 Costs of suboptimal breastfeeding reported in the literature [78, 83–96]

Country	*Cost of suboptimal breastfeeding (excess cost per annum or lifetime)*	*Source*
Globally (96 countries)	$302 billion (0.49% of gross national income) in economic losses from cognitive deficits	[83]
South East Asia (7 countries)	US$ 1.63 billion in cognitive outcomes US$ 294 million in treatment costs	[84]
UK	£17 million in treatment of childhood diseases £31 million in treatment of maternal breast cancer (lifetime)	[78]
Australia	Australian $9 million in treatment costs Australian $11.5 million including special education costs	[85]
Australia	Australian $ 1.5 million in treatment costs	[86]
USA	US $14.2 billion total (between $8.8 and $19.6 billion) as the result of premature deaths	[87]
USA	US $331 per infant	[88]
USA	US $3366 per neonate	[89]
USA	US $200 per infant US $9669 per infant in neonatal unit	[90]
USA	US $3.35 billion in treatment costs US $13 billion including the value of premature deaths	[91]
USA	Between US $1.2 and 1.3 billion in treatment costs	[92]
USA	US $3.6 billion including the value of premature deaths	[93]
USA	$200 per infant	[94]
Netherlands	€250 per newborn	[95]
Italy	€160 per infant	[96]

the usual practice. Other interventions, such as breastfeeding groups with weekly group meetings facilitated by a health professional, are not cost-effective [100].

Lack of good-quality cost-effectiveness evidence does not necessarily lead us to conclude that breastfeeding support interventions are not cost-effective. Rather, this is a reflection of the current lack of good-quality studies in this area; a lack of evidence does not imply evidence of lack. Several interventions (e.g. kangaroo skin-to-skin contact, peer support, simultaneous breast milk pumping, multidisciplinary staff training and the

Baby Friendly accreditation of the associated maternity hospital) that are intended to support women breastfeeding their babies have the potential to be effective despite the limitations in the evidence base [101]. However, where breastfeeding support interventions are run concurrently in a combination of health system, home and community settings, they would have higher impact than if they were run individually [102]. This necessitates the need to look at breastfeeding support policies as a "collection" or "package" of interventions as "it is unlikely that specific clinical interventions will be effective if used alone" [101].

It is therefore important to note at this point that in providing breastfeeding support in whatever forms and sizes, scarce resources are utilised [103]. Use of scarce resources comes at a price and the assessment of this opportunity cost is therefore needed. This further means that contemporary policymakers are in fact in severe need of more good-quality economic evaluation studies in this area.

Key Points

- Modern lifestyles/behaviours are complex to understand; more complex is how to modify them to improve population health status.
- Tobacco use, physical inactivity and suboptimal breastfeeding are a few behaviours costing dearly to the national health services across the globe.
- Despite huge variations in health behaviours within and between countries, most public health interventions aimed at modifying lifestyles/behaviours are or have the potential to be effective and cost-effective.
- The greatest challenge for contemporary public health policymakers is the "type" of evidence on which to base their decisions.
- It is recognised that in order to maximise the health and wider benefits of public health interventions, a comprehensive approach is required in which interventions are delivered concurrently as a 'package.'
- The evidence showing the value for money of such a multifaceted approach is sparse.

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CHAPTER 3

ROI Analysis: Art or Science?

Abstract The post-2008 financial crisis led many governments worldwide to adopt austerity measures with profound impact on the public financing of services. This chapter argues that public health budgets should be a priority as whilst individuals may be less willing to pay for many public health interventions, consumption decisions (e.g. choosing not to breast-feed) often do not consider the full economic costs and benefits (externalities). Return on investment (ROI) analyses provide a single, simplified metric comparing the costs and benefits of an investment portfolio. ROI information can be useful in supporting resource allocation decisions; however, its use in decision making may be influenced by how this information is communicated to stakeholders.

Keywords Public financing • Public health • Return on investment • ROI

Why are we more concerned about the economic returns from public health interventions now than ever before? We saw in the previous chapter that in the absence of public health interventions, suboptimal lifestyles and behaviours would prevail at the population level with substantial costs to our national health services and to society at large. Understanding population levels of behaviours is complex; more so is to modify them for maximal health. Notwithstanding this complexity, reducing the substantial

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costs of suboptimal behaviours as seen in the previous chapter requires upfront investment with most public health benefits accruing in the distant future. This investment requires one to sacrifice the use of resources or health gains elsewhere in the system. How can one justify that?

The 2008 financial crisis led many countries around the world, including the UK, to consider "austerity" as their mantra in deciding the use of public resources. All government departments including health services were given targets for "efficiency savings" and this soon became the norm in public finance. Ministers and commissioners started to look at where "cuts" could be made. "Disinvestment" from existing services became the default policy position unless a business case was made. This led to a high level of scrutiny on all publicly financed services and public health was no different. The public health community needed to respond proactively to this changing decision climate. The 2013 "Public Health is ROI" campaign in the USA [1] and the development of ROI indicators [2] and NICE ROI tools in the UK [3, 4] were some of those responses. Demonstrating economic returns, for example, every £1 invested in smoking cessation gives a return of £2.82 [5], was seen as a helpful means to justify continued or new investment in public health [6].

3.1 The Science of ROI Analysis

In the most simplified term, ROI is a metric that allows one to compare financial consequences (returns) of one's actions (investments or costs). Where returns exceed costs, a net gain is generated. A net gain means the investment is worth its costs and therefore a decision in favour of that investment can be made.

A number of slightly more complicated notions will follow then. First, there may be more than one ROI metric. A report published by the National Institute for Health and Care Excellence (NICE) in the UK defined ROI as "a general term encompassing the techniques for comparing the costs and benefits generated by an investment" and suggested that several indicators could be used as ROI metrics, namely, benefit-cost (B-C) ratio, net present value (NPV) savings, incremental net benefit (INB) and even the conventional cost-effectiveness measure, the incremental cost-effectiveness ratio (ICER) [7]. However, it is important to note that the ROI analysis—in its traditional form—should essentially provide a metric indicating the "rate of return" (RR) from an investment which is "a single, simplified metric weighing up-front investment costs against benefits accrued over a defined period of time" [6]. In technical

terms, "the [cost-benefit ratio] CBR (sic) is the benefit divided by the cost, and the ROI is the benefit minus the cost expressed as a proportion of the cost, that is, the CBR−1" [8]. Therefore, this requires that the benefits (health and wider) are expressed in monetary terms, implying that the ICER (cost/QALY) is not a preferable metric to use in ROI analysis.

Second, although numerically the ROI is the net benefit as a proportion of upfront investment [(benefits-costs)/costs], it is important to note that investments need to be calculated as "incremental costs", that is, what additional resources one needs to commit to in order to implement this action (investment). There may already have been an existing intervention and the investment may be over and above that. If it is entirely a new investment, the concept of incremental costs still hold—the costs in question are now the costs of implementing new interventions minus zero (i.e. costs of "doing nothing"). However, note that in public health "doing nothing" often comes with costs in the form of having to treat additional cases—this must be considered as negative benefits. Likewise, returns need to be calculated as "incremental benefits", that is, what additional benefits this action is likely to generate over and above what is out there now. So, understanding the counterfactual (the baseline or comparator) is essential to calculate the ROI.

Third, what perspective one takes in evaluating benefits and costs is important. For example, including cost savings generated as a result of reduction in disease incidence attributed to an intervention is important from a healthcare provider's perspective whereas it may be desirable to evaluate productivity outcomes if one takes a wider perspective such as that of local economy. Note that the purpose of an ROI analysis is to understand whether the investment is worth its costs. Therefore, having the right perspective allows the analyst to consider explicitly where (e.g. in the NHS or the wider economy) the displacements (both health and non-health) due to the intervention would occur.

Fourth, the benefits of public health interventions often accrue in the distant future. Take, for example, a vaccination programme, a Stop Smoking Service or a mass media campaign encouraging people to move more (to increase physical activity). Their effect in the form of a reduction in mortality due to target diseases (e.g. lung cancer in the case of smoking) is usually observed several years after the receipt of the intervention. Considering what time horizon would be sufficiently long enough to capture changes in health and wider benefits is therefore critical in the ROI analyses. It may be useful, in addition, to analyse the ROI for shorter time horizons too, as this would allow one to understand at what point in the future one's investment is likely to show positive returns (i.e. it makes more money than the initial outlay).

Fifth, the notion of ROI comes from the business sector (financial economics) and takes an investment view to compare and set priorities in the context of a project "portfolio". A portfolio may have more than one action (investment). In the decision-making process, the portfolios that yield higher rates of returns (RRs) are therefore prioritised over the ones that yield lower RRs. One clear advantage of this framework in public health is it allows evaluation of a "package" of interventions on a topic area such as a care pathway (e.g. healthy weight care pathways) or mitigating an exposure (e.g. tobacco control).

Finally, whilst the ROI metric dictates that an investment portfolio gets priority over others if it generates a net gain over a predefined period, it does not provide any guidance as to how big the net gain should be. In other words, there is no ROI threshold against which the magnitude of net gains is benchmarked—most often this is a judgement of the decision maker. In public health ROI modelling though, the health gains generated by an investment in the form of QALYs are so important that ignoring this gain is often inappropriate. One option would be to translate those QALY gains into monetary benefits using a "threshold" value. The threshold, also known as the ceiling ratio, should be the marginal cost of producing a QALY within the healthcare system—this gives the true societal willingness to pay for a QALY based on the willingness to fund healthcare. The value of this threshold differs from country to country reflecting local preference and there are many countries where this threshold does not exist. In the UK, thresholds of £20,000 and £30,000 are adopted [9]. For example, in deriving the benefit-cost ratio of say 3 (i.e. a return on investment [ROI] of £3 for every £1 invested in smoking cessation in England), the long-term health gains are valued at £20,000 per QALY. Therefore, although there is no such thing as an ROI threshold, there may still be direct (decision maker's judgement) or indirect (willingness-to-pay for a QALY) thresholds one should be aware of.

3.2 Applicability of ROI Analysis in Public Health

How we apply the above concepts around the ROI metric to making business cases for new or continued investment (or disinvestment) in public health in the real-world decision-making context can be challenging. Conventionally, public health has been regarded as an economic good

which is characterised largely by its preventive attributes. The consumption benefits of public health are usually large but accumulate over time, mostly in the distant future. In addition, there would be spillover benefits (e.g. herd immunity through vaccination) or costs (not breastfeeding) beyond those who do (or do not) choose to consume the good (this phenomenon is commonly known as "externalities"). However, in order to generate those benefits, this good must be produced with the use of scarce resources (upfront and recurring costs). Many individuals may not be willing to pay for such goods (e.g. vaccination) or they do not bear the full costs of their consumption decision (e.g. not breastfeeding)—a scenario conducive for market failure. When a market fails, resources need to be allocated with some rational criteria and governmental provision using those criteria becomes an acceptable policy intervention. This means that public funds are utilised to provide those services where market failure is expected.

The ROI metric is one such criterion that helps a government or public body to make decisions on what investment is needed for maximal population health and well-being. There are a number of methodological challenges in applying the principles of ROI to public health decision making though. Most of these challenges are generally the ones that are prevalent in the larger field of public health economics.

One helpful survey by Edwards and colleagues, who systematically reviewed 16 national and international guidelines that were available for the economic evaluation of public health interventions, has identified those challenges at three levels (theoretical, methodological and practical) [10]. The essence of their findings is depicted in Fig. 3.1. To begin with, it appears that significant variation exists in recommending what theoretical underpinning one should use in order to conduct such analyses. Whilst economic evaluation studies in public health in the UK started with their grounding on broad public policy economics (welfarist principles) in the 1960s mainly to comply with the culture of evidence-based medicine (EBM) that was prevalent within the NHS at the time, this position then moved on to include cost/QALY (extra-welfarist principles) as the basis for such scrutiny [10]. Welfarist principles rely on maximising individual utility as the measure of welfare gain whereas the extra-welfarist approach goes beyond to explicitly include "health" (and other non-utility measures) as the unit of outcome. Moving on, other theoretical constructs

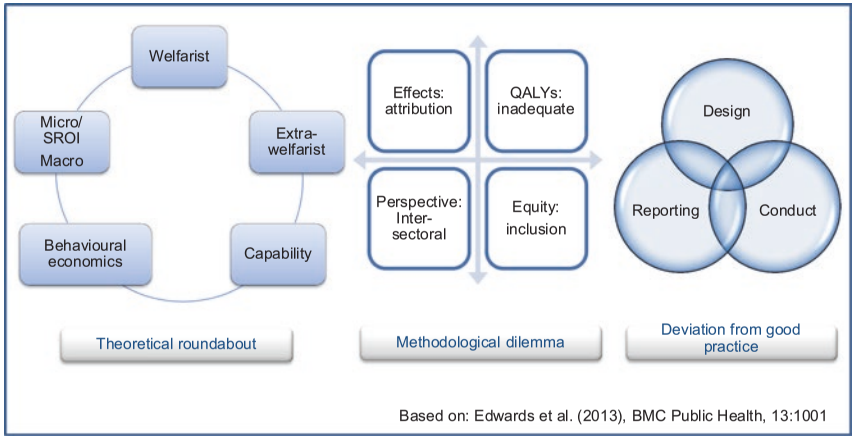

Fig. 3.1 Challenges in conducting economic evaluations in public health [10]. Based on: Edwards et al. (2013), BMC Public Health, 13:1001

such as capabilities, behavioural economics and social return on investment (SROI) were considered but dominance of welfarist and extra-welfarist approaches in public health economics is still apparent [10]. Although this theoretical roundabout is interesting to note, most economic evaluation studies in public health have used the extra-welfarist approach [11] as this is the one that NICE recommends.

Unsurprisingly, the theoretical roundabout lends itself to the methodological dilemma. Depending on what theoretical position one takes, the methods are likely to change. For example, cost-benefit analysis (CBA) may use a willingness-to-pay approach to value an intervention within the welfarist framework or cost-utility analysis may compare extra cost of intervening with extra health benefits measured by the number of additional QALYs gained within the extra-welfarist approach. The results of the two methods may not necessarily converge [12]. In addition, within a specific method, a further dilemma exists between different perspectives to take, whether to consider QALY gains in different subgroups differently and how to attribute the effects to the intervention (Fig. 3.1).

Given those challenges, it is crucial to be explicit about the way an economic analysis is designed, conducted and reported (Fig. 3.1). Sadly, most economic evaluations deviate from best practice in almost all those areas. Reporting guidelines such as the Drummond and Jefferson checklist [13] and more recently the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) [14] are somewhat a remedy to address this challenge, although they cover only the main generic issues related to best practice and do not address context-specific aspects of best practice. Notwithstanding these developments, a recent systematic review looking at economic models of smoking cessation found that all included studies (n=64) failed to report one or more key study attributes necessary to be judged as of good quality [15].

All the above challenges also apply to ROI analyses, as it is a special case of economic evaluation. The ROI can be a helpful design if one wishes to take a narrow perspective and calculate just the financial benefits and costs as a balance sheet. For example, one could estimate the reductions in lung cancer-related hospital admissions in the next couple of years as the result of a smoking cessation service and compare that with the interventions costs to estimate the ROI. This approach relaxes the assumptions about more complex outcomes such as the health gains over a longer period of time as measured through QALYs. However, such analyses do not provide the full spectrum of benefits and costs and, although useful on some occasions, can be misleading. If QALYs are to be included, how they would be

valued (monetised) is another challenge. One option would be to use a threshold value showing societal willingness to pay for a QALY, such as the one recommended by NICE (£20,000–£30,000).

Most of the work we have conducted in this area has extended standard economic evaluation frameworks to provide meaningful ROI metrics for the decision makers and followed the NICE approach and recommendations [9]. In that sense, economic modelling to predict both costs and consequences of intervening is inevitable. Modelling is another area full of challenges. Whether one models a single health behaviour at a time or models the entire care pathway with multiple exposures is an academic debate. Within that, how one would take into account multiple interventions with variable effectiveness and population preference (uptake) would add to the complexity in an unprecedented way. As the model gets more complex, it is likely that input data to populate the model may not be available in the format required. In addition, given its simplified appeal, ROI estimates are often presented as point estimates and although uncertainty around those estimates cannot be ruled out they can be taken into account in sensitivity analyses.

Notwithstanding these methodological challenges, ROI analysis is increasingly being used to make business cases in public health. An example is presented in Box 3.1. ROI analyses frequently provide much needed data in a simplified, single metric to decision makers, which may be useful when an austere funding climate encourages them to reduce the public health budget. One such example is a recent systematic review demonstrating why it is important to invest in public health interventions [8]. Figure 3.2 provides a cross section of interventions included in the review, all showing good value for money at varying time horizons. Not shown in Fig. 6 but important to note is the review's finding that the average ROI (CBR–1) of public health interventions at a local level is 4, showing that every £1 investment in providing those services would not only pay off the original investment but also yield a return of £4 [8].

Box 3.1 Does a Breastfeeding Support Intervention Provide Good ROI? [16, 17]

A group of researchers estimated the potential economic impacts from improving breastfeeding rates in the UK [16, 17]. At the time of the study, the UK had one of the lowest exclusive breastfeeding prevalence in Europe: <1% at 6 months and 7% at 4 months. However, the breastfeeding initiation rate was much higher (65%). Based on the

available robust evidence, the researchers hypothesised that if women who chose to breastfeed were supported by local healthcare systems to exclusively breastfeed for longer (i.e. increasing current exclusive breastfeeding rates), this would lead to fewer cases of four childhood conditions to treat—gastrointestinal illnesses, lower respiratory tract infection and acute otitis media in infants and necrotising enterocolitis in preterm babies in the neonatal units. They estimated the size of the reduction in disease incidence would translate to an annual cost savings of £17 million nationally to the NHS.

Using Lancashire as a local area where a breastfeeding support programme with multiple interventions was implemented, they estimated that this (incremental) return would be roughly £553,000 per annum in one scenario. The breastfeeding support programme would require an upfront investment of £446,000 in the first year over and above the existing budget. The upfront investment included costs of neonatal networking training, provision of donor milk, support service to filter harmful advertising and strategic leadership. Some costs were already in the budget (e.g. the costs of Baby Friendly accreditation) and hence assumed to be zero. The upfront investment of £446,000 was therefore incremental costs.

On the basis of the incremental benefits and costs, we can calculate CBR = (Incremental Benefit/Incremental Costs) = (£553,000/£446,000) = 1.24.

Therefore, every £1 spent on breastfeeding support in Lancashire would generate a return of £1.24 within a year. As the return is positive, the programme is considered to provide good value for money. A business case for continued investment could therefore be made.

Some caveats of this example are worth considering though. First, the estimate of benefits is conservative (cost savings from treating fewer cases of just four infant diseases that were included without considering potential QALY gains) and the above example uses the most optimistic scenario. Second, the level of investment (implementation costs) would decrease from the second year on, as the healthcare system would not have to pay for one-off costs (e.g. training costs) and there would be efficiency gains as a result of trained and more experienced staff. On balance therefore the continued investment is more likely to be favourable than otherwise.

Based on a UNICEF UK study [16, 17]

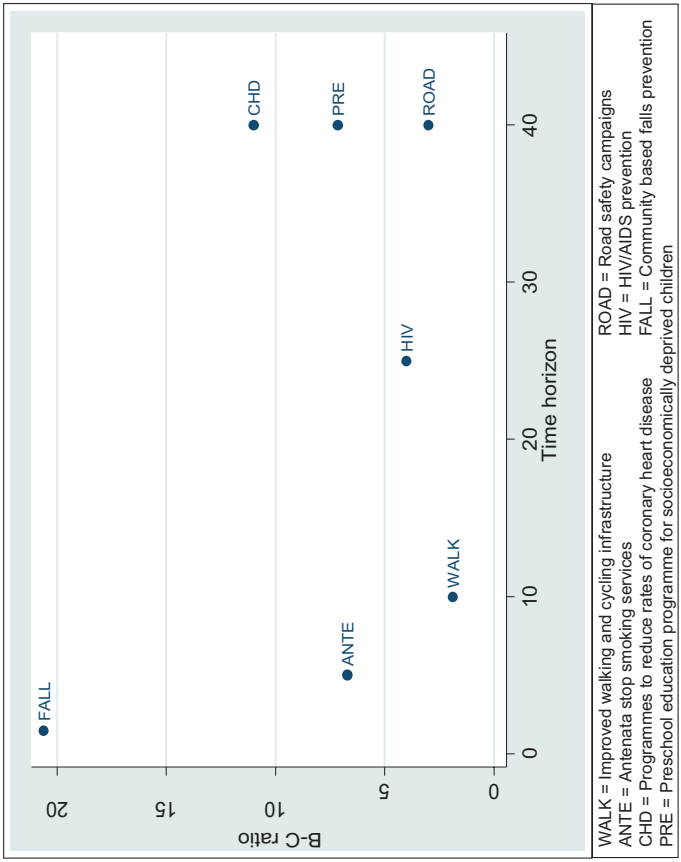

Fig. 3.2 The ROI of a cross section of interventions reported in a recent systematic review [8]

3.3 The Art of ROI Analysis

No analysis is perfect and ROI analysis is no different. In fact, one could argue that there are more methodological challenges in extending a conventional cost/QALY analysis to an ROI analysis for the reasons outlined in the section above. Therefore, acknowledging the caveats of an ROI metric is essential. Designing an ROI analysis and communicating that to policymakers is often not straightforward. Is ROI analysis an art as well as a science then?

There are a number of reasons why it is important to look at the art of ROI analysis in addition to appreciating the underlying science behind ROI metrics. First, the uptake of cost-effectiveness evidence in decision making at the local levels appears to be low. In Chap. 1, we touched upon—based on our own work in tobacco control—the potential existence of a "disconnect" between availability of evidence and policymaking. The way cost-effectiveness evidence is presented and communicated to policymakers seems to have a strong bearing on whether and how it is used in policymaking [7]. In fact, this problem is not limited particularly to economic evidence; this appears to be a much wider problem generally in all types of evidence. There is a separate, vast literature around "knowledge-to-action" gaps and barriers to the uptake of evidence in policymaking that have long been identified on both demand and supply sides [18]. More recent studies, some of which are from us, have sought to understand these barriers to the uptake of health technology assessment (HTA) type evidence [19–21]. Development of an ROI tool, a customisable, user-friendly computer model allowing one to simulate various investment scenarios, is a recent initiative to fill in the gap between evidence and policymaking [3, 4, 22].

It thus seems reasonable to say that the "art" of ROI analysis is simply a matter of how one "performs", particularly in communicating the ROI analyses and results to policymakers and wider stakeholders. This will require one to understand better what factors determine a policymaker's intention to use such analyses, how ROI analyses may meet the needs of contemporary policymakers and what impact the ROI analyses might make going forward. We will return to this in Chap. 8.

Key Points

- The post-2008 financial crisis led many governments worldwide to adopt austerity measures. This has had a profound impact on the public financing of services; public health was no different.
- It is not uncommon to see cuts to public health budgets during a time of austerity as most public health benefits accrue in the distant future. However, public health budgets should be a priority as whilst individuals may be less willing to pay for many public health interventions, consumption decisions (e.g. choosing not to breastfeed) often do not consider the full economic costs and benefits (externalities).
- The public health community has responded to the austere funding climate by looking for robust evidence on the return on investment (ROI) of public health interventions.
- ROI analyses provide a single, simplified metric comparing the costs and benefits of an investment portfolio. This metric provides the extent of health and economic returns that the current investment would generate in different time horizons.
- ROI information can be useful in supporting resource allocation decisions; however, its use in decision making may be influenced by how this information is communicated to stakeholders.

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CHAPTER 4

What Is ROI, By The Way?

Abstract Health outcomes derived from public health programmes must outweigh the costs of implementation and adoption. This chapter discusses how return on investment (ROI) analyses can help those spending the budget both to determine how it can be best allocated in order to maximise health benefit and to justify increased budget allocation from a centralised budget. Before an ROI analysis is commenced, one has to define the "decision problem" considering the needs of the audience or end users of the ROI analysis/tool. A major difference between the development of ROI tools and standard economic evaluation models is that the ROI tools are commissioned directly to facilitate immediate decisions through demonstrating a business case for the introduction of potential programmes or policies.

Keywords Cost-benefit • Budget • Public health • Return on investment • ROI

Let us consider what ROI is (and is not) in more details. In particular, what is involved in conducting an ROI analysis? Before going any further, it is important to reiterate the case for ROI analyses. Charleston, in a paper focusing on the potential value from an Environmental Public Health Tracking Program, emphasises that potential improvements to the public health derived from such public health programmes must outweigh the

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costs of implementation and adoption [1]. This is the essence of return on investment—the need to demonstrate that the value of investments exceeds the costs.

The decision process for investment in healthcare interventions/programmes must involve choosing between a set of alternatives taking into consideration both the impact of the programmes on population health and their cost implications. This begins with framing the decision problem, followed by developing a conceptual framework and economic model, collecting supporting data to populate the model and, finally, using the ROI results to inform health funding decisions through making business cases for specific interventions/programmes [2–5]. This chapter will follow this process outlining the steps involved along the way of generating an ROI analysis.

4.1 Defining the Decision Problem

It may be helpful at this point to examine the factors that have led to the increased demand for return on investment evaluations of public health interventions and the challenges faced in conducting these analyses. In the past, justification of investment in public health interventions and campaigns has tended to focus primarily on the health benefits of the programme. Conveying the benefits of programmes was hoped to be adequate to justify the continued or initiation of funding for a programme [6]. For example, the support for addition of fluoride to the water supply would be justified through quantification of the number of cavities prevented. In recent years, however, it is evident with the steady reduction in funding of public health interventions and the steady increase in funding of treatments for disease especially through pharmaceutical interventions that focusing only on the healthcare benefits may not be adequate to justify funding. Increasingly, there is a need to provide evidence that the money invested in public health interventions is good value and produces a return on the investment which is preferable to alternative uses of the available resources for healthcare.

Given the investment crunch there are also many situations today where decision makers are looking for areas in which they can disinvest. If the current investment is not providing value for money, then disinvestment may be justified; however, without clarity regarding the ROI, the decision as to which programmes are discontinued is not fully informed. Additionally, due to decentralisation of many services, local authorities are

increasingly facing difficult decisions related to healthcare budgets. Over the past 20 years there have been moves in many countries to transfer responsibility for public health to local levels of government. In many cases the transfer of funding to local authorities has not kept pace with the downloading of services. Local governments are also faced with the downloading of other services (e.g. social housing), which puts greater pressure on their budgets for public health. Decisions must be made how to distribute funding amongst the many areas of responsibility and to justify the transfer of funds from upper levels of government.

Return on investment tools can help those spending the budget both to determine how it can be best allocated in order to maximise health benefit and to justify increased budget allocation from a centralised budget. Questions that may be answered using an ROI tool include:

- Is the current mix of programmes offering value for money?
- Would moving current investment to alternative interventions/programmes provide a better ROI?
- Are there new programmes which offer value for money? How should we reallocate resources to these programmes in order to maximise value?

Economic evaluation is an essential tool for decision makers when comparing alternative healthcare interventions [7]. It involves a systematic comparison of the costs and benefits using a time horizon long enough to include all relevant costs and outcomes relating to the intervention. Options are assessed in terms of their cost-effectiveness with the underlying objective of maximising population health with the limited healthcare resources available. There are, however, challenges to conducting economic evaluations of public health interventions that are distinct from economic evaluations of other healthcare interventions. One of the difficulties arises from the fact that it is often challenging to conduct randomised controlled trials of public health interventions. Even if studies have been conducted, there is often a significant gap between the study intervention and the intervention actually implemented [4]. To address these challenges, researchers may need to look at alternative sources of effectiveness estimates.

Additional problems include difficulty in incorporating estimates of uncertainty via probabilistic methods. The data and the expertise are often not available in public health to allow for this. In other areas health benefit is often measured through impact on life years or quality adjusted life years

(QALYs), whereas in public health the focus is often on monetarily valuing of health benefits and looking at break-even metrics. Finally, in public health decision making there is often the need for information to be made available in a timely fashion to allow immediate decisions regarding investments.

Keeping in mind the types of questions which can be answered by ROI analyses in public health and the challenges faced in conducting this research, we will now illustrate how to begin the process of conducting an ROI analysis by framing the question. The factors critical to framing the question are the audience for which the ROI is intended and the disease area of interest.

4.1.1 Defining the Audience

The decision problem will depend on the needs of the audience or end user of the return on investment tool. The audience may include policymakers, practitioners, employers, researchers and the public. For context, it may be helpful to understand the audience for previously conducted public health ROI analyses and how these have been used. There is a significant body of ROI literature which originates in the USA examining the ROI of preventative health programmes within the workplace, from an employer's perspective [8]. As there is no comprehensive publically funded universal healthcare system within the USA, it is often employers who provide insurance for employees. Employers are looking for ways to maximise health and productivity in the most efficient way, thereby reducing the need to restrict benefits or set usage limits on health services [9]. Clearly, if the employer is the audience for the return on investment of the intervention or set of interventions, not only are the upfront costs of investing in the programme and the value of health benefits of interest but also the impact of the intervention on productivity of employees would be relevant. Employers are also often looking for more immediate returns on investment and therefore the ROI analysis would be best focused on a shorter timeframe of one to five years.

More recently, within the literature there has been a growing interest from the public healthcare sector in ROIs. There are examples of such including Medicare in the USA and the NHS in the UK. Charleston and colleagues reported on the estimated ROI from investment in an environmental public health tracking system in the USA [1]. The objective of the system was to produce a tracking system for a network of programmes

which have been developed to measure the burden of disease due to environmental exposures. The tracking system would provide data which can be used by healthcare professionals, policymakers, the public and researchers in decision making regarding interventions or policies which would reduce the health impact of environmental exposures.

Given that the audience of this ROI analysis includes the public and policymakers, the format of the output of the analysis must be adapted to be relevant to these individuals; however, as researchers will also use the system, the data must be sufficiently detailed for research purposes. Researchers may be interested in working with raw data, whereas policymakers are often interested in summary results with supporting evidence. There may be a lag time between the investment in the intervention and the recognised benefits. This is particularly true with respect to environmental exposures where the development of chronic diseases can be years on from the exposure [1]. As policymakers are a key audience for this analysis, it would be important to consider how this impacts the scope of the project. In this particular example the policies aimed at reducing environmental exposure and the investments in interventions/enforcement are likely to come from multiple sectors [1].

It is clear from these examples that the audience for ROI research of public interventions is often quite varied and may include policymakers, healthcare professionals, researchers, patients, and so on. Defining your audience is important as it significantly influences the scope of the intended ROI analysis and the technological needs. Table 4.1 provides a guide to questions that may be helpful in defining the audience and assessing their needs.

4.1.2 Framing the Decision Problem

Once you have gained an understanding of the audience for the analysis, their needs, technological skills and an idea of the scope of the research, the next step is to focus the ROI analysis through a clear statement of the decision problem. For illustrative purposes we will refer to a UK tobacco control model, namely, the NICE (National Institute for Health and Care Excellence) ROI tool [10], in order to provide a practical example of an ROI analysis tool. More details of this tool are provided in Chap. 5.

In the NICE ROI the primary audience included both the NHS and local authority commissioners. Tobacco control measures are implemented at the national, the local and the subnational level. The tool was to be used by policymakers and healthcare decision makers to assist in making cost-

effective choices with respect to investment in smoking cessation at both a national level and a local level. The audience had an understanding of return on investment metrics, but often not the time or technical expertise to engage in the design and analysis of the ROI. This leads to the definition of the following research question:

> What is the return on investment of the complete current portfolio of tobacco control interventions implemented at subnational/local levels in England, and what is the return on investment of alternative portfolios of tobacco control interventions which could be implemented at both the subnational and the local level, relevant to the current package?

Arriving at a clear decision problem or question is an iterative process, ideally including interactions with the intended audience. There is often the need to limit the scope of the research to ensure successful completion. It is also important to understand how decisions upfront affect the usability of the ROI analysis by the audience upon completion.

4.2 Developing Conceptual Framework and Economic Model

The conceptual framework for a public health ROI analysis broadly follows the conceptual framework for developing a health economic model [2, 5], but with a number of additional considerations resulting from the unique characteristics of public health interventions and the audience for the analyses, as discussed above. Often the best first step in developing the framework and the economic model is to conduct a literature search for both return on investment and economic modelling studies which have been previously completed within the area of interest [3]. Once you have an understanding of how others have approached similar research questions, you can begin developing the conceptual framework and economic model fit for your audience's purpose. However, it is important to make sure that stakeholders are consulted appropriately to inform your study design.

A series of steps will follow next and include defining the population, understanding the disease process, selecting the interventions for inclusion in the analysis, specifying effectiveness measures, defining resource use and costs, specifying the timeframe of analysis, defining the metrics, understanding the current situation and specifying the usability requirements [2–5]. Each of these is described in more detail below using the aforementioned tobacco control ROI tool as an example.

Table 4.1 A guide to questions to understand the audience and their needs for ROI analyses

Main questions	• *Subquestions*
Who are your audience? What is their level of understanding of return on investment/ cost-effectiveness analysis?	• What are the issues they are facing? • What motivated their interest in this ROI analysis? • Do they wish to be able to conduct their own analysis? • Can they conduct their own analysis if provided with data or do they need a tool that produces output? Alternatively, would a summary of results with supporting documentation be sufficient?
What is the technological expertise of the audience?	• Understanding the technological skills of the end users helps in determining the type of ROI tool that is required. For example, is there a need to create a user-friendly interface which allows changes to be made to the package of interventions?
How does the audience for the ROI analysis affect the scope of the project?	• Should costs focus only within a single section (e.g. healthcare costs) or should the costs to all sectors be considered? • Should the benefit of the interventions be focused within a single sector, for example, the healthcare system, or would a more broad societal perspective be of interest to the audience?
What outcomes are of relevance to the audience?	• The perspective of the audience will also influence the costs and benefits included within the analysis. For example, employers will likely be interested in the effect on safety incidents and lost productivity, whereas from a medical insurer's perspective, their interest may be limited to the medical savings. The decision makers within a public healthcare system may be interested in examining outputs from a variety of perspectives—societal and healthcare. Although the societal perspective more comprehensively reflects the total costs and benefits, if the expenditure is within the healthcare system, it may be important to know the specific impacts from this perspective. • What time period is of concern to your audience? Are they interested only in the immediate benefits realised from a programme or policy or would they be interested in the long-term outcomes?
What metrics are of relevance to the audience?	• What metrics would be understandable and meaningful to both those using the tool and the decision makers? For example, if the audience is specifically interested in assessing opportunity costs of investment decisions, cost-benefit or cost-effectiveness analyses may be most relevant. If the audience is interested in the impact on workplace activity and productivity then a narrower focus may be warranted. When the audience is concerned solely with the financial impact of policies and programmes traditional economic return on investment metrics such as net present value and benefit-to-cost ratios may be more relevant.

4.2.1 Population of Interest

We begin by defining the population of interest, which in the case of the NICE ROI included both current and former smokers within England. The next question to address is whether this population is sufficiently homogeneous to allow consideration as a whole, or should, given sufficient heterogeneity, the population be stratified into more homogenous groupings? The rationale for consideration of such stratified groups or subpopulations typically requires that inputs may vary either in terms of the disease process or in terms of intervention effectiveness. For example, within the smoking population one could consider heavy and light smokers separately, as intervention effectiveness may vary by smoking intensity. Additionally, one could consider the time since quitting within the former smoking population, as this may influence both disease outcomes and relapse rates. Pregnant women could also be considered as a subgroup as the disease outcomes in this group are unique, in that they affect both the mother and the child. Although there may be rationale for considering subpopulations, division of the overall population will have impacts with respect to both the complexity of the project and associated timelines. Additionally, although there may be rationale for the consideration of subpopulations, the ability to model them will depend on the availability of data specific to the subpopulation.

It is best to begin by laying out all the subpopulations that may be of interest, followed by a ranking of the importance of these analyses to the audience for the ROI analysis. From there an assessment of the time required to incorporate them and the data availably can be pursued. With respect to the NICE ROI, there was interest from the end users of the tool to consider pregnant women as a subpopulation and to consider the population of individuals initiating smoking. As the initiation of smoking requires a completely distinct model from a model focused on smoking cessation, the complexity of this request was high and the time required would also be significant. As such, this item was placed in the lowest priority position. The separate modelling of pregnant women could be considered within the existing economic model; however, the data availability specific to this population was uncertain. It was therefore placed at higher priority than the initiation of smoking analysis; however, it was secondary to the development of the cessation model for smokers as a whole.

4.2.2 Perspective of Analysis

ROI analyses can be conducted from multiple perspectives, e.g. the perspective of the healthcare system or from a societal perspective. If the healthcare system perspective is chosen, only costs incurred by the health provider would be included and impacts would be limited to those affecting the health of individuals. If, on the other hand, a societal perspective is selected, all costs associated with implementing the interventions should be included as should benefits not just with respect to health of the individual, but also with respect to productivity losses and other extended benefits. Whilst adopting a societal perspective may appear attractive, it should be noted that the implicit assumption through adopting this perspective is that a decision maker is willing to give up health benefits for other outcomes such as improved productivity. Thus, the choice of perspective should relate to the fundamental objectives of the organisation for which the ROI tool is commissioned for.

It can be very challenging to accurately incorporate all costs of public health interventions and all extended benefits, and this needs to be taken into consideration when making the decision over the choice of perspective. For the NICE ROI two perspectives were included, based on the interests of the intended audience. The first was that of the healthcare system, and the second was labelled a "quasi-societal" perspective. The "quasi-societal" perspective included the impacts on lost productivity and the impact of second-hand smoking. The use of the term "quasi-societal" was intended to recognise that the full societal costs and benefits are not addressed due to the challenges of estimation.

4.2.3 Disease Process

Understanding the disease process and the link between exposure and the development of disease requires a systematic search of the literature and consultation with experts. Defining the pathways of transitions in the population over time and the consequences is an important step in designing the model. Specifically, for the NICE ROI tool, with respect to current smokers, they may either quit or remain smoking in any given year. If they quit smoking, they may either remain former smokers or they may relapse to smoking. Relapsed smokers also may either quit or remain smoking in any given year. Over the longer term, based on their smoking history, current smokers and former smokers will have the potential to develop smoking-related diseases and are at increased risk of mortality relative to

non-smokers. In the shorter term, smoking may have a negative impact on smoker's quality of life and lead to greater healthcare resource use. Understanding these pathways assists in designing an accurate model.

It is important to consider the potential for both short-term and long-term disease impacts. In deciding which impacts should be included within the model one must assess the strength and validity of the evidence relating the risk factor to the disease. In reviewing the association between smoking and disease, one finds there are diseases in which the causal link is well supported, for example, with lung cancer, coronary heart disease, stroke and chronic obstructive pulmonary disease (COPD), whereas there are other areas in which the link is less clear, for example, asthma. For the NICE ROI, the decision was made to assess the long-term benefits of smoking cessation with respect to the prevention of cases of lung cancer, coronary heart disease, stroke and chronic obstructive lung disease. Differential mortality by smoking status was also incorporated. There is also some evidence of differential use of short-term health care resources by smokers versus non-smokers, which was of considerable interest to the end users of the tool. Consequently, consideration was also given to the inclusion of these impacts.

4.2.4 Interventions

A decision must be made regarding which interventions to include taking into consideration the availability of both effectiveness and usage data. Although research may begin with a literature review of researched interventions, many public health interventions have not been researched in traditional trials. It is therefore also important to assess the current situation with respect to interventions implemented within the population and to investigate the availability of any data supporting the uptake and effectiveness of those interventions. To be comprehensive, an ROI tool should consider not just currently adopted programmes but potential programmes and interventions which may be adopted. The challenge with respect to the latter may be limited real-world data on the impact and uptake of such programmes.

4.2.5 Resources and Costs

Clearly, the perspective of the analysis drives the selection of the included resources and costs. Resource use in relation to an ROI analysis may

include research into the current uptake of interventions within the population of interest. For example, with the NICE ROI tool, it was important to understand what percentage of smokers is currently using each of the smoking cessation interventions available in the UK to assist with quitting.

In many cases, the costs of the resources required to deliver current or proposed interventions can be easily obtained from standard sources. Some public health interventions, however, prove extremely difficult to cost as they can involve the design of programmes, piloting, education, implementation, assessment and modifications. As completely as possible, the full cost of implementing programmes should be incorporated.

4.2.6 Timeframe of Analysis

As mentioned previously within the framing of the question section, it is important to define upfront the timeframe for the analysis. When investing in interventions, there is always the desire to see results sooner rather than later. This relates directly to the concept of time preference which is commonly incorporated into ROI tools through the process of discounting future costs and benefits to present value.

Many public health interventions do not have immediately realised benefits, but may have significant impact over the lifetime of an individual. It would be best, in these cases, obviously to focus on a lifetime horizon. There may, however, be shorter-term impacts on resource usage and patient quality of life which may be captured in analyses based on short-time periods, although these are often substantially less than the benefits seen over the long term. The timeframe selected can have a significant impact on the estimated ROI as the beneficial effects captured will be highly influenced by the timeframe. In an ROI analysis by Finkelstein and colleagues which examined programmes targeted at childhood obesity within the USA, with an analysis timeframe of five years, they found little chance of a positive ROI for the study programmes [11]. The authors noted, however, that many obese children go on to become obese adults and consequently a longer time horizon may have produced different results. With respect to the NICE ROI tool, there are both short-term and long-term benefits of smoking cessation and therefore the tool was designed to allow estimation of the ROI over different time frames, specifically, two years, five years, ten years and a lifetime.

4.2.7 ROI Metrics

Standard practice within cost-effectiveness analyses of healthcare interventions is to adopt metrics such as the incremental cost per life or QALY gained adopting a healthcare system perspective. These can be defined as

$$\text{Incremental cost per QALY gained} = \frac{\text{Net health costs from adoption}}{\text{Net QALYs gained from adoption}}$$

$$\text{Incremental cost per life year gained} = \frac{\text{Net health costs from adoption}}{\text{Net life years gained from adoption}}$$

With public health interventions, when the long-term benefits are often unknown, there has been greater focus on cost benefit analysis, where health outcomes are valued monetarily. Many public health ROI analyses are focused on break-even metrics, which refer to the concept of the value of the benefits being equal to the costs of the investment [3]. These measures require estimation of all the benefits from an investment (including any health benefits) to be valued in monetary terms. Metrics for such analyses are simply different methods of presenting the impact on net present value of costs (through adoption of the investment) and net present value of benefits (through health benefits and cost savings from the perspective of the decision maker). Net present value is simply the sum of all future values weighted by the decision maker's chosen discount factor. The process of placing such monetary values on health benefits is controversial.

Specific metrics relating to demonstrating the business case from ROI analysis include NPV, ROI, and cost-benefit (CB) ratio [12]. These can be defined as follows:

$$\text{NPV} = \text{Net Present Value of Benefits} - \text{Net Present Value of Costs}$$

$$\text{CB} = \frac{\text{Net Present Value of Benefits}}{\text{Net Present Value of Costs}}$$

$$\text{ROI} = \frac{\text{Net Present Value of Benefits} - \text{Net Present Value of Costs}}{\text{Net Present Value of Costs}}$$

Finally the internal rate of return (IRR) is commonly calculated. The IRR is the discount rate that would be required for the estimate of net present value. Thus, if the IRR is greater than the decision maker's chosen discount rate, the business case for the investment is demonstrated.

4.2.8 Understanding the Current Situation

One of the factors which is unique to public health interventions from traditional cost-effectiveness analyses is that it is important to fully understand the current situation with respect to the real-world implemented interventions. This includes understanding which interventions are currently available, who is responsible for providing them, what is the uptake of these interventions and are the interventions funded and by whom?

4.2.9 Usability Requirements

In specifying usability requirements, the desire of the end user to conduct analysis themselves and their technological expertise must to taken into consideration. Although experienced researchers may engage fully with an economic model, the availability of a more user-friendly interface may facilitate the ability of those without modelling expertise to conduct their own analyses. In the case of the NICE ROI tool, the economic model is embedded within a user-friendly interface which is programmed within Visual Basic for Applications (VBA) and enables the end user to assess the impact of changing assumptions regarding the population, costs, effectiveness and uptake of interventions. They may also add user-specified interventions in order to consider the ROI of user-defined interventions.

4.3 Collection of Supporting Data to Populate the Model

Once the conceptual framework and structure of the economic model have been developed, the next step involves the collection of data to populate the model.

The data requirements for an ROI economic model include those required for standard cost-effectiveness analyses. There are numerous references which are helpful in providing guidance with respect to the appropriate sources of the data and we would refer to you those, as required [7]. Here,

we will address some of the unique challenges faced in collecting data specifically focused on the return on investment of public health interventions.

For these analyses there is often the need for detailed population data and information regarding the current use of interventions within the population. For example, for the NICE ROI tool, data regarding the numbers of current smokers by age and sex and by region were required, as was an estimate of the percentage of current smokers who used each of the cessation interventions in attempting to quit smoking over the course of a year. Health surveys may be a suitable source for this information. Although, to truly understand the uptake and usage of interventions in the population, other sources such as public health providers may be able to provide useful insights. Because of the challenge of sourcing this information, there may need to be a balance between the traditional values used to judge model inputs and the practicalities of the data sources available.

There is also the difficulty with public health interventions of the "disconnect" between the interventions implemented in randomised controlled trials and the interventions implemented within the "real world" [3]. This should be considered in assessing the effectiveness of interventions and the use of real-world databases to confirm or adjust the effectiveness estimates may be warranted.

In all instances, a return ROI tool must confront the data limitations and not exclude viable options solely on the basis of lack of data. This follows the Institute of Medicine's recommendations that decision making requires that we "recommend strategies based on the best available evidence as opposed to waiting for the best possible evidence" [4].

4.4 Using ROI Results to Make Business Cases

A major difference between the development of ROI tools and standard economic evaluation models is that the ROI tools are commissioned directly to facilitate immediate decisions through demonstrating a business case for the introduction of potential programmes or policies. Leatherman and colleagues have argued that without providing such a business case there will be limited incentives for the private sector to adopt proven quality improvements [13]. In their study, Leatherman and colleagues examined the costs and benefits to different stakeholders (providers, purchasers, employers, patients and society), of four high-profile cases (management of high-cost pharmaceuticals, diabetes management, smoking cessation and wellness programmes in the workplace). They argued

that a business case for a health intervention "exists if the entity that invests in the intervention realizes a financial return on its investment in a reasonable time frame, using a reasonable rate of discounting" [13]. Return may be through visible profit, loss reductions from current programmes or through avoided long-term costs. Furthermore, a business case can be generated through ROI analysis by considering the indirect effect of an investment on the performance of the organisation [13].

Goetzel conducted a systematic review of ROI tools related to disease management programmes [9]. The review was conducted from a US perspective and found 44 studies which examined the ROI from programmes relating to asthma, congestive heart failure, diabetes, depression and multiple illnesses. Goetzel recognised that given the large number of disease management programmes adopted the number of studies which provide a business case for their adoption is relatively small [9]. However, the studies identified did suggest there was consistent evidence of a business case of adopting effective programmes for congestive heart failure and for patients with multiple disease conditions, with some evidence suggesting similar potential in the area of diabetes disease management.

A specific example of an ROI analysis providing a business case for the adoption of a programme was the analysis by Javitz relating to the ROI of smoking cessation programmes from an employer's perspective [3]. Through conducting a randomised controlled trial, Javitz and colleagues were able to determine the ROI and IRR of two different dosing schedules of bupropion in combination with medium- and moderate-intensity behavioural interventions. Analysis incorporated 1524 adult smokers with smoking-related outcomes assessed through self-reported point-prevalence seven-day non-smoking status at 12 months. From the perspective of demonstrating the business case to employers of adopting the programmes, the primary measures were employer net benefit, employer ROI and the IRR. Analysis found that the different doses of bupropion were equal, suggesting a greater business case for the lower dose of bupropion but that there was a stronger business case for the adoption of this dose alongside the moderately intensive behavioural programme.

In summary, this chapter provided an illustrated example considering the steps involved in developing an ROI analysis and corresponding metrics commonly adopted in practice. In the next chapter, we will provide greater details about this process with a recent ROI tool developed to facilitate decision making related to smoking cessation within England.

Key Points

- Health outcomes derived from public health programmes must outweigh the costs of implementation and adoption— return on investment (ROI) is a metric used to demonstrate that.
- Decision process for investment in healthcare interventions/programmes must involve choosing between a set of alternatives taking into consideration both the impact of the programmes on population health and their cost implications.
- ROI tools can help those spending the budget both to determine how it can be best allocated in order to maximise health benefit and to justify increased budget allocation from a centralised budget.
- Before an ROI analysis is commenced, one has to define the "decision problem" considering the needs of the audience or end users of the ROI analysis/tool.
- A series of steps are required to conduct an ROI analysis. These include defining the population, understanding the disease process, selecting the included interventions, specifying effectiveness measures, defining included resources and costs, specifying the timeframe of analysis, defining the metrics, understanding the current situation and specifying the usability requirements.
- A major difference between the development of ROI tools and standard economic evaluation models is that the ROI tools are commissioned directly to facilitate immediate decisions through demonstrating a business case for the introduction of potential programmes or policies.

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CHAPTER 5

Modelling the ROI of Public Health Interventions

Abstract The National Institute for Health and Care Excellence (NICE) in the UK has published several return on investment (ROI) tools. This chapter describes in detail how economic modelling was conducted in the Tobacco Control ROI tool as an example. The tool uses a Markov-state transition model to predict the costs and health outcomes for a cohort of current smokers in a chosen area. ROI metrics included in the tool are benefit-to-cost (B–C) ratio, net present value (NPV) savings and incremental cost-effectiveness ratio (ICER). The tool allows the users to estimate ROI from a two-, five- and ten-year and lifetime perspective. It is important to understand the input parameters, how they were implemented in the ROI tool and the underlying key assumptions before using the tool.

Keywords Modelling • Markov • Return on investment • ROI • Cost-benefit

Modelling the return on investment (ROI) of one or more public health interventions in the context of real-world decision making can be challenging. Here, we describe the development process of a publicly available, widely used decision support tool [1]. This description is based on the technical report available from the NICE website [2]. The objective of

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this tool was to enable the assessment of the ROI of tobacco control programmes (including smoking cessation services) in England. The tool was commissioned by NICE to assist local commissioners with investment decisions in tobacco control. We use the structured process detailed in Chap. 4 to demonstrate its application to this real-world example. Hereafter, this new tool is called the "Tobacco ROI tool" for short.

5.1 Objective

The overall objective was to provide a user-friendly tool which would allow local authority (LA) commissioners in England to evaluate the ROI of both the currently funded mix of smoking cessation programmes and alternative mixes of programmes. Additional interventions not included by default can be added using the custom function.

5.2 Defining the Audience and Assessing Their Needs

Tobacco control activities within the UK are implemented at local level, subnational level and national level. Local Stop Smoking Services (LSSS) are the responsibility of LAs. The primary audience for the Tobacco ROI tool was local authority and NHS commissioners; however, other users could include service providers, representatives from the local authority smoke-free regional clinics, local authority representatives, academics and public health directors. The local authority commissioners required the tool to evaluate the ROI of the programmes implemented by the local authority and to provide evidence to the funding body of the value of the services. As the local authority commissioners are the primary audience, their needs were explored more fully before developing the tool.

Commissioners felt that it was important that the tool provide an estimate of the ROI from the currently implemented package of smoking cessation interventions against which changes in funding could be recognised. Currently available programmes included funding for pharmaceutical interventions, counselling interventions and self-help guides. Commissioners also wanted the flexibility to incorporate novel cessation interventions within the tool in order to assess their ROI.

One area of particular interest to the local commissioners was the concept of the "subnational tobacco control programme". This is an umbrella term which includes a set of interventions implemented and/or coordi-

nated by regional offices of tobacco control. It includes such activities as monitoring and enforcement of legislation (e.g. indoor smoking bans and preventing illicit tobacco sales), undertaking mass media campaigns and promoting effective provision of smoking cessation.

The commissioning of "subnational" programmes to tackle tobacco provides the coordination, resources and expertise needed to stimulate coordinated, strategic implementation of effective local community tobacco control delivery and optimise economies of scale. Local delivery is particularly successful in targeting individuals who wish to stop smoking through the LSSS. However, reducing the uptake and promoting continued reduction in smoking rates also requires environmental changes—through enforcing regulation, managing access and changing social norms about smoking—which are best coordinated over a larger footprint at the subnational level. It was important that the tool was able to capture the ROI of the entire scope of subnational programmes, local programmes and national programmes. Given the variety of end users of the tool, it was also deemed essential that the tool could conduct analysis at the regional, county or local authority level and at the subnational and national levels.

Local commissioners also expressed an interest in understanding the ROI of interventions directed specifically at the subpopulation of pregnant women. They recognised that this subpopulation has different quitting and relapsing patterns, requires unique interventions and that the impact of smoking is not just for the mother but also the child.

Additionally, in estimating the benefits of smoking cessation end users wished for the tool to be able to provide a broad scope estimate of the societal impact. This would include the gains to the local economy through the reduction in lost productivity costs, the impact on healthcare spending and the benefits of reduced social care. It was important that these benefits be estimated both as a whole and for the individual sectors so that it was clear where savings were derived from.

With respect to the timeframe of the analysis, commissioners were interested in capturing the short-term gains from smoking cessation as these were likely to provide the most impactful argument for funding of interventions; however, they also realised that the majority of the benefit of smoking cessation with respect to disease prevention is not realised until the longer term. Consequently, shorter timeframes don't necessarily capture the true benefits that are experienced by people stopping smoking; however, the further out you estimate, the more uncertainty as a greater number of assumptions are required. To allow the user flexibility in capturing these impacts, it was deemed important to allow a selection of

timeframes to be chosen by the user. In the final tool, the timeframes included two years, five years, ten years and lifetime.

As the results of the analysis would be used both to assist in supporting funding decisions at the local level and provide evidence of the impacts of investment or disinvestment to funding bodies, it was important that the results of the analyses could be provided in a clearly formatted report for printing.

Local commissioners were also interested in examining the return on investment of tobacco control programmes aimed at preventing people from starting to smoke. These programmes are primary aimed at school age children.

As is evident, the desires of end users are often extensive and time and budget constraints mean that these objectives must be prioritised and focused. In moving forward with the ROI tool, the decision was made to put the interest in interventions targeted at preventing initiation of smoking on the back burner for development in a future version of the tool. The rationale for this stems from the fact that, unlike the pregnant subpopulation which can be modelled with minor modifications to an adult smoking population model, modelling of interventions to prevent smoking uptake requires the development of a completely separate model.

5.3 Population of Interest

The two populations which were deemed to be of primary interest were adult males and females with a particular focus on pregnant smokers. The age of 18 and above was selected as the majority of current smokers in Britain report having initiated smoking by this age.

5.4 Perspectives of Analyses

Before moving to the design of the economic model, consideration was given to the perspectives from which the analysis would be completed. As mentioned above, it was important to the commissioners that the tool was able to produce results both restricted to the perspective of the healthcare system and from the broader societal perspective. To meet these needs, three perspectives were adopted in the modelling and summarising of outputs. These perspectives are detailed in Box 5.1, moving from a narrow perspective to a wider perspective.

Box 5.1 Perspectives Considered in the NICE Tobacco Control ROI Tool

NHS and Personal Social Services perspective

In evaluating any intervention with implications for population health, NICE recommends that NHS and personal social care perspectives be taken as a minimum. This includes considerations of benefits and costs to the healthcare sector (NHS) and social care (LA). NHS costs include costs of treating smoking-attributable conditions and, due to paucity of data, the personal social care costs only include LA costs of looking after people living with smoking-attributable stroke. This perspective is retained for all payback timescales: two years, five years, ten years and a lifetime.

Quasi-societal perspective

In addition to considerations of benefits and costs to the NHS and social care, further benefits and costs to the local economy (i.e. lost productivity due to tobacco use and gain in productivity as the result of any tobacco control measures) are incorporated in the analyses. This perspective is retained for all payback timescales: two years, five years, ten years and a lifetime.

Short-term quasi-societal perspective

The existing tool also provides short-term (two-year) count estimates for days absent from work, hospitalisations, primary care (GP visits, nurse visits and prescriptions) and passive smokers (both adult and children). In order to retain this feature, the costs of such resource use events, productivity losses and passive smoking for adults and children are added to the analysis of benefits and costs to the NHS and personal social care.

5.5 The Economic Model

To enable the estimation of the ROI firstly required the estimation of costs and effects of cessation interventions through the development of an economic model. The model at the heart of the Tobacco ROI tool was built in Microsoft Excel. It was adapted from a previous model [3] whose model was based mainly on a Markov model developed by Flack and colleagues [4]. An integrated front-end user-interface programmed in Visual Basic software was incorporated to enable end users to conduct analyses independently.

The outcome data that are presented to a user are generated from a cohort model in which the population of interest (e.g. adult smokers or pregnant women who smoke currently) is followed up on their smoking status and associated morbidity, mortality and healthcare resource use for their lifetime (maximum age of 85). The population segments are depicted in Fig. 5.1, using London as an exemplar. Depending on the uptake of tobacco control interventions and how effective those interventions are, the risk of mortality and morbidity for current smokers changes and any benefit of the intervention package can thus be captured. Although the main idea for cohort modelling remains the same, there are some fundamental differences in the way different population groups are modelled (details in respective sections below).

5.6 Model Structure

The economic model underlying the Tobacco Control ROI tool uses a Markov-state transition model in which a cohort of smokers transition through three states: Smoker, Former Smoker and Dead (Fig. 5.2). At the start of the simulation the entire cohort begins as smokers. With each one year cycle, the cohort is subjected to a set of transition probabilities which allow them to either stay within their current state or move to one of the other two states. Death is an absorbing state, meaning that those who enter this state remain within the state. Within each cycle both smokers and former smokers may develop smoking-attributable diseases including lung cancer, coronary heart disease, COPD, myocardial infarction or stroke.

5.6.1 Modelling Smokers

For the adult male and non-pregnant female smokers 18 years of age and older, the model first estimates the proportion of the population who fall into three categories for each yearly cycle of the model—(a) current smokers; (b) former smokers; and (c) those dying in the current year. The proportion of the population who are smokers and former smokers is based on both the background quit rate in the population and the relapse rate because (a) not every smoker can be offered an intervention, nor all who are offered assistance will take it up; (b) some smokers may be able to quit unassisted; and (c) those who quit may relapse. The number of smokers who will die is based on the differential risk of death for smokers and for-

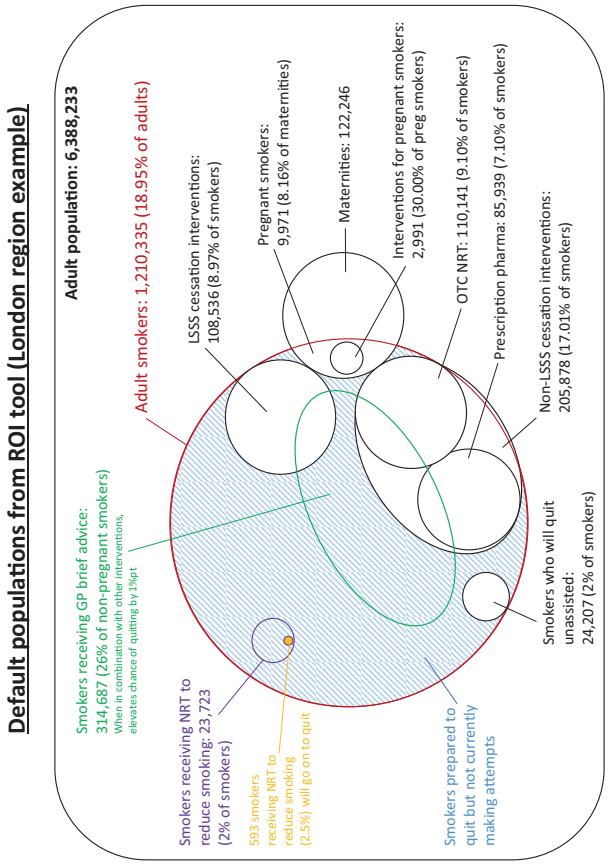

Fig. 5.1 Segmentation of population for the ROI analysis [2]

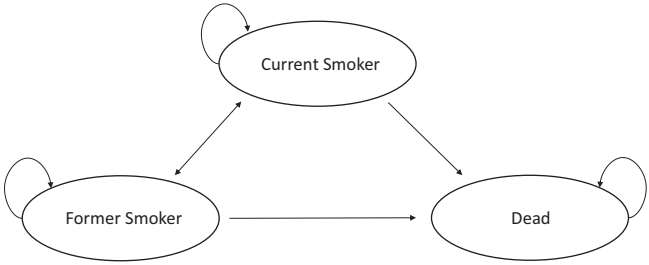

Fig. 5.2 The three states considered in the Markov model

mer smokers. This allows estimation of the number of deaths and life expectancy for different time horizons.

Based on clinical data relating to the attributable risk of smoking with respect to disease, the model provides an estimate of the number of cases each year of lung cancer, coronary heart disease, COPD, myocardial infarction and stroke which is dependent on the age and sex of the cohort. The inclusion of these five diseases was informed by Flack and colleagues [4]. These are allocated costs which allow the derivation of total healthcare costs associated with these diseases for different time horizons. These are also allocated utility values which allow estimation of the expected quality adjusted life years (QALYs) for the population.

The population of smokers is divided into three potential categories: (1) smokers who did not use a tobacco control intervention in the first year, (2) smokers who used a tobacco control intervention and are able to quit smoking in their first year, (3) smokers who used a tobacco control intervention and were unable to quit smoking in their first year.

For the first group, smokers who did not use an intervention in the first year, a portion of these smokers will quit by the end of the first year, the percentage of which is defined as the background quit rate. The background quit rate represents the balance of quitting and relapsing within the smoking population within the UK without intervention and is estimated at 2% within the UK. The 2% background quit rate in England is suggested by West [5]. This means 2% of current smokers are assumed to quit each year anyway. In subsequent years, further smokers quit smoking based on the same underlying quit rate.

For the second group, smokers who use an intervention and are able to quit smoking in their first year become former smokers at the end of the first year cycle, provided they do not die in the first year (as per all-cause mortality rates). In subsequent years, former smokers may relapse to begin smoking again and those that have relapsed may also quit smoking, which is estimated based on the background quit rate without intervention.

For the final group, smokers who use a tobacco control intervention and are not able to quit smoking in their first year, all individuals remain smokers at the end of the first year, provided they do not die within the first year. In subsequent years, a portion, as estimated based on the background quit rate without intervention, go on to quit smoking.

The proportion of smokers who fall into each of the three categories above is determined by the uptake of local tobacco control interventions and their associated probability of quitting. That is, if 20% of smokers attempt to quit using a particular intervention with a probability of quitting of 10%, the proportion of smokers falling in to the three categories would be:

A. Smokers who did not utilise an intervention in their first year $=1 - 0.2 = 0.8$.
B. Smokers who use an intervention and are able to quit smoking in their first year $=0.2 \times 0.1 = 0.02$.
C. Smokers who use an intervention and are not able to quit smoking in their first year $=0.2 \times (1-0.1) = 0.18$.

The model is run for a cohort of population (e.g. current smokers), taking into account the differential risk by age and gender of smoking behaviour, mortality, disease incidence and days lost due to absenteeism. For cohorts of 1000 individuals of each sex (male and female) and age (18 to 85 years), the prevalence of smoking-attributable diseases, the costs associated with smoking-attributable diseases, the number of smoking-attributable deaths and the life years and quality adjusted life years is estimated.

To allow calculation of quality adjusted life years different utility values are applied for current, former and never smokers. For those developing smoking-attributable diseases, a disutility associated with the disease is also incorporated. The model also estimates the value of lost productivity associated with smoking and, in both children and adults, the costs attributable to exposure to passive smoking. The model provides estimates of the outcomes for each cohort with a timeframe of two years, five years, ten years and a lifetime. A rate of 3.5% has been applied to discount the

future streams of costs and benefits although this rate can be adjusted by users within the interface.

As this is a ROI tool, we are wishing to calculate the costs and outcomes not for an individual cohort, but for the entire smoking population of the area of interest (e.g. England). To estimate the costs and effects of the array of currently implemented tobacco control interventions relative to the absence of any interventions and for an array of tobacco control interventions as defined by the user as compared with the current interventions, the results for the specific age and sex cohorts must be weighted by both the proportion of the population in the area of the interest that falls into each age and sex bracket defined within the cohort and by the proportion of the population that falls into each of the categories of taking an intervention and quitting, taking an intervention and not quitting, not taking an intervention and quitting and not taking an intervention and not quitting.

5.6.2 Intervention Efficacy, Uptake and Costs

The first step in the estimation of intervention efficacy is the identification and selection of interventions and parameter values. Discussion took place between stakeholders regarding the desired evidence for input into the model from which a defined search strategy was developed.

With regard to smoking cessation interventions, many published randomised controlled trials (RCTs) are available to allow an estimation of effectiveness, particularly with respect to pharmaceutical interventions. One of the challenges, however, is the appropriateness of the comparator group within trials. It was felt that, given the number of previous systematic reviews completed, wherever possible use of sources that had synthesised evidence from the available literature would provide the most valid effectiveness estimates. Synthesised data represent a wide scope of interventions and provide a summary measure of their overall effectiveness.

Three databases were selected for the search which included the NICE Public Health Guidance page, Medline and the Cochrane library. The search was narrowed to focus on reviews and on articles published from 2008 to 2013 and for specificity. From this search a comprehensive list of interventions was created.

Given the context of ROI on public health interventions, and the gap between trial evidence and the actual implemented interventions, the evidence supporting the effectiveness of the interventions was restricted to either those having clear RCT evidence supporting them (at least two high-quality RCTs and a pooled odds ratio significantly different from

1.0) or those having real-world observational data supporting them in the form of a difference between success rates of those using/exposed to the intervention versus a comparison with important potential confounding variables adjusted for statistically.

Data regarding the current uptake of interventions was sourced from the most recent services data and the costs of the interventions were derived from NICE economic modelling reports, inflated to the most recent year, when needed. Input from experts was sought to ensure the appropriateness of the estimates.

5.6.3 Pregnant Women Who Currently Smoke (16–44 Years)

As discussed previously, the motivations for quitting, success and relapse rates and the types of interventions directed at pregnant women differ from the general adult smoking population. The model for current and former adult smokers does not include pregnant women, as they are modelled as a separate subpopulation. The pregnant smoking women model captures the high spontaneous quit rate in pregnant women and the high relapse rate in the year post pregnancy.

The impact of interventions is modelled using the same approach as with the adult smoking cohort; however, there is the opportunity for the user to incorporate interventions which may be specifically targeted at pregnant smokers.

In addition to the impact on pregnant women themselves, additional costs of treating babies of pregnant women in the first and up to fifth year of their life have been included in the model (NICE PHG 26). So has the likelihood of low-birth weight and SIDS in babies (Trapero-Bertran 2011). No pregnancy-related comorbidities such as excessive vomiting or gestational pre-eclampsia in pregnant women were modelled, as there exists no robust evidence to support their inclusion.

5.7 Overall Results

The end users of the analysis are interested in the return on investment from the currently funded package of smoking cessation interventions within a specific population of interest. The cohort models produce estimates of outcomes (costs, life years, QALYs, productivity losses and passive smoking costs) for cohorts of smokers who successfully quit with and without intervention and for those who do not quit with and without intervention. To estimate the results for the population of interest, the

output of the cohort models must be weighted by both the age and sex distribution of the population of interest and by the percentage of the smoking population which falls into each of the four categories, based on the effectiveness and uptake of the interventions within the package. This allows estimation of the longer-term impacts of smoking cessation with respect to decreased mortality, disease prevention, lost productivity, passive smoking and social care costs.

The short-term impact of smoking cessation from a healthcare system perspective is calculated by summing the results for GP consultations, nurse consultations, outpatient visits, prescriptions and admissions. The total short-term societal costs are calculated as the sum of the costs to the healthcare system, costs associated with passive smoking, costs due to lost productivity and social care costs for stroke victims.

The short-term costs are presented over the first two years, whereas the timeframe of the long-term costs can be adjusted to two, five, ten years and a lifetime horizon.

5.8 Model Outcomes (Results)

Given the diversity of end users of the ROI analysis, there was an interest in the tool producing the traditional measure of cost effectiveness, that is, cost per life year and cost per QALY, and in expressing the outcomes in more traditional return on investment terms such as the benefit-to-cost ratio and the net present value of savings. In deciding which outcome measures to include in an ROI tool one must consider not just the interests of the audience, but also the diversity of knowledge of economic measures within the audience. There is a need to balance the need for understanding and comprehension and the resultant complexity of the output.

To understand the return on investment the results are presented in a comparative format, thereby allowing the user to understand the returns realised by the increase in investment versus the comparator. As a default, the current investment package is presented relative to a scenario in which there is an absence of investment in smoking cessation interventions (no intervention package). This allows the user to estimate what benefits they are currently realising from their investment in smoking cessation interventions. The user is then able to make changes to the current package to create an alternative investment package. Alternative investment packages can look at what is lost from selected disinvestment or what is gained from additional investment in either existing smoking cessation interventions or

Box 5.2 Short-Term Outcomes—Estimated Only for the Two-Year Timeframe

Healthcare system savings

Reducing the number of smokers results in a reduction in the prevalence of smoking-related diseases thereby leading to reduced costs to the healthcare system. The total savings to the NHS are the sum of the savings due to reduced hospital admissions, GP consultations, outpatient visits, prescriptions and practice nurse consultations. Within the interface, the savings to the NHS are reported as both a total value and broken down based on these subcategories.

Productivity gains

The value of productivity gains realised by implementing a package of smoking cessation interventions is calculated based on the product of the average number of days of lost work each year for smokers, the proportion of smokers in employment and the average daily wage for full- and part-time workers.

Total passive smoking savings

The total passive smoking savings associated with a reduction in smoking is estimated from the literature based on the annual incidence of smoking-attributable diseases in adults and children exposed to passive smoke.

Total social care savings

Specifically with respect to strokes, patients receive social care interventions within the community that are provided by the regional/local authority. Reducing the number of strokes would thereby reduce the social care cost burden on the local authority.

Short-term Investment and Net Present Value of Savings

The short-term investment reflects the cost of implementing the package of smoking cessation interventions reported for both the current package of implemented interventions and an alternative user-defined package of cessation interventions. The net present value of savings reflects the estimated savings produced by implementation of the package due to reduced productivity losses, reduced passive smoking-attributable disease, reduced NHS healthcare usage and reduced social care for smoking-attributable diseases over the two-year period subsequent to implementation of the package. The net present value of savings is reported as the total cost savings over two years, the annual cost savings per smoker and the annual cost saving per capita at local authority level.

new cessation interventions. Box 5.2 provides a detailed explanation of the short-term model outcomes which are reported within the tool.

The long-term return on investment metrics may be reported at two, five, ten years and a lifetime. These include the benefit-to-cost ratio, the net present value, the avoidable burden of disease and the incremental

Box 5.3 Long-Term Outcomes—Estimated Only for the Two-Year Timeframe

Benefit-to-cost ratio

The benefit-to-cost ratio is the ratio of the benefits of the intervention to the cost of the intervention per recipient. Within the ROI model this ratio is calculated from two perspectives. The first incorporates only savings associated with implementation of the package of interventions with respect to reduced healthcare system usage and improved productivity, reduced need for social care and reduced passive smoking-related illness. In the second case, the value of the health gains realised is also incorporated in the benefits calculation by multiplying the number of QALYs gained by the monetary value of a QALY. As the result is a ratio of the benefits to costs, for both analyses a value greater than 1 indicates that the benefits of the intervention exceed its costs.

Net present value

The net present value of cost savings due to implementation of a package of smoking cessation interventions is the difference between the cost savings realised by the implementation of the package and the cost to implement the package. This is reported from two perspectives. Firstly, from a quasi-societal perspective the cost savings associated with reduced healthcare system usage and improved productivity, reduced need for social care and reduced passive smoking-related illness are included within the calculation of the cost savings realised by the package of interventions. In the second perspective the value of health gains, calculated as the product of the number of QALYs gained and the monetary value of a QALY, is added to the quasi-societal savings. As the net present value is the difference between the value of health gains and the cost of implementation of the package, a value greater than zero indicates that the benefits of the package are greater than the costs for both analyses.

Avoidable burden of disease

The avoidable burden of disease is the number of quality adjusted life years gained through implementation of the smoking cessation package. This is reported as both the QALYs gained per 1000 smokers and the QALYs gained across all smokers within the local authority.

Incremental cost-effectiveness ratio

There are three outcome measures for which the incremental cost effectiveness ratio is calculated:

- The cost per smoking-related death averted
- The cost per life year gained
- The cost per QALY gained

The cost calculation within this estimate includes the NHS costs avoided by reducing the number of smoking-attributable diseases and the productivity gains realised through reducing the number of smokers. This represents a quasi-societal perspective.

cost-effectiveness ratios. Box 5.3 provides a detailed explanation of the long-term model outcomes which are reported within the tool.

5.9 Piloting with Stakeholders

The usefulness of receiving feedback through piloting the tool with stakeholders cannot be overemphasised and is a vital step in the development of an ROI tool. For the Tobacco ROI tool several face-to-face, telephonic and Web-ex conferences were organised with key stakeholders to test underlying model assumptions as well as functionality of the tool. A large number of responses was received—mostly related to improving the user interface and hence user experience, the way the tool handles different possibilities of a single input parameter, providing pop-up windows to aid users with extra information and verifying the use of data in the model. This served as a reality check and based on this set of stakeholder feedback a number of changes were made to the original tool with further updates scheduled to be made in future versions of the tool.

5.10 Key Assumptions and Limitations

As is the case with all models, a number of assumptions are required and it is particularly important to ensure that these assumptions are transparent to the end user of the ROI tool. This helps to ensure that the output of the tool is interpreted correctly. Many of the assumptions and limitations are necessary due to the inadequacy of data to fully provide information on both the design and the parameter estimation within the model. The following provides details of the assumptions that needed to be made within the Tobacco ROI tool in order to enable the analyses and the associated limitations.

5.10.1 Mortality

The model applies mortality data from UK-specific life tables. For mortality rates based on smoking status, the population-based mortality rates are adjusted using relative risks of death in smokers and former smokers which are derived from the literature. These rates were derived from the best available evidence; however, the reference dates from 1994 and therefore requires the assumption that these rates have not changed substantially in the intervening time period. Disease-specific mortality was not incorporated separately into the model in order to avoid double counting the impact of smoking and smoking-related disease.

5.10.2 Morbidity

As the current model is designed, there is no adjustment for time since quitting smoking. An average risk of smoking-attributable disease and mortality is applied to former smokers in the absence of distributional data regarding time since quitting and duration of smoking. Although during one cycle patients may have more than one smoking-attributable disease, the prevalence of each disease is independent of the prevalence of other diseases.

Although there may be reported differences in smoking-attributable diseases between smokers, former smokers and never smokers in people under the age of 35, based on expert clinical opinion it was felt that these differences are unlikely to be due directly to smoking behaviour. Consequently, the risks of smoking-attributable diseases in those less than 35 years of age for coronary heart disease (CHD), COPD, MI and stroke and in those less than 45 years of age for lung cancer were equated across smoking groups.

5.10.3 Quality of Life

This is a prevalence-based model in which the corresponding utility value for a specific disease is applied to the prevalent cases of disease in each model cycle. This requires the assumptions that the disutility associated with multiple diseases is additive. Disutility associated with smoking and being a former smoker is also incorporated within the model. These values are adjusted for comorbidities. Within the model it is assumed that the disutility associated with being a former smoker lasts for the lifetime of the person. In the absence of data regarding the distribution of severity of the diseases within smokers and former smokers average values for disease states are used.

5.10.4 NHS and Personal Social Services Costs

In the absence of data regarding the distribution of disease severity within smokers and former smokers, disease-specific average costs were applied. Costs were assumed to be additive. Personal social care for stroke is provided for only one year post stroke.

5.10.5 Impact of Interventions

The impact of interventions is assumed to be only one year in duration. After which time, the cohort within the model experiences an average background quit rate.

5.10.6 Underlying Quit Rate

The underlying quit rate which is applied to those not receiving an intervention and within all other cohorts after the first year represents a balance of those who quit smoking each year and those who start or relapse to smoking. This produces an underlying quit rate of approximately 2% in the general smoking population. This assumption is supported by a meta-analysis which showed that there was no difference in relapse rates after 12 months regardless as to whether the patients used an intervention to quit smoking or no intervention. [6].

5.10.7 Productivity Losses

Data was sourced regarding the excess number of absentee days per year that smokers have as compared with non-smokers. It was assumed that quitting smoking would result in a reduction in absentee days for those smokers currently in employment. This reflects the assumption that absentee days truly are days of lost work.

5.10.8 Passive Smoking

To calculate the costs of passive smoking-related illness in adults and children which are attributable to each smoker the total burden of passive smoking-related disease was allocated equally to all smokers. In the absence of more detailed information regarding passive smoking this represented an assumption with minimal bias.

Key Points

- The National Institute for Health and Care Excellence (NICE) in the UK has published several ROI tools, one of which is the Tobacco Control ROI tool. These tools are freely available to use.
- This chapter described in detail how economic modelling was operationalised in the Tobacco Control ROI tool as an example.
- The Tobacco Control ROI tool used a Markov-state transition model to predict the costs and health outcomes for a cohort of current smokers in a chosen area (e.g. a local authority in England). In this construct, a current smoker could quit smoking and become a former smoker or die in any given year; former smokers could relapse or die in any given year.
- The tool took NHS and Social Care and quasi-societal perspectives to determine the ROI of alternative packages of interventions.
- ROI metrics included benefit-to-cost (B-C) ratio, net present value (NPV) savings and incremental cost-effectiveness ratio (ICER).
- The tool allows the users to estimate ROI from a two-, five- and ten- year and a lifetime perspective.
- It is important to understand the input parameters, how they were implemented in the ROI tool and the underlying key assumptions before using the tool.

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CHAPTER 6

A Journey to Real-World Decision Problems

Abstract The principal aim of return on investment (ROI) analysis is to support decisions as it provides a decision maker with explicit data about the costs and consequences of alternative courses of action. Three questions dominate a decision maker's dilemma: do I invest, do I invest more, do I disinvest? These questions are not necessarily mutually exclusive. Real-world decisions are complex to make and therefore the decision problems must be defined appropriately. This chapter shows how the PICO (population, intervention, comparator and outcomes) framework can be helpful in framing the decision problem at hand.

Keywords Decision making • Return on investment • ROI • PICO

The principal aim of ROI analyses is to support decisions. Decision makers, for example, service commissioners, policymakers or chief executives in insurance companies, need to support their investment decisions by exploring the costs and impact of different public health measures. ROI analyses are also helpful in reviewing the current public health agenda and answering three fundamental questions related to decision making: do I invest; do I invest more; do I disinvest? It is important to note, however, that the three questions are not necessarily mutually exclusive—it depends on the nature of the investment(s) one is considering.

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6.1 Approaching Real-World Decision Problems

Real-world decision problems can be much more complex than what they look at first sight and therefore are more difficult to address. Budgets are limited and the use of a pot of money in providing one service means that the same pot cannot be used to provide another service (opportunity cost). This inevitably creates a situation where one has to choose where the money is spent.

Should I invest a proportion of my budget in delivering smoking cessation or littler collection or constructing cycle pathways? If I decided on the former, should it be Stop Smoking Services (i.e. medication and behavioural support to individuals willing to make quit attempts) or a mass media campaign (i.e. influencing a population not to initiate or stop smoking) or plain packaging of cigarettes? If I decided on Stop Smoking Services, what pharmacotherapy interventions (nicotine replacement, bupropion or varenicline) should I offer? Or, should I offer all of those until my budget is used up? If so, how do I know what the optimal mix is going to be? These are the sort of questions local policymakers encounter in everyday life.

Let's do a little postmortem of the complexity around the above real-world questions. First, no policymaker asking those questions has a luxury to start fresh in the real-world context. This means that certain services are already in place and some segment of the population, if not everyone in the target group, is benefitting from those services. A complete reallocation of services, which would have been a good starting point theoretically, is therefore politically challenging and more often is considered infeasible. Therefore, this adds to the complexity in the choices offered by the above questions. This is one of the reasons why most public health budgets appear to be simply the roll-on from the previous year's budget despite some services being considered ineffective and costly.

Second, the growing culture of evidence-based medicine (EBM) in the health sector requires one to find either high-quality evidence or implement evidence-based guidelines such as the NICE guidance to justify actions. Most evidence or guidelines are underpinned by studies carried out under controlled environments, for example, double-blind randomised controlled trials (RCTs). This means that the real-world intervention that policymakers consider to invest in is likely to be different in its shape and size from the ones reported in the trials (i.e. the "disconnect" problem). One of such problems is the attrition in effect size of an intervention from RCTs to real-world implementation [1]. Therefore,

answering the above question based on existing evidence can be challenging for real-world decision makers.

Given these complexities, one way to approach real-world decision problems is to look at it through the lens of modelling. A series of "what-if" scenarios if framed appropriately would offer real-world decision makers a good option to simulate the costs and consequences of implementing the interventions that are in their mind. Several such scenarios could be created and evaluated for their costs and consequences against the current practice (current budget) and/or each other. This approach elegantly does two things: (a) it explicitly considers current provision of services but at the same time allows a change within current practice, thereby avoiding the danger of making politically sensitive decisions as discussed above; and (b) it presents the real-world decision maker with real options where they could draw on existing evidence but at the same time allows enough flexibility in considering uncertainty around the evidence when it gets to real-world implementation, thereby avoiding the risk for "disconnect" as discussed above. In order to do that, one needs to ask three simple questions: do I invest, invest more or disinvest? These questions are essentially "what-if" scenarios around current practice or prospective or alternate ways of doing things in a real-world decision context. Some examples based on key reports [2–5] are provided in Box 6.1.

Box 6.1 A Tale of Three Questions: Invest, Invest More, Disinvest?
The evidence that many public health interventions are cost-effective is robust [2, 3]. Yet, decision makers need to continually search to economically justify investment in public health measures. The big question therefore is, how research, particularly economic modelling, can support real-world decision making? To answer this, one has to break the big question down into three specific decision problems—do I, as the decision maker, continue to fund existing services (do I invest); do I invest in new/additional services (do I invest more); do I stop investing from less effective services (do I disinvest)? A group of researchers in the UK [4] and Europe [5] have studied these three questions in relation to tobacco control. They developed a ROI tool to help decision makers explore the costs and consequences of various investment scenarios. In the tool, they included several interventions with best available evidence (usually

from controlled studies) with enough flexibility for it to be adjusted for real-world contexts. A user of the tool could explore the following questions:

Do I invest?

- Is my current tobacco control programme a good investment? In other words, what is the ROI of my current "package" of interventions?
- Can I make any economic argument for continued investing in my current package of tobacco control?
- Are there any productivity gains by continuing to invest in my current package?
- Are there any savings to the NHS by continuing to invest in my current package?

Do I invest more?

- Can I maximise the ROI of my current tobacco control package by changing the proportion of smokers taking up specific interventions?
- What would be the additional costs and additional benefits of doing so?
- Would this new package provide reasonable ROI?
- If I scaled up my current tobacco control programme, how much more would I need to invest?
- How would it compare with the additional benefits that my scaling up would provide?
- I am thinking about implementing a novel intervention. What would be its ROI?
- At what point in time does my investment package pay for itself and start to make money?

Do I disinvest?

- What intervention(s) in my current practice are less effective but costly to run?
- Is there a case to be made for disinvestment from any intervention from my current practice?
- If I chose to disinvest from a service, in what other services would I have to reinvest in order to maximise the ROI of my investment package?

6.2 Framing a Decision Problem

We touched upon how to define a decision problem in Chap. 4. This will be explored further here. In order to translate the questions such as those presented in Box 6.1 into a meaningful ROI analysis, it would be necessary to put them in the context of a "decision problem". In the world of evidence-based medicine (EBM), defining a decision problem allows one to access the best available evidence that would support clinical decision making [6]. This would require a structure or framework which is often defined over four key attributes: population, intervention, comparator, outcomes (PICO) (Fig. 6.1).

The use of the PICO framework to define a decision problem is recommended by many guidelines development bodies such as NICE in the UK [6]. By explicitly answering specific questions around population, intervention, comparator and outcome, one would be able to identify relevant, best available evidence to underpin decisions. For example, the first question under "Do I invest" in Box 6.1 ("Is my current tobacco control

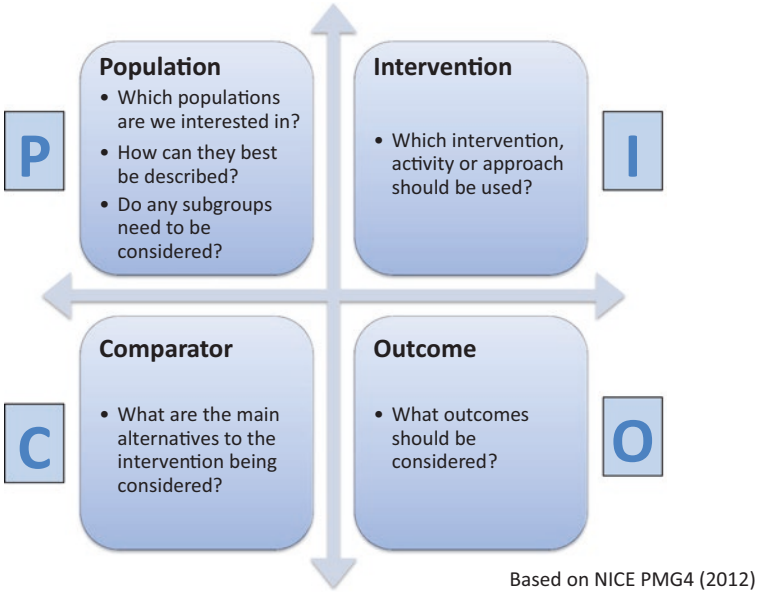

Fig. 6.1 The PICO framework for defining a decision problem [6]. Based on NICE PMG4 (2012)

programme a good investment?") is not a well-defined decision problem according to the PICO criteria. This question does not specify what population the tobacco control programme is referring to (e.g. is it adult smokers or school children); does not specify what alternatives are available (e.g. doing nothing is always an option) and does not specify what outcomes would be measured (e.g. will the ROI be based on quitter's health resource use or health gains such as QALYs). Although it specifies the type of intervention (tobacco control), it is not clear whether it is population-level interventions (such as mass media campaigns) or cessation (such as pharmacotherapy). Thus a better question would be, for example:

> Amongst the *adult smoking population (18 years and over) in my local area*, would my *current tobacco control programme that involves Stop Smoking Services working together with national legislations and policies* lead to less resource use (*hospital admissions due to lung cancer, coronary heart disease, stroke and chronic obstructive pulmonary disease*) and provide more *QALYs* in the next 10 years, compared with *doing nothing*?

Obviously, the more specific the question becomes the longer it becomes. However, it is always helpful to break the question down to each component of PICO. In the example above, just note the words in italics and copy them down below:

P = adult smoking population (18 years and over) in my local area
I = current tobacco control programme that involves Stop Smoking Services working together with national legislations and policies
C = doing nothing
O = hospital admissions due to lung cancer, coronary heart disease, stroke and chronic obstructive pulmonary disease, QALYs

Thus, it is now very clear what one would like to evaluate, against what, how that would be measured and in which population. Once the results are known, it would be easier to recommend a decision than when the decision problem is less clear (in which case, getting the relevant results is itself challenging). To put this into perspective, suppose the ROI analysis based on the above decision problem gives a benefit-cost ratio of 2.3. This means, compared with a scenario of disinvestment from current tobacco control programme (as defined above) for adult smokers in "my area", every £1 spent currently would yield a return of £2.30 in ten years from

now. The benefits come from savings in the treatment costs as we would expect fewer cases of smoking-attributable diseases (lung cancer, coronary heart disease, stroke and chronic obstructive pulmonary disease) and the value of the QALY gains. This information thus lends itself to a recommendation that current provision should be continued.

6.3 How Would ROI Analyses Support Decisions?

Anyone who is interested in public health issues, for example, service commissioners, public health professionals, advocacy organisations, academics and researchers, can use ROI analyses to explore the benefits and costs of investing in public health. However, it is important to note that whilst ROI information is helpful in making the available choices (e.g. investing in tobacco control versus cycling paths), it does not make a decision for the user. Judgement of the user therefore is necessary to determine the extent to which the ROI information should be used in decision making. There are several frameworks for public-sector decision making such as the multi-criteria decision analysis [7]. In other words, the result from the ROI analysis is just one of several ingredients of the decision-making recipe. However, this ingredient can be very important in supporting the decision in favour for one or more of the available choices, as ROI analysis makes it explicit to the decision makers what alternative provides (more) value for money (Box 6.2). We will return to this in Chap. 9.

Key Points

- The principal aim of ROI analysis is to support decisions as it provides a decision maker with explicit data about the costs and consequences of alternative courses of action.
- Three questions dominate a decision maker's dilemma: do I invest, do I invest more, do I disinvest? These questions are not necessarily mutually exclusive.
- Real-world decisions are complex to make and therefore the decision problems must be defined appropriately.
- The PICO (population, intervention, comparator and outcomes) framework is helpful in framing the decision problem at hand.
- ROI analysis is just one of many ingredients to the decision-making process.

Box 6.2 ROI Analysis: Supporting Decisions [3, 8]
The UK has experienced major budget cuts recently [8]. It is one of the countries that chose to follow a stringent austerity path since the Conservative–Liberal Democrat Coalition government came into power in 2010. This trend was still apparent at the time of writing this book. In a climate of austerity, it is not uncommon to see political support for public health diminishing. Its own nature (most public health interventions provide benefits in a distant future, not immediately), coupled with very strong commercial vested interests (e.g. that from tobacco companies), often leads politicians to ignore investment in public health [8].

How would ROI analyses support decisions in public health? A recent systematic review [3] provides the ROI estimates of several public health interventions and estimates average ROI if public health interventions were implemented at local and/or national levels. The ROI was also calculated for types of interventions. Their findings were striking:

Intervention	*Median cost-benefit ratio*	*Median ROI*
Health protection	41.8	34.2
Legislation	5.8	46.5
Health promotion	14.4	2.2
Local level	10.3	4.1
National level	17	27.2

The table above suggests that public health interventions are cost saving and therefore should be funded. For example, every £1 spent on legislative interventions yields a return of £5.80 plus the original investment back. Often such interventions (e.g. vaccination or tax) only require one-off costs and are implemented at the national level.

The most important implication of this ROI analysis is what the investigators concluded, "the cuts to public health budgets therefore represent a false economy. They are likely to generate billions of pounds of additional costs to the health services and wider economy" [3].

For politicians and decision makers, such an explicit elicitation of what would happen in the event of disinvestment is hard to ignore. Therefore, one can expect that the ROI analysis would feed meaningfully to the boardroom discussions and thus support the decisions.

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CHAPTER 7

Evaluating Current and Prospective Policies

Abstract The National Institute for Health and Care Excellence (NICE) has developed return on investment (ROI) tools on tobacco control, physical activity and alcohol. These tools are freely available to download and use. This chapter provides a step-by-step guide to use these tools. The ROI tools can be used to evaluate the ROI of current practice in your area compared with a counterfactual or baseline (no services). The tools can also be used to evaluate the ROI of alternate practice in which one or more interventions in your current practice could be altered. The ROI of this new practice could be compared with the current one. The tools provide several ROI metrics to help users make their business cases.

Keywords NICE • Return on investment • ROI • Cost • QALY

The NICE ROI tools can be used to evaluate a portfolio of interventions for their expected economic returns in different payback timescales [1]. Using three different case studies covering smoking, physical activity and alcohol, in this chapter we show how different decision problems can be solved using the NICE ROI tools. But first we begin with a brief recap of the Tobacco Control tool covering its key features and an overview of how to use the tool. We then set out a decision problem to be solved and finish with a step-by-step guide on using the ROI tool to analyse the decision

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problem. The physical activity and alcohol tools follow a similar format; important differences will be noted in the relevant case studies.

Key Features of the Tobacco Control ROI Tool

- Model the effects of single, or multiple interventions on at-risk population groups
- Estimate the overall costs against the value of non-health benefits as well as health and well-being improvements
- Mix and match interventions to see which package provides the best outcome
- Identify cost savings or determine if the additional benefits are worth the extra costs
- Customise the tool to include data and interventions specific to your local area
- Use the results to help support your business cases

7.1 Overview of How to Use the Tobacco Control ROI Tool

To download the tool, go to the NICE webpage https://www.nice.org.uk/about/what-we-do/into-practice/return-on-investment-tools/tobacco-return-on-investment-tool.

Save the tool to your hard drive. Once you run the tool and ask it to export your results, in Word and Excel format, they will be saved in the same place as the tool. Consider creating a folder (e.g. called tobacco ROI) and save the tool and results in the folder.

To use the tool open it from where it is saved on your hard drive, enable the macros and content if prompted and then click to begin. The key steps covered are presented below and then followed by a worked example.

Five key steps:

1. Geographical data
   - ✓ Select an area you want to analyse. This can be either a local authority (LA) or Clinical Commissioning Group (CCG).

2. Population groups
   - ✓ Population groups are automatically pre-populated when you select an area.
3. Individual interventions
   - ✓ All interventions in the tool are allocated a population, impact and cost based on NICE guidelines and current practice (at the time the tool was last updated). There are two levels for manipulating interventions:
     - Basic Level
       - ✓ By clicking on each intervention group you can allocate the overall population who receive the interventions in that group.
     - Advanced Level
       - ✓ By clicking on each intervention you can allocate the percentage of your population who receive it and, if appropriate, (re)set the estimates of effectiveness and costs.
       - ✓ You can also add custom interventions.
4. Subnational programme
   - ✓ Allows you to add a subnational programme covering a range of tobacco control activities, for example, monitoring and enforcement of legislation such as indoor smoking bans.
   - ✓ By clicking on "advance" you can allocate the percentage of your population exposed to the programme and, if appropriate, (re)set the estimates of effectiveness and costs.
   - ✓ You can also add custom interventions.
5. Calculations
   - ✓ Here you can view your results, including an overview, metrics and access a full report.
   - ✓ You can review your choices and make any necessary adjustments.
   - ✓ You can also create another package and compare it with your previous package(s).
   - ✓ You can also export your results in Word and Excel format.

7.1.1 Case Study: Smoking Cessation Interventions

Using the NICE Tobacco Control ROI tool, you can evaluate the ROI of any change in the current Local Stop Smoking Services (LSSS). To help the user to conduct this analysis, a step-by-step guide is provided below.

7.1.1.1 The Decision Problem

You run a LSSS which offers 30 different smoking cessation interventions for adult smokers. A new product has come on to the market which is more effective than some of your existing interventions but it is also more expensive. Your budget is fixed so you cannot afford to fund the new product on top of your existing interventions. So you want to find out what happens to the total cost of your LSSS and associated ROI when you replace one of the existing interventions with the new "better" intervention. In this case study, your selected local area is Southwark.

Decision problem

What is the effect on the Local Stop Smoking Service of replacing Mono NRT + one-to-one support with a new more expensive and more effective intervention?

P = Current smokers in Southwark

I = LSSS in which currently offered Mono NRT + one-to-one support is replaced with a new more effective but more expensive intervention

C = LSSS as currently offered

O = Health resource use, productivity, QALYs

Southwark case study

- Currently 6.52% of all adult smokers in Southwark are allocated to Local Stop Smoking Services (all other groups of interventions in the tool are excluded)
- Existing intervention to be replaced—Mono NRT + one-to-one support
  - Uptake 1.27%, Effectiveness 15%, Cost £183.72
- New intervention
  - Uptake 1.27%, Effectiveness 17.2%, Cost £200.00

7.1.1.2 Steps Involved in Running the Tool

Step 1: Open the tool from where you have saved it on your hard drive and **click to begin**. Click on **Close** to close the pop-up "welcome to the input area". You will see a menu box with Introduction, Individual Interventions, Sub-national Programme and Disclaimers. Select individual level interventions and then select basic. This will bring up a new screen. On the right hand side (RHS) you will see the parameter menu. This is where you select the geographical location of interest to you. In our case study we selected the London region and then Southwark local authority. Note the population data will pre-populate once the area is selected. When making changes to the inputs please be patient as it can take a few seconds for the changes to appear on screen.

Step 2: Set all interventions except Local Stop Smoking Services (LSSS) to zero (Fig. 7.1)

Step 3: Because we are only interested in the interventions offered by the LSSS we next click on sub-national programme and set the percentage allocated to this programme to zero. This is necessary because the tool automatically sets the allocation to 100% of the population (Fig. 7.2).

Step 4: Next click on calculate current package and this will run the tool using data for the interventions selected. In our example the package is restricted to the interventions provided by the LSSS (Fig. 7.2). It will take a couple of minutes for the results to be displayed.

Step 5: Results. On the left hand side (LHS) of the screen you will see the interventions overview. On the RHS you will see the results overview. Note the display will be partially obscured by a message about the results page; you can remove this by clicking on close (Fig. 7.3).

On the results overview (RHS of screen) you can choose between different sets of results and metrics. You can also access a Microsoft Word report of the results and create a Microsoft Excel dashboard of the results. The dashboard is important if you intend to create lots of different packages and want to compare them now or in the future (Fig. 7.3).

On the interventions overview (LHS of screen) you can see how much your package of interventions costs and the number of extra quitters it will create compared with a background quit rate of 2%. In our example, the package costs an estimated £548,024 and generates an extra 464 quitters.

Step 6: Now we want to replace the intervention "mono NRT + one-to-one support" with the new intervention. The quickest and easiest way to do this is to make the relevant changes using the interventions overview on the LHS of the screen. In our example we decided to keep the uptake for the new intervention the same so we only need to change the cost from

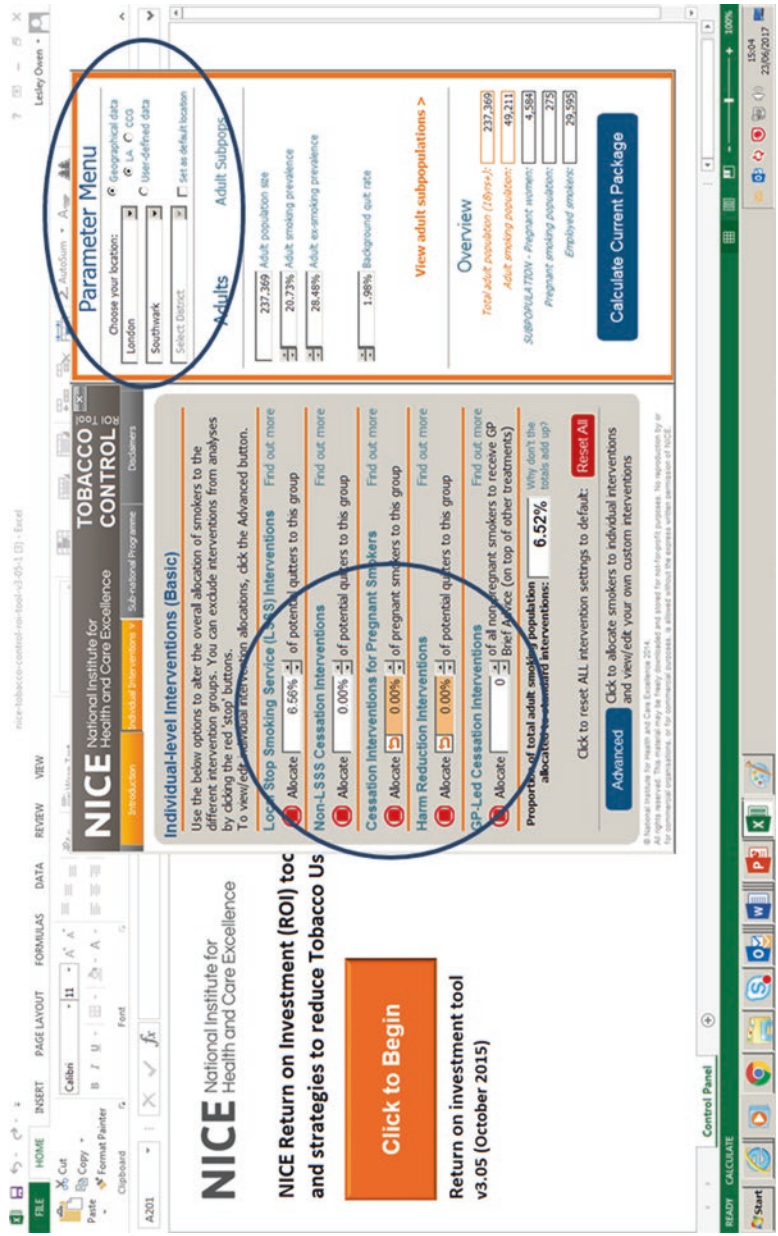

Fig. 7.1 Tobacco Control ROI Tool screenshot 1

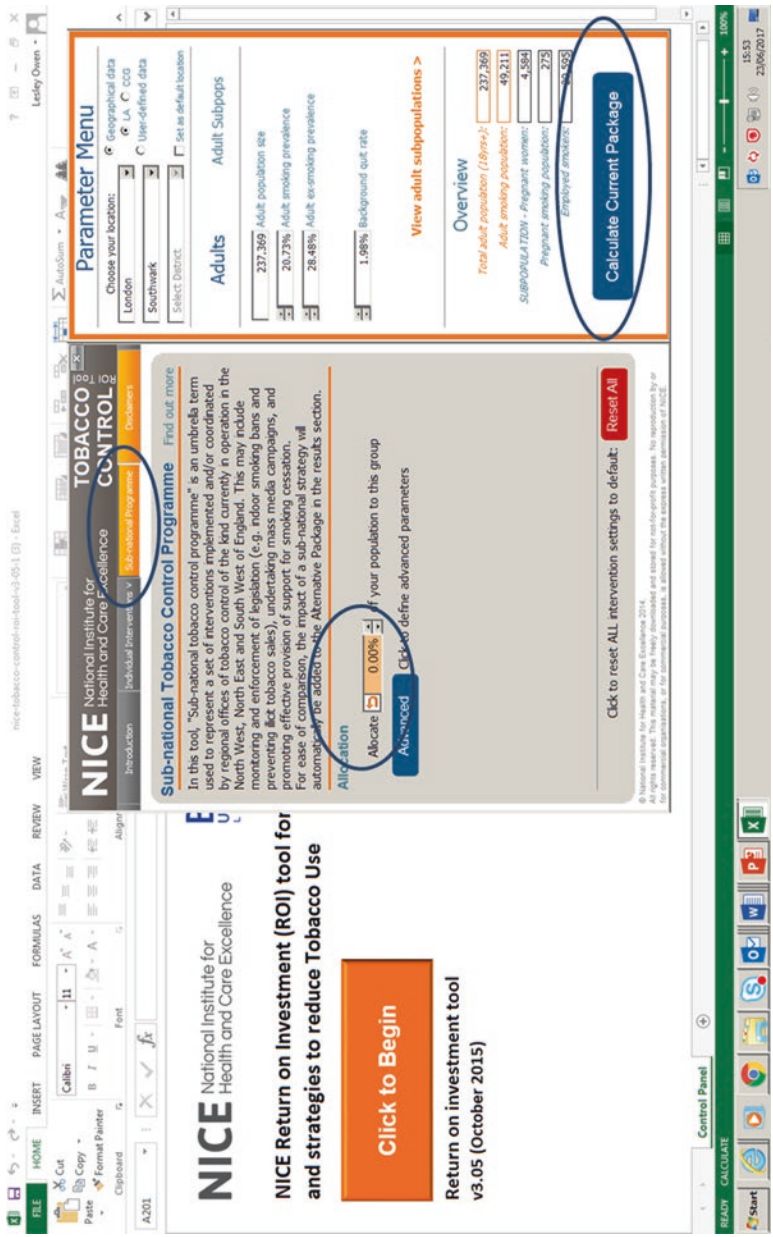

Fig. 7.2 Tobacco Control ROI Tool screenshot 2

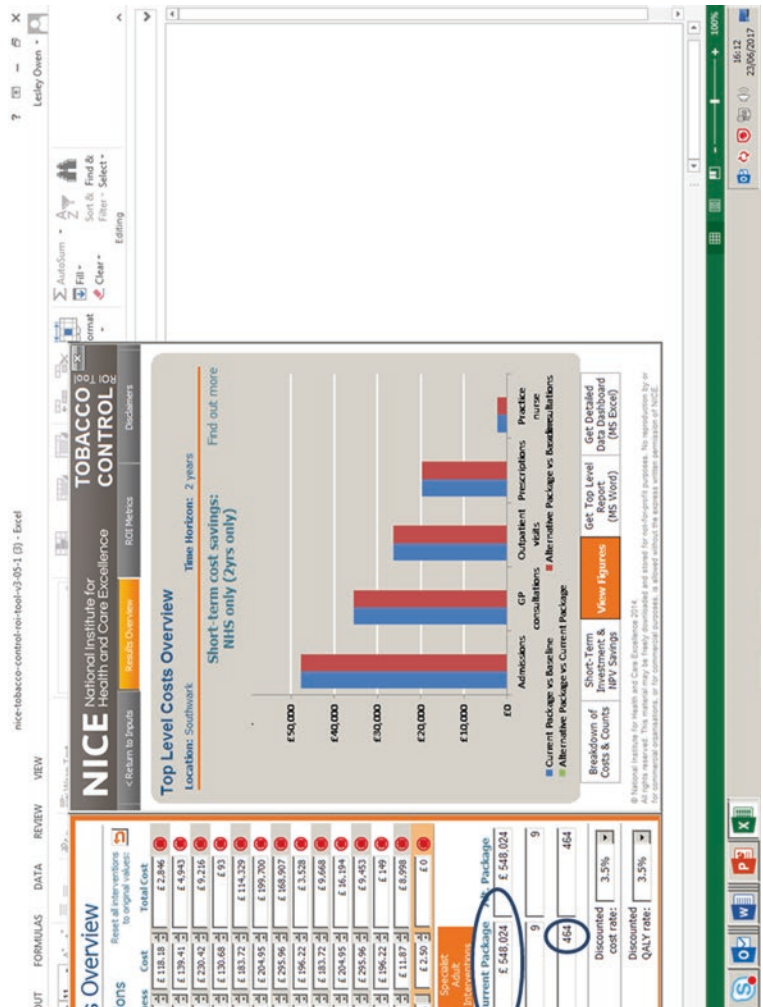

Fig. 7.3 Tobacco Control ROI Tool screenshot 3

£183.72 to £200 and the effectiveness from 15% to 17.2% to match the data for the new intervention. Changes to any of the original data will be shown in a different colour (Fig. 7.4).

Step 7: At the bottom of the interventions overview you can see the updated results for the package with the new intervention added under the heading Alt. Package. Compared with the original package, the new package costs £558,155, which is an additional cost of £10,131 and generates a total number of 13 additional quitters.

That the new package of interventions generates additional benefits but costs more than the original package raises an important question about whether the extra benefits are worth the extra costs. To find out if the new package is still cost-effective and good value for money you need to use one of the ROI metrics such as the incremental cost per QALY or benefit–cost ratio (BCR). You can obtain this information by clicking on get top level report (MS Word), get detailed data dashboard or ROI metrics (Fig. 7.5).

Step 8: In our example we used the ROI metrics option to obtain the additional results. After clicking on ROI metrics we selected Benefit Cost Ratio (BCR) and then Quasi Societal Savings (Fig. 7.6). To change the way the results are displayed you can toggle between view figures and view chart. We chose view figures. To access each and every ROI metric simply select the metric of interest (e.g. BCR) and the perspective (e.g. quasi-societal) and repeat the process for each metric. It is also important to choose the time horizon over which the costs and benefits are calculated for your package of interventions. You can do this from the interventions overview (LHS screen) but only when using the ROI metric tab. In our example we used the lifetime horizon (Fig. 7.6). Note: The metrics in the tool are Benefit Cost Ratio, Net Present Value, Avoidable Burden of Disease and the incremental cost effectiveness ratio (ICER).

Step 9: In our example we also wanted to see how the benefit-cost ratio would change if we included the value of the health gains in the calculation. To do this we selected the Benefit Cost Ratio (BCR) and then Quasi Societal Savings + Value of Health Gains (Fig. 7.7) and displayed the results using view figures.

Step 10: Presenting the business case. You have analysed the decision problem and now have all the information you need to present the business case for changing the package of interventions offered by your LSSS. In our example we have produced a summary table showing some of the key results (Table 7.1). The benefit-cost ratio of 1.06 suggests that

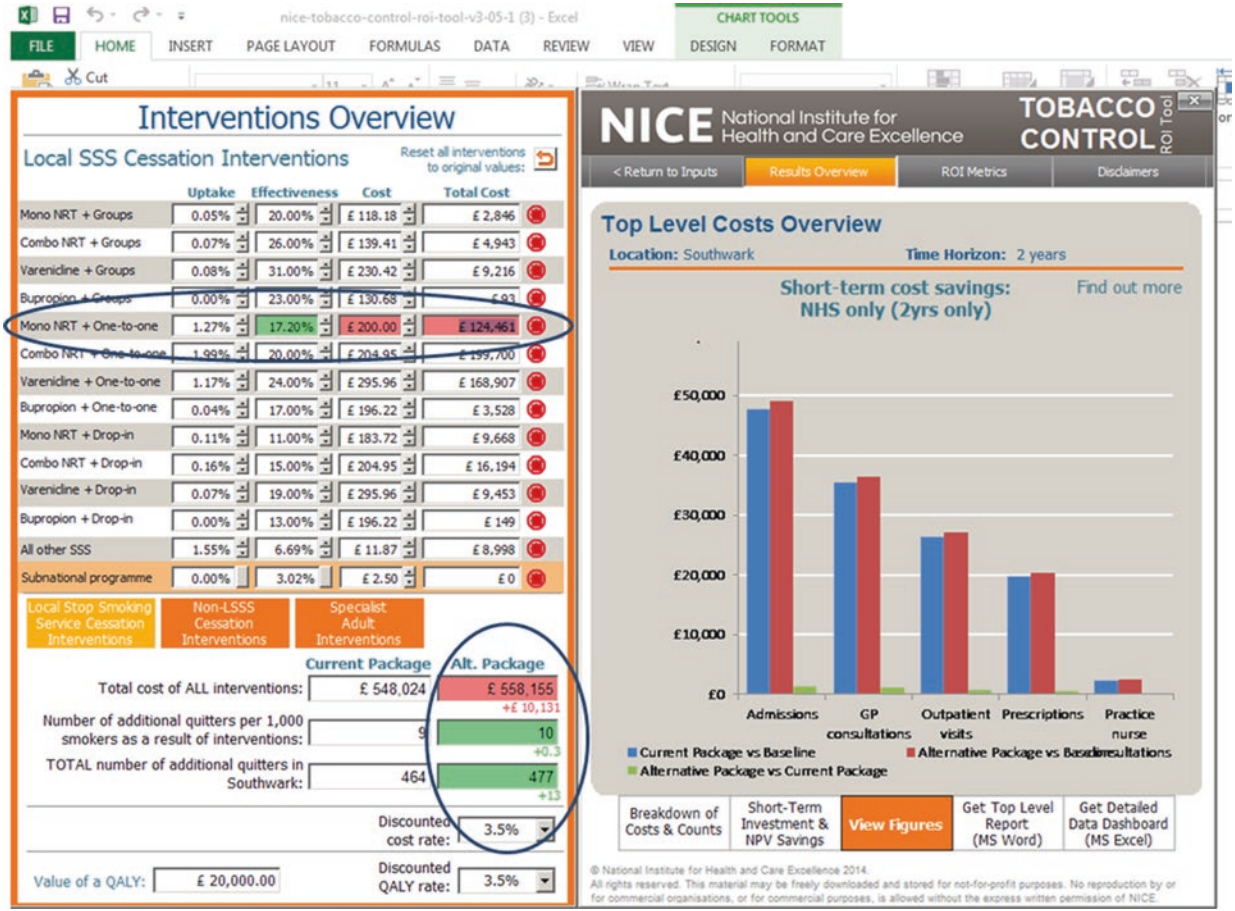

Fig. 7.4 Tobacco Control ROI Tool screenshot 4

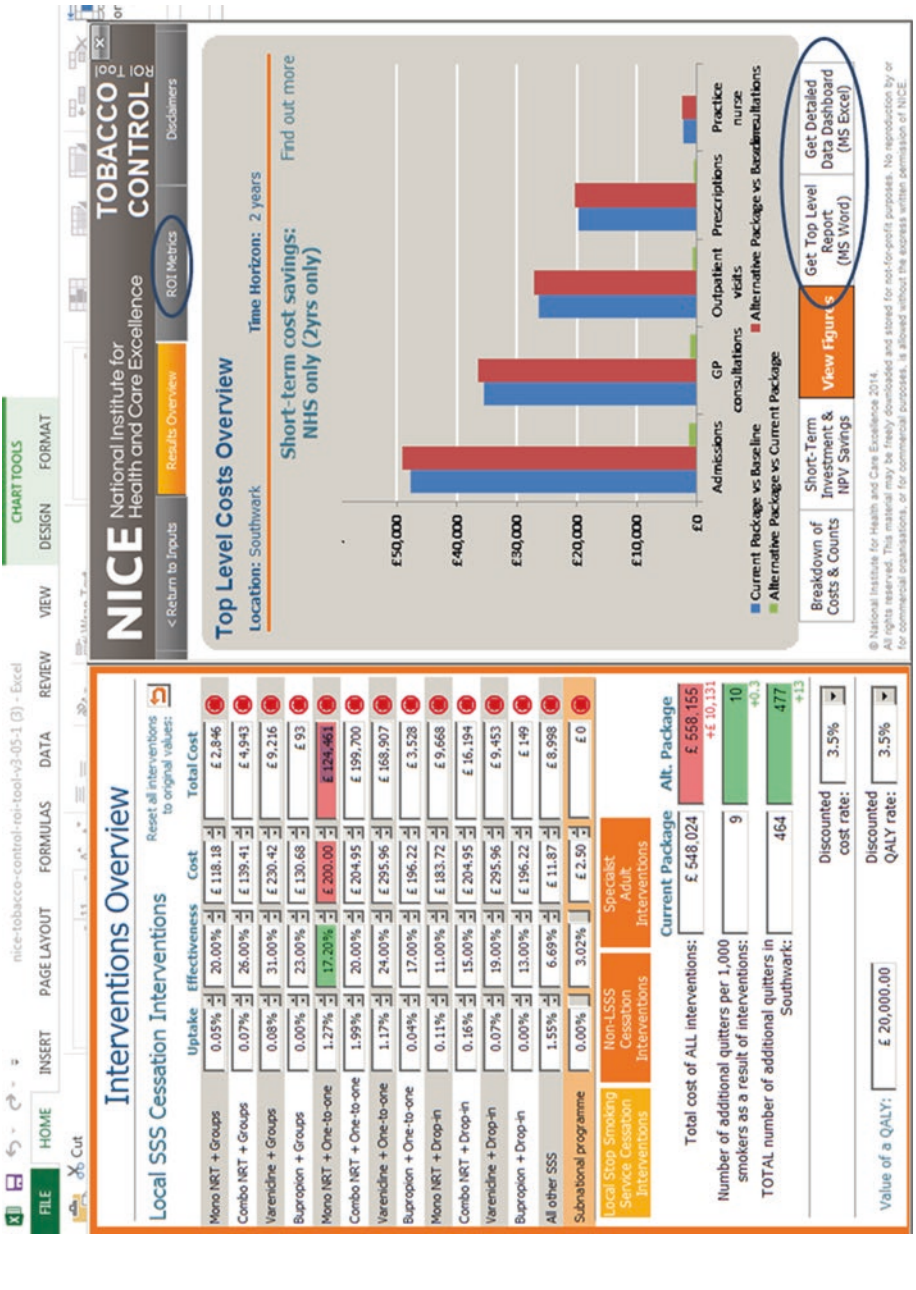

Fig. 7.5 Tobacco Control ROI Tool screenshot 5

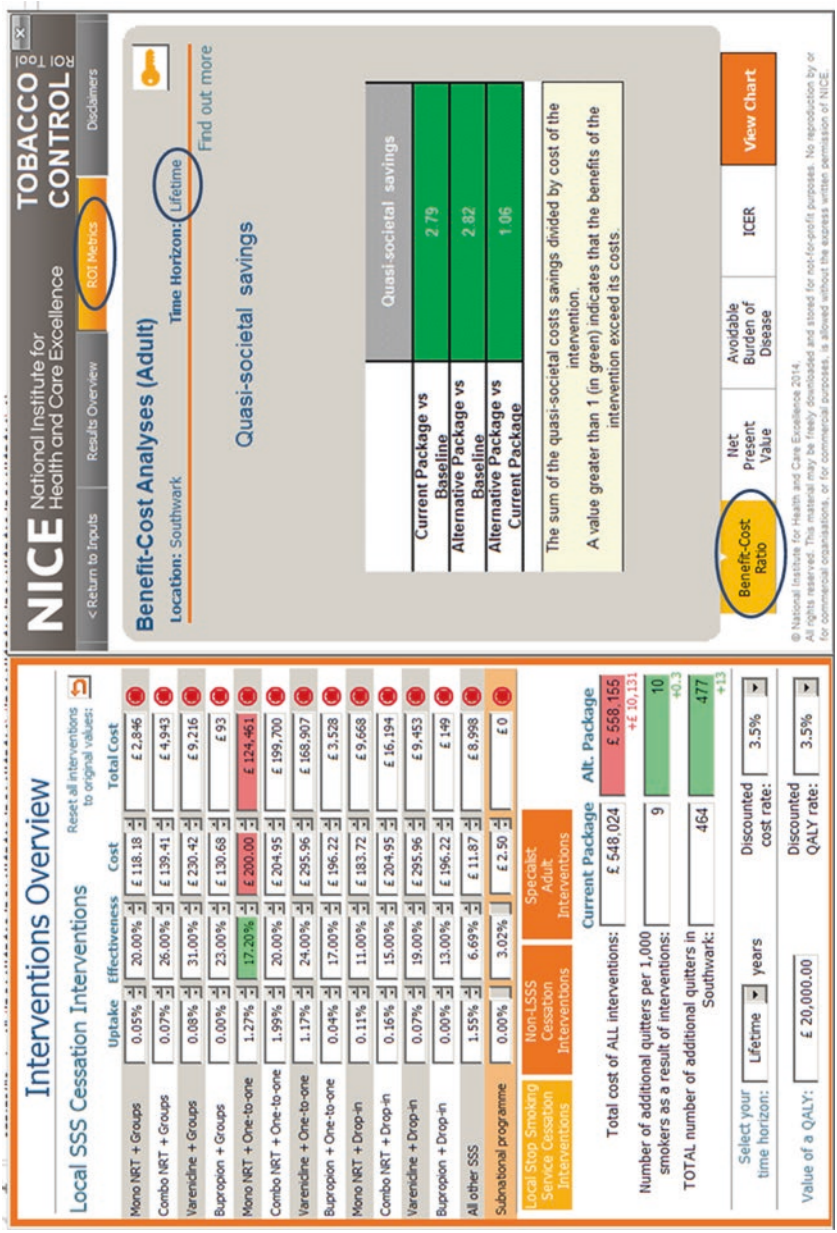

Fig. 7.6 Tobacco Control ROI Tool screenshot 6

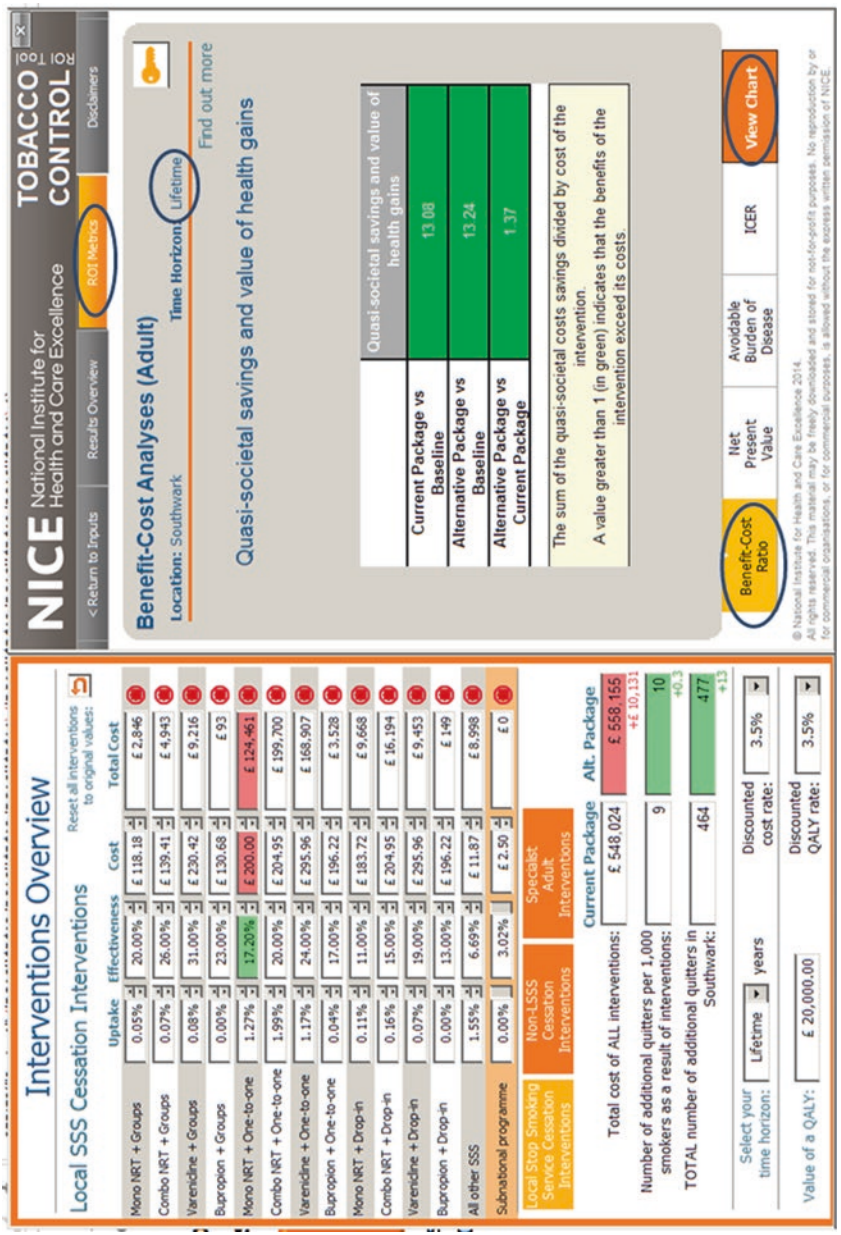

Fig. 7.7 Tobacco Control ROI Tool screenshot 7

Table 7.1 Southwark Local Stop Smoking Services[a]

	Current versus baseline	*New package versus baseline*	*New package versus current*
Total cost	£548,024	£558,155	*+£10,131*
Additional quitters	464	477	+13
Additional QALYs across all smokers	282	291	9
Cost/QALY	Current dominates	New package dominates	New package dominates
BCR lifetime	2.79	2.82	1.06
BCR lifetime + value of health gain	13.08	13.24	1.37

[a]Quasi societal perspective; Baseline (counterfactual: no-LSSS) assumes 2% background quit rate

the new package generates a return of £1.06 for every £1 spent compared to the current practice (if we consider just the quasi-societal savings). The return increases to £1.37 if we include the value of QALY gains as well. These results indicate the new package compares favourably with the original package. Like the original it offers very good value for money as compared with the baseline it generates a benefit cost ratio of 13.24.

7.2 Overview of Physical Activity ROI Tool

Unlike the Tobacco Control tool which on opening automatically sets up an initial package of interventions based on current practice, the initial intervention package in the physical activity tool has to be set up by the user. The other key difference is how the population-level interventions are handled. In the Tobacco Control tool, the subnational programme combines several "population"-level interventions. In the physical activity tool, the population-level interventions can be selected individually or in combination.

To download the physical activity tool go to the NICE webpage https://www.nice.org.uk/about/what-we-do/into-practice/return-on-investment-tools/physical-activity-return-on-investment-tool.

Save the tool to your hard drive. Once you run the tool and ask it to export your results, in Word and Excel format, they will be saved in the same place as the tool. Consider creating a folder (e.g. called physical activity ROI) and save the tool and results in the folder.

To use the tool open it from where it is saved on your hard drive, enable the macros and content if prompted and then click to begin. The key steps required to answer the decision problem follow below.

As with the tobacco ROI tool, it can take a few seconds for any changes you make to appear on the screen. The analysis may take a couple of minutes before the results appear.

7.2.1 Physical Activity Case Study

Using the NICE Physical Activity ROI tool, you can evaluate the physical activity interventions included in the tool. To help the user to conduct this analysis, a step-by-step guide is provided below.

7.2.1.1 The Decision Problem

You work in a local authority and your responsibilities include inputting strategies to improve physical activity in the authority. Three years ago you made a convincing case to the authority to fund a pedometer intervention to increase levels of physical activity. The budget provided was sufficient to fund a pedometer intervention that would reach 20% of your adult population. Your manager has emailed you a copy of a recent systematic review of the effectiveness of pedometers. It suggests the effectiveness of pedometers is 26%. In evaluation studies effectiveness can be measured in a variety of ways. The NICE tool uses two measures, and one or both may be reported in a study: (a) per cent increase in adults who are low active (30–149 minutes per week); (b) per cent increase in adults who meet the English Department of Health (DH) target (150+ minutes per week). The effectiveness of pedometers used in the original business case and in the recent systematic review was the DH target (b). When you made your original business case the best available evidence indicated an effectiveness of 54%. Your manager wants to know whether the pedometer intervention is still cost-effective and a good investment if its effectiveness is less than half the original estimate.

Decision problem

Is a pedometer intervention to increase physical activity still cost-effective and a good ROI if the most recent estimate of effectiveness suggests it is less than half as effective as the estimate used in the original business case (26% and 54%, respectively)?
P = Adult population in Liverpool
I = Pedometer intervention now

C = Pedometer intervention in the original business case
O = Healthcare cost savings

Liverpool case study

- Currently 10% of adults in Liverpool are allocated to the pedometer intervention (no other interventions are included in this study)
- Data on pedometers used in original business case
  - Uptake 20%, Effectiveness 54%, Cost £52.50
- New effectiveness data on pedometers
  - Uptake 20%, Effectiveness 26%, Cost £52.50

7.2.1.2 Steps Involved in Running the Tool

Step 1: Open the tool from where you have saved it on your hard drive and click on begin. Click on X Close to close the pop-up "welcome to the input area". Select Individual interventions and then select Display Advanced Settings. The screen will refresh and on the right hand side (RHS) you will see the parameter menu. This is where you select the geographical location of interest to you. In our case study we selected the North West region and then Liverpool local authority. Note the population data will pre-populate once the area is selected (Fig. 7.8).

Step 2: Next select Adult Interventions followed by one-to-one Pedometer and then set the population allocated to 20% and the effectiveness for per cent increase in adults who meet DH (150 minutes+ per week) to 26% (Fig. 7.9). Then click calculate current package.

Note: The 54% effectiveness applies to adults who meet the government guideline of 150+ minutes/week. No studies were identified that reported the effect of pedometers on increasing low activity levels (i.e. 30–149 minutes per week).

Step 3: Results. Click on X Close to remove the pop-up "Welcome to the results area". On the left hand side (LHS) of the screen you will see the interventions overview. On the RHS you will see the Results Overview (Fig. 7.10).

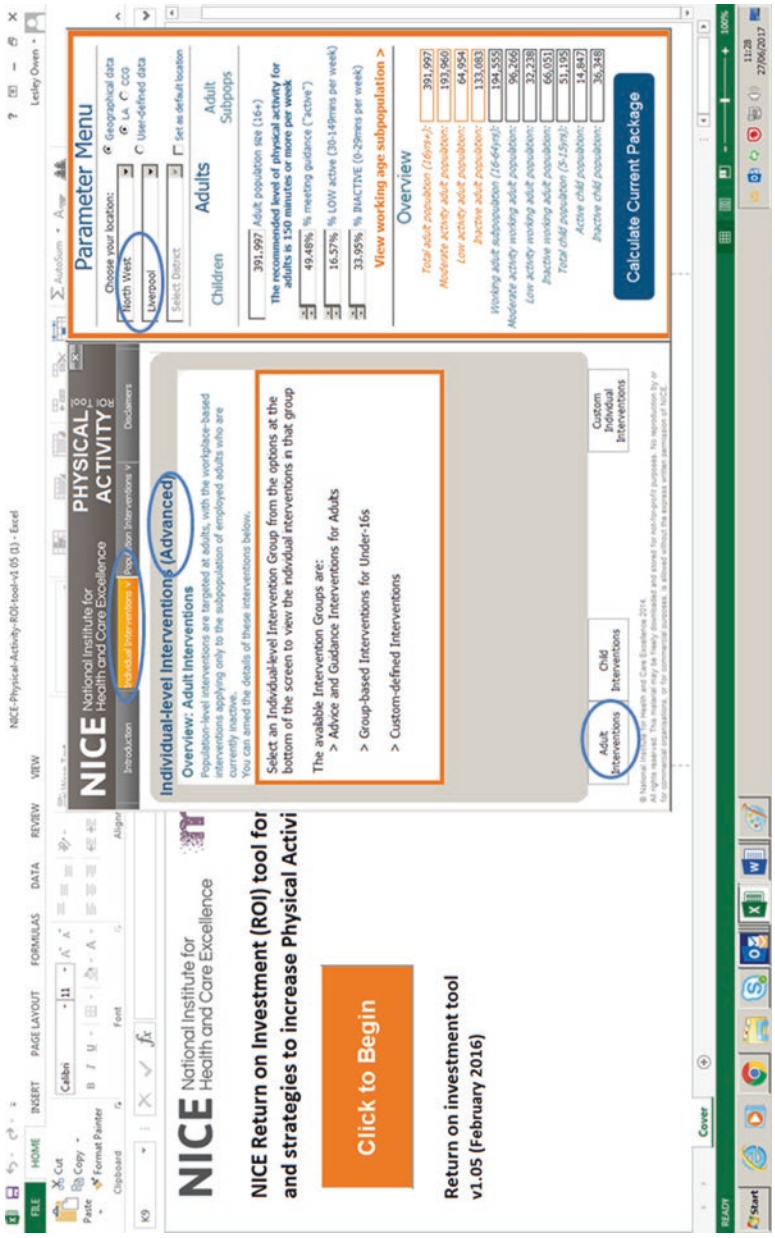

Fig. 7.8 Physical Activity ROI Tool screenshot 1

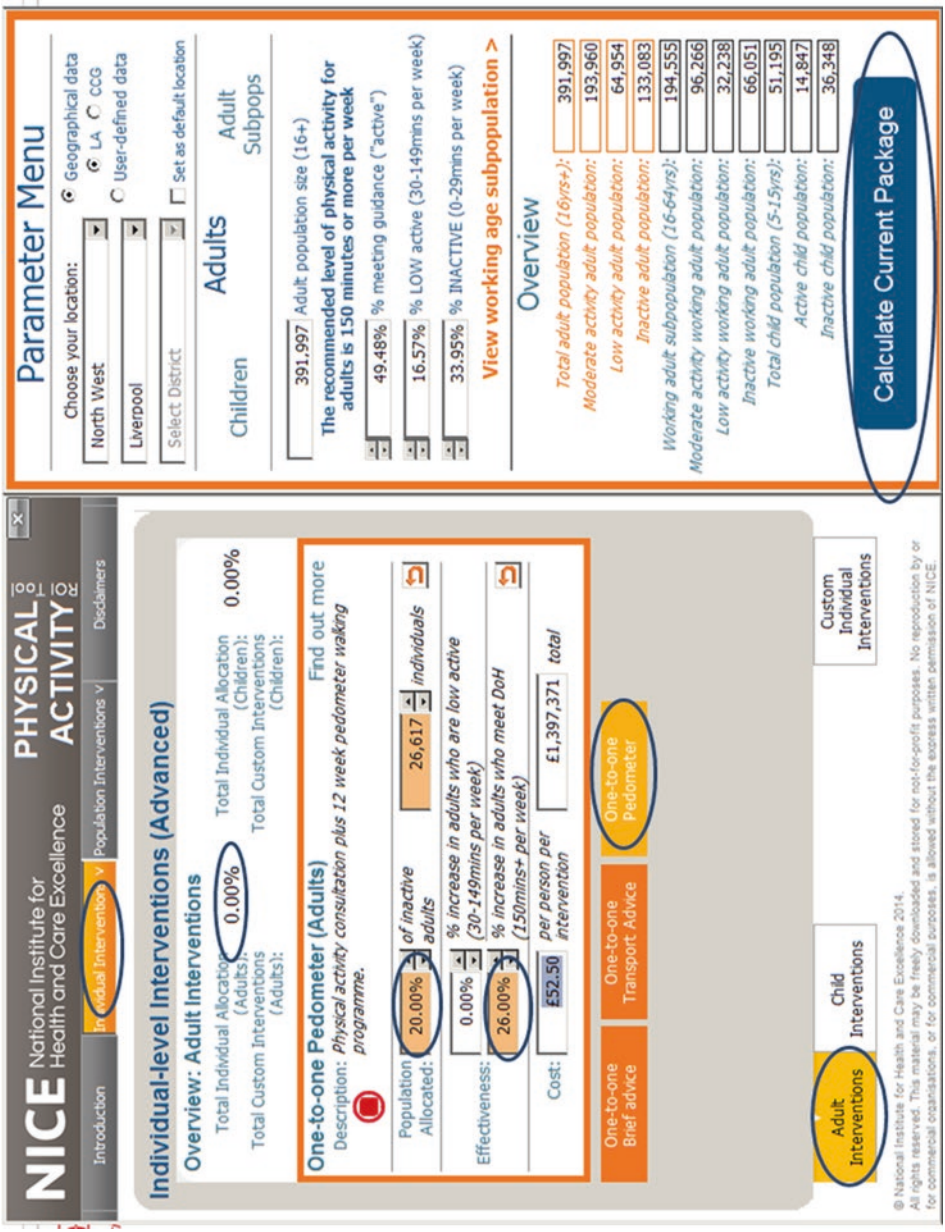

Fig. 7.9 Physical Activity ROI Tool screenshot 2

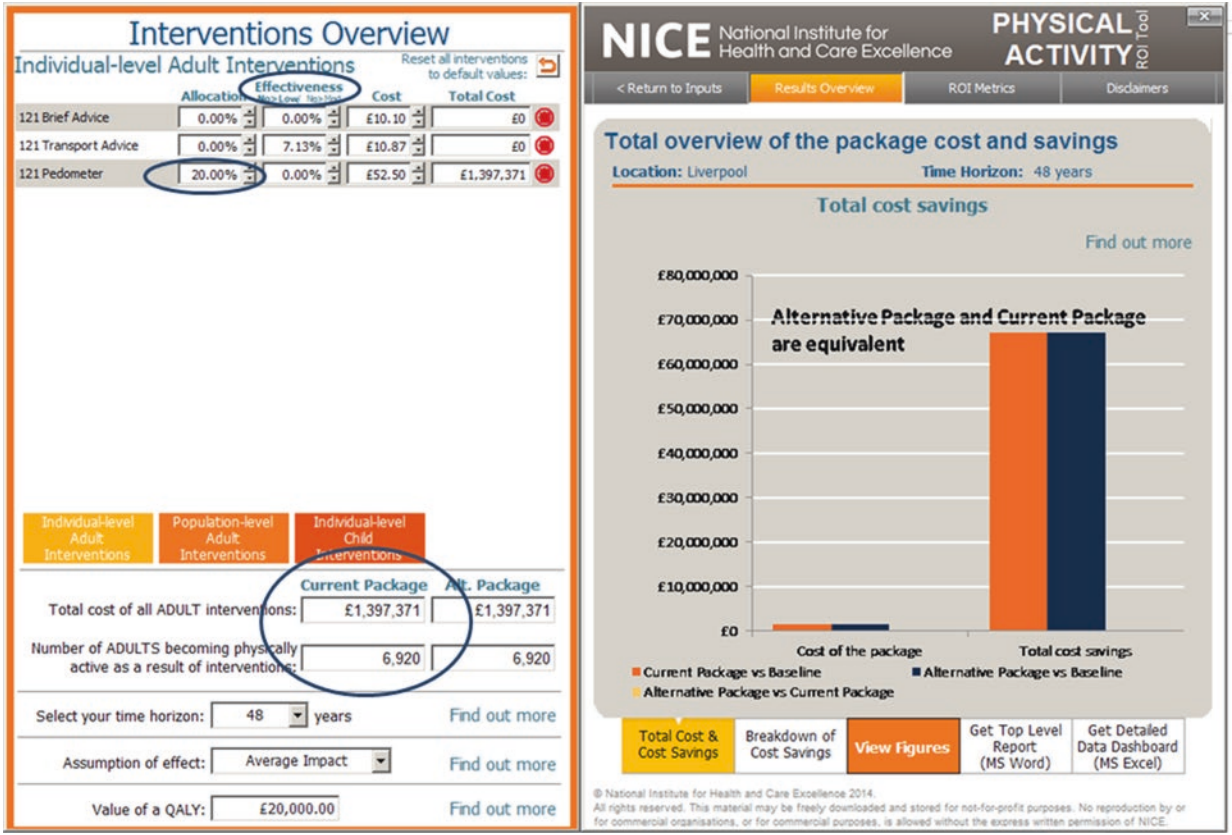

Fig. 7.10 Physical Activity ROI Tool screenshot 3

A couple of points to note in the LHS interventions overview:

- The effectiveness of pedometers appears to be 0%. In the effectiveness column you can toggle between No > Low and No > Mod. These refer to the two different outcomes mentioned earlier: a change from no activity to low activity and a change from no activity to moderate activity. The evidence for pedometers is measured as a change from no activity to moderate activity. By toggling between the two different outcomes you can see the estimates of effectiveness that have been applied to your population.
- Current and alternative (alt.) package: the first time you run the calculation it will populate both packages with the same data as you only have one package. When you run the next calculation, if you have changed any of the inputs in the current package, for example, percentage of the population allocated to the interventions or the costs, or the effectiveness, and so on, the results will be updated and reported as the alt. package.

On the RHS of the screen—results overview—you can choose between different sets of results and metrics. You can also access a Microsoft Word report of the results and create a Microsoft Excel dashboard of the results. The dashboard is important if you intend to create lots of different packages and want to compare them now or in the future (Fig. 7.10). Note: In Fig. 7.10, Alt. Package column shows the same results but will change once you have changed some of the inputs, for example, effectiveness, costs, and so on.

On the LHS you can see how much your package of interventions costs and the number of adults who become physically active as a result of the intervention. In our example, the package is a single intervention (pedometer) which costs an estimated £1,397,371 and results in 6920 adults becoming moderately active.

Step 4: To see whether the new estimate is still cost-effective compared with doing nothing (baseline) change the allocation from 20% to 0% (Fig. 7.11).

Step 5: At the bottom of the interventions overview you can see the updated results for the pedometer intervention under the heading Alt. Package. With no one in the population allocated to the intervention the

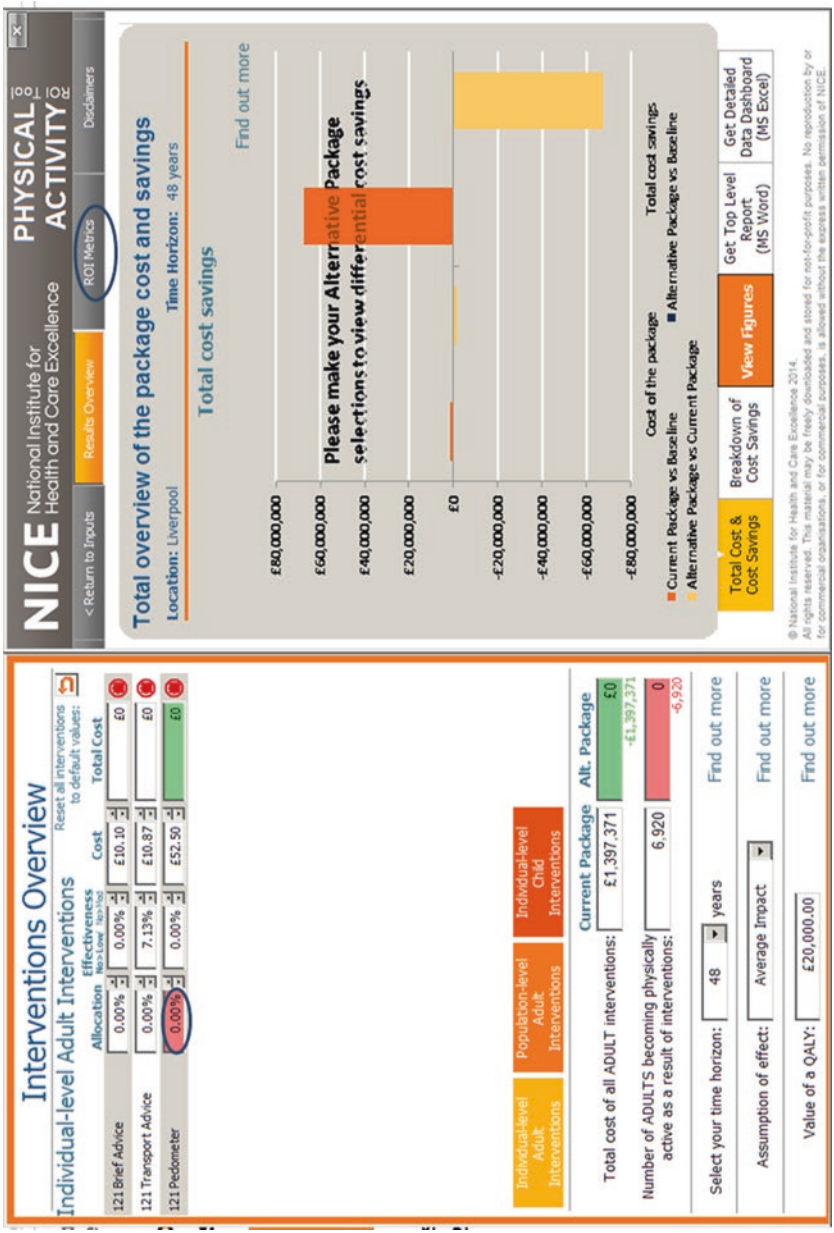

Fig. 7.11 Physical Activity ROI Tool screenshot 4

cost of the (alt.) package is reduced to zero £s. Whilst this represents a saving of £1,397,371 it also results in a potential loss of 6920 adults becoming physically active at the level that meets the DH target. So, going back to the decision problem, you want to know whether the intervention is still cost-effective and still offers value for money even though it is less effective. To do this you will need to obtain one or more of the ROI metrics offered in the tool.

Step 6: At NICE, an NHS intervention is considered to be cost-effective if it generates an incremental cost per quality adjusted life year (QALY) of £20,000 or less. To obtain the cost per QALY for the pedometer intervention you can click on get top level report (MS Word), get detailed data dashboard or ROI metrics (Fig. 7.11).

Step 7: In our example we clicked on ROI metrics and then selected ICER for the metric. We then have to choose the perspective—that is whether you want the results reported using only health care cost savings or all cost savings included. In our example we first chose only health care cost savings (Fig. 7.12).

Compared with the baseline, the pedometer intervention with an effectiveness of 54% (current package) generates an ICER of £313.64/QALY. When the effectiveness is reduced to 26% (alternative package), the ICER increases £1317.15/QALY. Although the cost per QALY is higher when intervention effectiveness is reduced it is well below the £20,000/QALY threshold. When the two packages are compared against each other (alternative versus current), the current package which comprises the pedometer intervention with an effectiveness of 54% is dominant. Note: the results are displayed in a table (Fig. 7.13) but you can also choose to display them in a chart.

Step 8: Presenting the business case. You have analysed the decision problem and now have all the information you need to go back to your manager with an answer. Compared with doing nothing the pedometer intervention with an intervention effectiveness of 26% has an estimated incremental cost per QALY of £1317.15. This is well below the NICE threshold making it highly cost-effective and good value for money. In our example we have produced a summary table showing some of the key findings (Table 7.2).

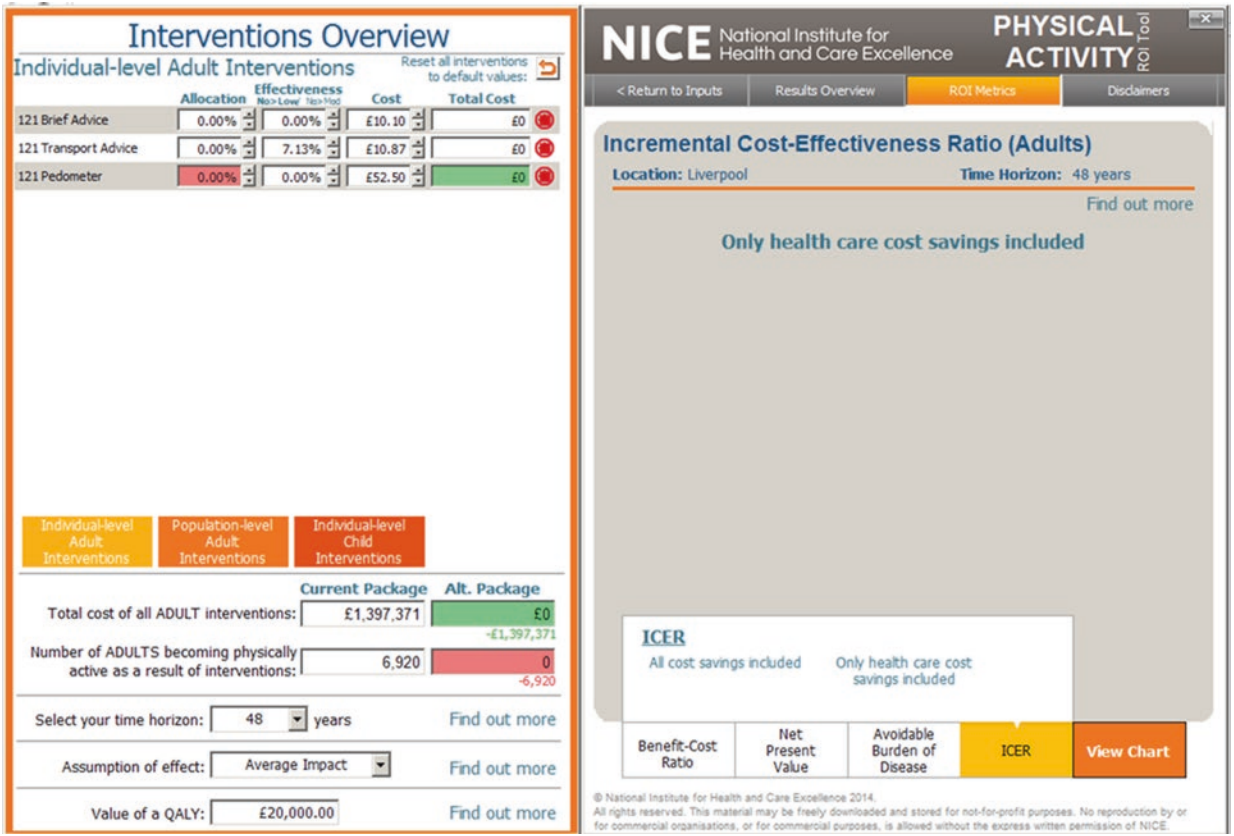

Fig. 7.12 Physical Activity ROI Tool screenshot 5

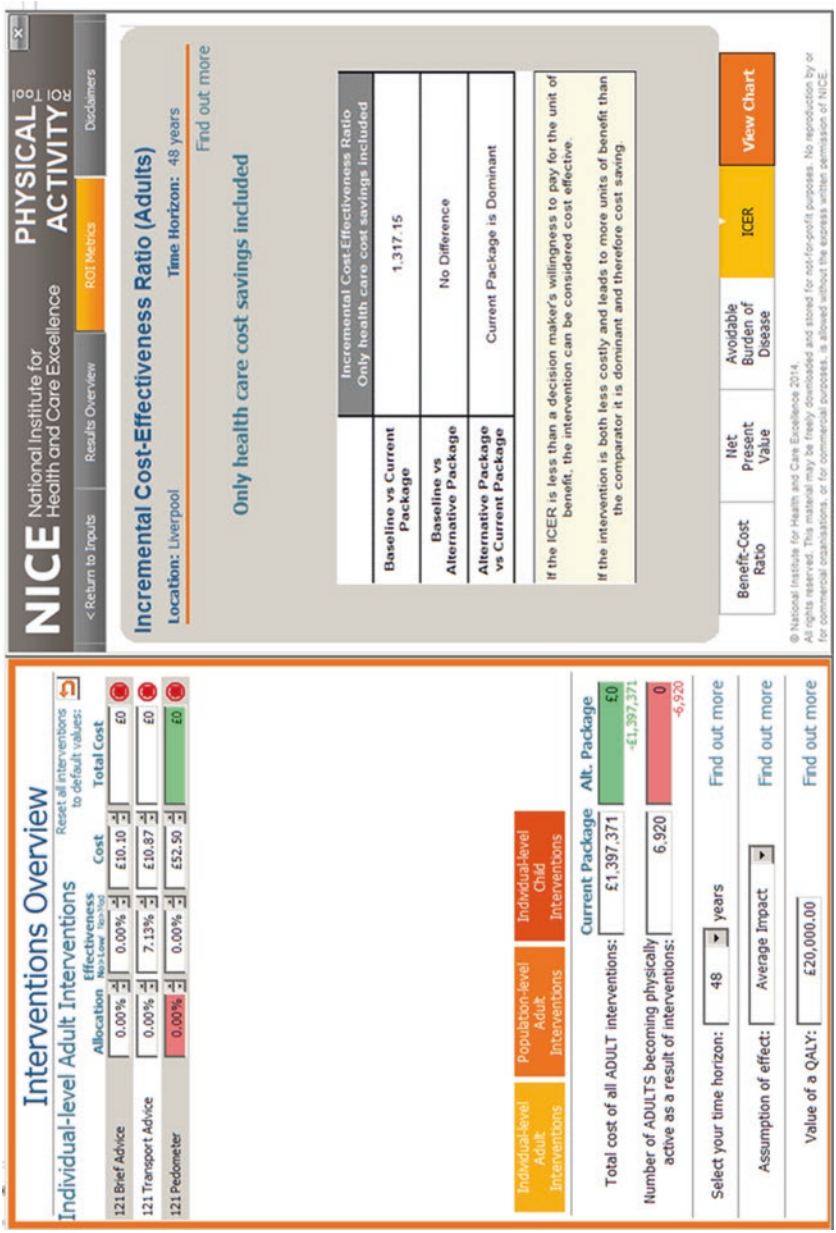

Fig. 7.13 Physical Activity ROI Tool screenshot 6

Table 7.2 Liverpool—business case for pedometers: original versus new evidence

	Original business case	*Business case new evidence*	*Original versus new business case*
Total cost of intervention	£698,686	£698,686	
Number of adults becoming physically active	7186	3460	
ICER compared baseline	£313.64	£1317.15	Original business case dominates

7.3 Overview of Alcohol ROI Tool

The alcohol ROI tool contains individual- and population-level interventions aimed at preventing or reducing the use of alcohol and interventions for treating patients who are dependent on alcohol. In this tool, the population-level interventions can be selected individually or in combination.

To download the alcohol tool go to the NICE webpage https://www.nice.org.uk/about/what-we-do/into-practice/return-on-investment-tools/alcohol-return-on-investment-tool.

Save the tool to your hard drive. Once you run the tool and ask it to export your results, in Word and Excel format, they will be saved in the same place as the tool. Consider creating a folder (e.g. called alcohol ROI) and save the tool and results in the folder.

To use the tool open it from where it is saved on your hard drive, enable the macros and content if prompted and then click to begin. The key steps required to answer the decision problem follow below.

7.3.1 Alcohol Case Study

Using the NICE Alcohol ROI tool, you can evaluate interventions included in the alcohol tool. To help the user to conduct this analysis, a step-by-step guide is provided below.

7.3.1.1 The Decision Problem

You work in a local authority. A national survey of drinking habits has just been published and the results show a sharp increase in the number of 15 year olds who drink at least once a week. A breakdown of the results shows your area is higher than average. You are aware the NICE alcohol ROI tool includes three school-based interventions to prevent and reduce the use of alcohol. You would like to know the cost and impact of each intervention given the demographics of your local area.

Decision problem

What is the cost and impact of three different school-based interventions to prevent or reduce the use of alcohol among 10–15 year olds?
P = Young people 10–15 years old
I = Three different school-based interventions
C = Absence of school-based interventions
O = Healthcare cost savings

Tameside case study

The total child population aged 10–15 years is 15,642
The total young person population aged 16–17 years is 5,717
Increasing/higher risk of alcohol use under 18 subpopulation is 2,308
National survey indicates 11% of 15 year olds in Tameside drink at least once a week

Three interventions	*Effectiveness*[a]	*Cost per pupil*
Skills activities: 17 sessions over 8 to 10 lessons and 12 sessions over 5 to 7 weeks the following year	0.34%	£35.00
Curriculum: 40-session year-long curriculum for 11 year olds with aim of teaching social competency and refusal skills	0.23%	£170.50
Targeted brief advice with school nurse: children referred to a school nurse if showing signs of drinking and given brief advice. Parents contacted and given literature on alcohol education	4%	£22.58

[a]Effectiveness is measured as the proportion of those receiving the intervention who will reduce their alcohol use

7.3.1.2 Steps Involved in Running the Tool

Step 1: Open the tool from where you have saved it on your hard drive and click to begin. Click on Close to close the pop-up "welcome to the input area". You will see a menu box with Introduction, General Interventions v, Treatment Interventions v and Disclaimers. Select General interventions v and then display basic settings (Fig. 7.14). This will bring up a new screen.

Step 2: On the right hand side (RHS) you will see the parameter menu. This is where you select the geographical location of interest to you. In

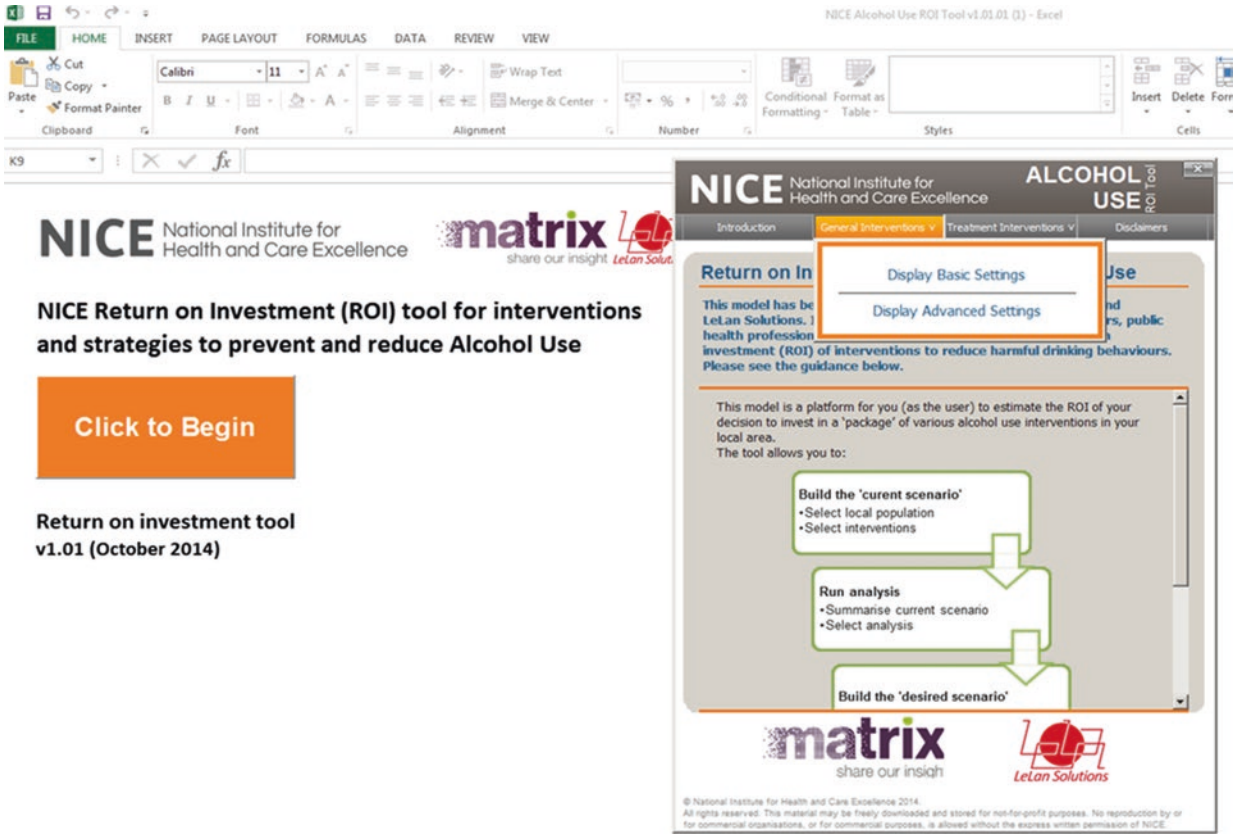

Fig. 7.14 Alcohol use ROI Tool screenshot 1

our case study we selected the North West region and then Tameside local authority. Note the population data will pre-populate once the area is selected (Fig. 7.15).

Step 3: The simplest way to obtain the data we want for our case study decision problem is to run the tool without any interventions and then select interventions of interest from the results screen. So click Calculate Current Package. You will get a warning that the tool does not have any individuals allocated to interventions. Click YES to continue anyway.

Step 4: A new screen will pop up. On the left hand side (LHS) is the Interventions overview and on the right hand side (RHS) is the Results overview. Click on General Interventions for Under 18s to see the three school-based interventions. The fourth intervention—TV ad ban—is not used in our case study (Fig. 7.16). Note the allocation for each intervention is 0.00%.

Step 5: To see the cost and impact for the first intervention we set the allocation for Classroom-based activities to 20%. The changes are shown in a different colour (Fig. 7.17). Note: We used 20% for the percentage allocated as we intend to offer this intervention to a one-year intake. The Interventions Overview is automatically updated. You can see the total cost of the intervention is £109,494 and the number of children reducing alcohol use as a result of the intervention is 11.

Step 6: To see the cost and impact for the second intervention from the Interventions Overview reset the allocation for classroom-based activities to 0.00% and then set the allocation to School curriculum to 20%. Note: We used 20% for the percentage allocated as this intervention is aimed at 11 year olds. The Interventions Overview is automatically updated. You can see the total cost of the intervention is £533,392 and the number of children reducing alcohol use as a result of the intervention is 7 (Fig. 7.18).

Step 7: To see the cost and impact for the third intervention from the Interventions Overview reset the allocation for school curriculum to 0.00% and then set the allocation to Targeted brief intervention to 11%. Note: The figure of 11% is taken from the recently published national survey mentioned earlier and is used for this intervention, which is aimed at children showing signs of drinking. The Interventions Overview is automatically updated. You can see the total cost of the intervention is £38,852 and the number of children reducing alcohol use as a result of the intervention is 69 (Fig. 7.19).

Step 8: Presenting the business case. You have analysed the decision problem and now have all the information you need about the cost and estimated impact of the three school-based interventions. It's important to note the assessment of the interventions is limited to one year as there

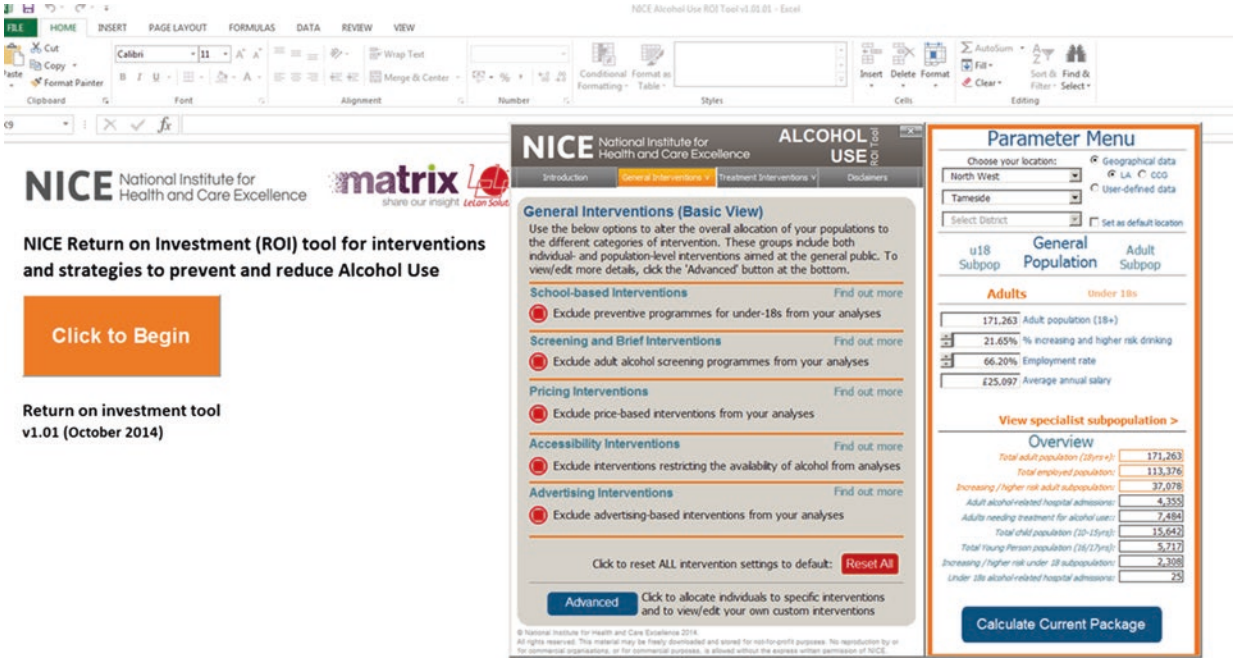

Fig. 7.15 Alcohol use ROI Tool screenshot 2

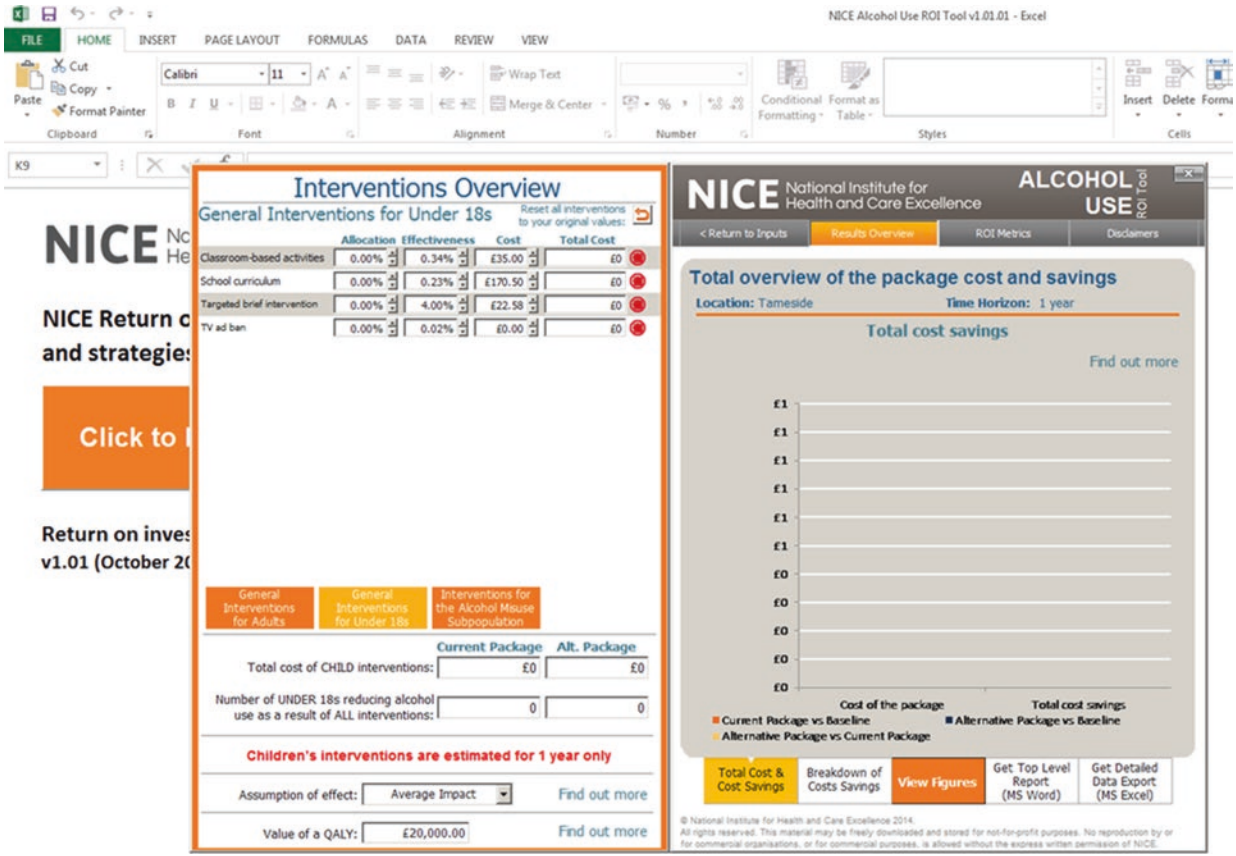

Fig. 7.16 Alcohol use ROI Tool screenshot 3

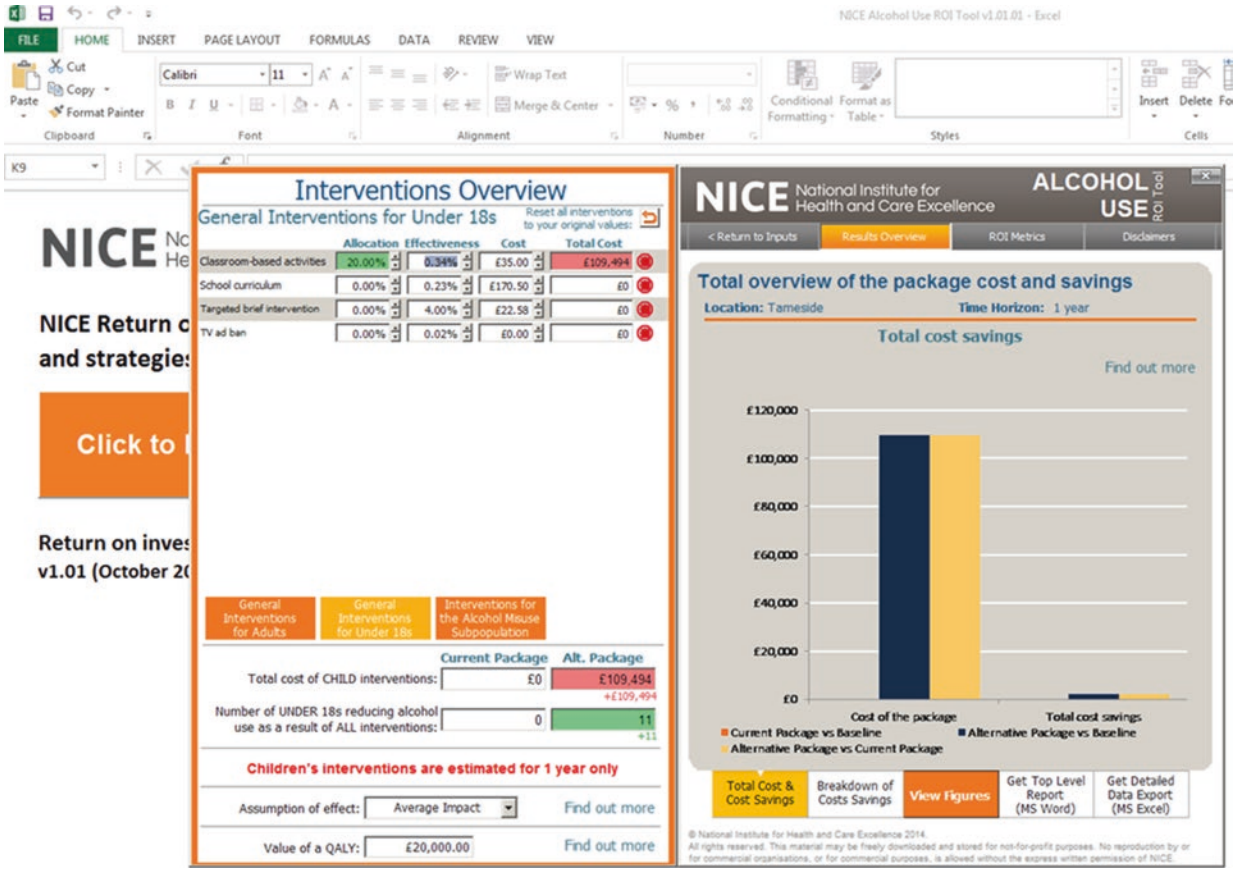

Fig. 7.17 Alcohol use ROI Tool screenshot 4

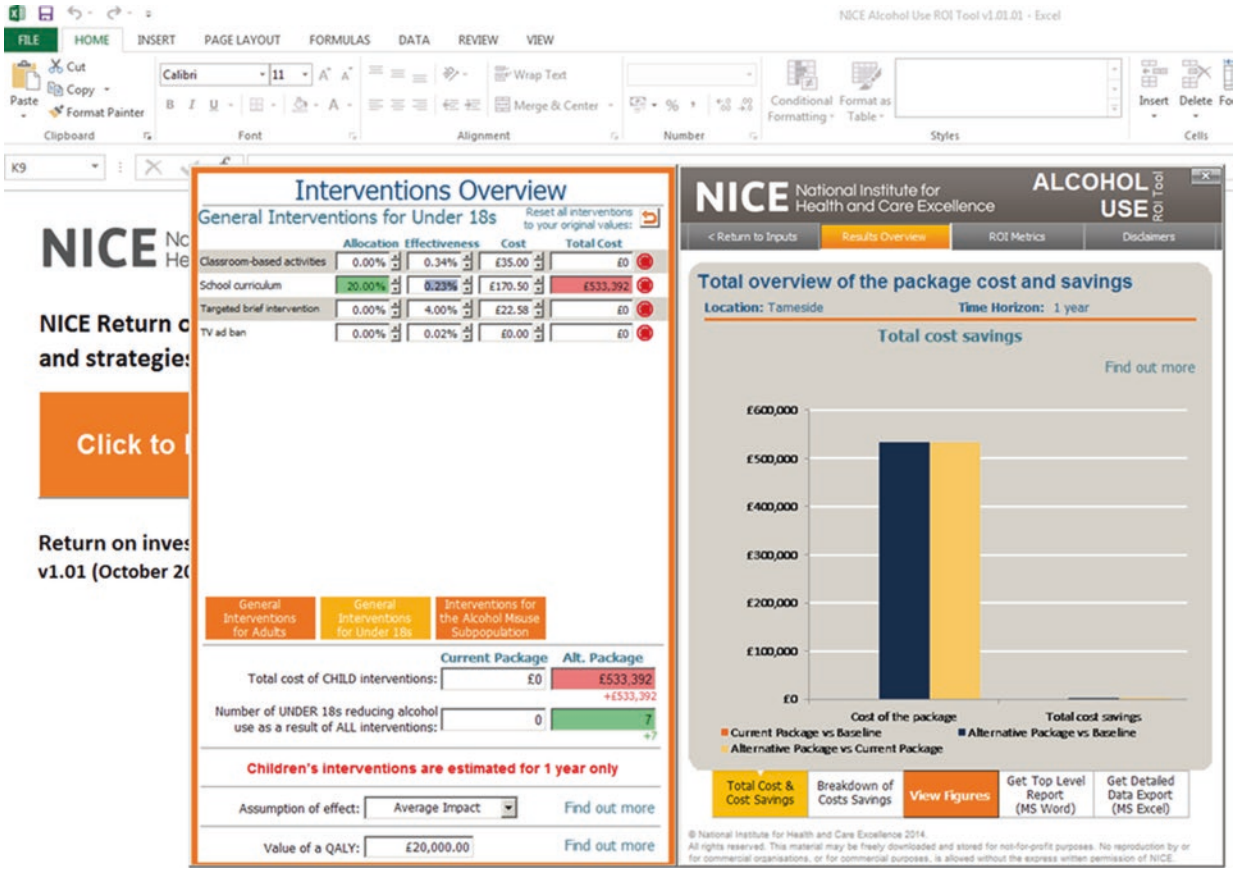

Fig. 7.18 Alcohol use ROI Tool screenshot 5

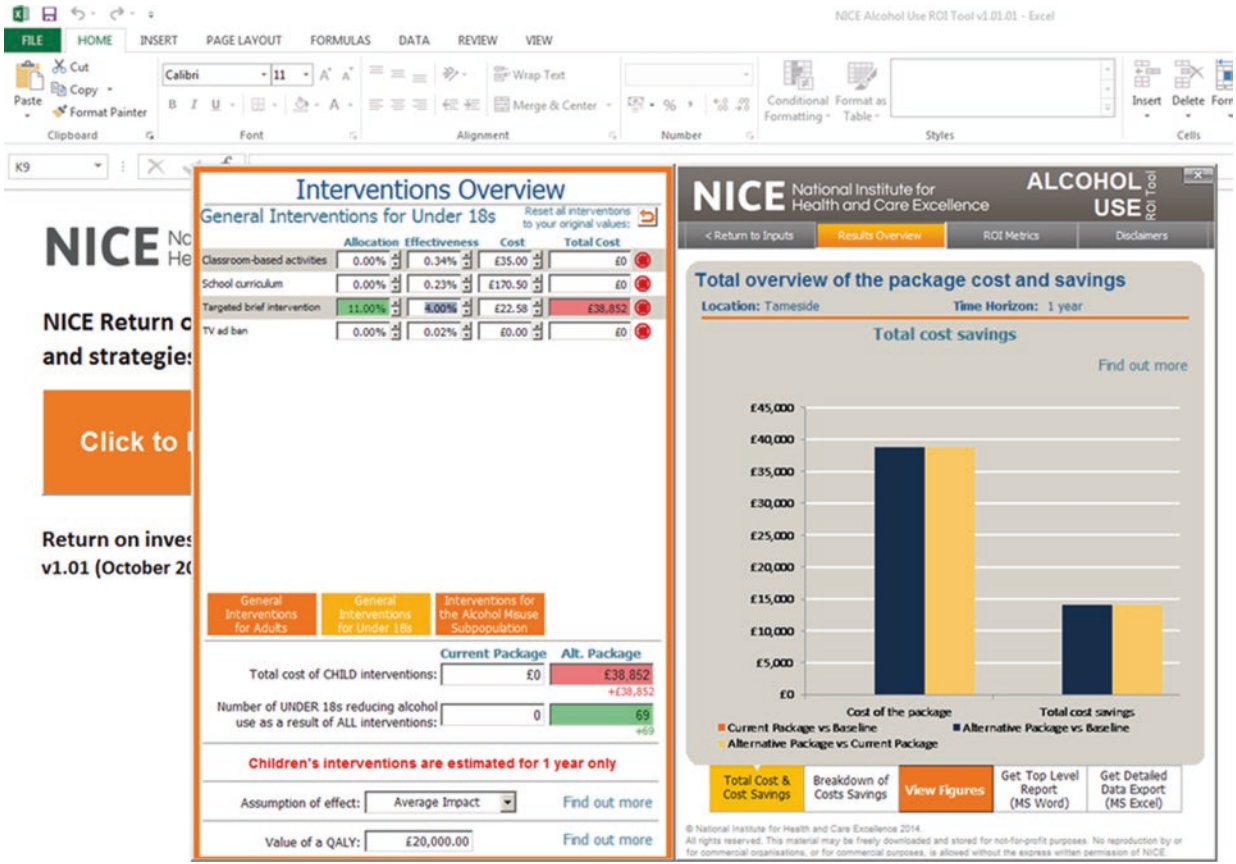

Fig. 7.19 Alcohol use ROI Tool screenshot 6

Table 7.3 Cost and impact at one year of three school-based interventions to prevent or reduce alcohol use

Three school-based interventions	*Total number who reduce alcohol consumption*	*Total cost of intervention*
Skills activities: 17 sessions over 8 to 10 lessons and 12 sessions over 5 to 7 weeks the following year	11	£109,494
Curriculum: 40-session year-long curriculum for 11 year olds with aim of teaching social competency and refusal skills	7	£533,392
Targeted brief advice with school nurse: children referred to a school nurse if showing signs of drinking and given brief advice. Parents contacted and given literature on alcohol education	69	£38,852

are no longitudinal data on the impact of alcohol interventions delivered to 10–15 year olds. For our example, we have produced a summary table showing the key findings (Table 7.3).

It is important to remember that in the analysis, each intervention was compared with doing nothing. Based on the data in the table, it is evident that targeted brief advice is substantially cheaper and has greater impact than the other two interventions. However, careful consideration is needed in applying these findings to your own local circumstances. For example, one or more schools in your locality may not have a school nurse, or the nurse might not be trained in delivering brief interventions or it may not have a strategy for identifying children who are showing signs of drinking. Under these circumstances it may not be possible to offer targeted brief advice. A good understanding of the evidence is also important in applying these findings. For example, it may be that studies have not considered additional potential benefits of whole year approaches. Whilst skills activities or curriculum-based interventions may result in a smaller number of children who reduce drinking, it is possible that they may result in fewer children consuming alcohol. The point here is that the cost-effectiveness data is an important component of decision making but it is not the only component.

7.4 Further Support

You can find more detailed guides on how to use the NICE ROI tools and technical reports describing the model, assumptions and sources of data in Box 7.1:

Box 7.1 Web Links to the Relevant Resource Materials

Tool	*Web address*
Tobacco control ROI tool	https://www.nice.org.uk/About/What-we-do/Into-practice/Return-on-investment-tools/Tobacco-Return-on-Investment-tool
Physical activity ROI tool	https://www.nice.org.uk/about/what-we-do/into-practice/return-on-investment-tools/physical-activity
Alcohol ROI tool	https://www.nice.org.uk/about/what-we-do/into-practice/return-on-investment-tools/alcohol

Key Points

- NICE has developed ROI tools on tobacco control, physical activity and alcohol. These tools are freely available to download and use. Accompanying user guide and technical reports describing the underlying model, assumptions and data are also available to download.
- A decision problem must be defined to use the ROI tools. One way to define a decision problem is to use the PICO framework.
- The ROI tools can be used to evaluate the ROI of current practice in your area compared with a counterfactual or baseline (no services).
- The ROI tools can be used to evaluate the ROI of alternate practice in which one or more interventions in your current practice could be altered. The ROI of this new practice could be compared with the current one.
- The tools provide several ROI metrics to help users make their business cases.

NICE guidance is prepared for the National Health Service in England. All NICE guidance is subject to regular review and may be updated or withdrawn. NICE accepts no responsibility for the use of its content in this product/publication.

Reference

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CHAPTER 8

ROI Analysis: Making Policy Impacts

Abstract In order for the return on investment (ROI) analysis to make an impact on health outcomes and wider economy, the findings must be used in policymaking. This chapter demonstrates that uptake of ROI concepts, tools and evidence are determined by several factors, such as the end users' attitude, their expectation on social support and training needs. Stakeholder engagement in ROI research is therefore essential to make policy impact–this engagement should be throughout, from the design of the study to dissemination and beyond. Stakeholder engagement helps one to understand the decision context so that the ROI analysis can be meaningful to decision makers. Policy briefs and infographics are effective means to communicating ROI findings to government policymakers and wider stakeholders.

Keywords Return on investment • ROI • Impact • Stakeholder • Decision context

What would be the point of conducting ROI analyses if they did not feed into policymaking? In fact, this question is relevant to "research" in general and therefore funders of research from all sectors—governmental, charities, bilateral and multilateral agencies—require that the researchers have an explicit plan eliciting their "pathways to impact". The Research Councils UK (RCUK), for example, set out this principle as follows:

S. Pokhrel et al., *ROI in Public Health Policy*,
https://doi.org/10.1007/978-3-319-68897-8_8

"A clearly thought through and acceptable Pathways to Impact statement is an essential component of research proposals and a condition of funding. Grants will not be allowed to start until a clearly thought through and acceptable Pathways to Impact statement is received" [1]. By impact, the RCUK means the immediate academic impact (e.g. advancing disciplines) and wider economic and societal impacts (e.g. economic competitiveness or enhancing quality of life). It is a complex matter to proactively influence the use of ROI analyses in policymaking in order for them to make the impacts as stipulated above. Therefore, in addition to learning the "science" of ROI analyses as discussed in previous chapters, one has to learn the "art" of ROI analyses too.

The process of developing impact pathways begins with "identifying and actively engaging relevant users of research and stakeholders at appropriate stages" [1]. Understanding the decision context is therefore critical to identify the needs of users. In Chap. 6, we considered three questions (decision problems) facing a public health policymaker: do I invest; do I invest more; do I disinvest? The irony is that despite most public health interventions demonstrating good value for money (hence they should be viewed positively in adoption and coverage decisions) [2, 3], significant cuts to public health budgets are very likely [3, 4]. We also considered in Chap. 6 that public health, by nature, is an unattractive investment portfolio for decision makers who often operate in the context of short-term returns. Therefore, evidence does not always translate to policymaking or national guidelines. However, available data does suggest that countries that use evidence in making investment decisions are the ones that fare very well in improving population health (Box 8.1). So why is this disconnect between evidence and policy? What can we do about this?

Box 8.1 Implementation of Evidence Is at the Heart of Tobacco Control [5–8]

In Europe alone, some 28% of the population smokes, with smoking claiming 700,000 lives every year and causing huge economic burden (in the form direct medical care costs and workday losses) and health inequalities [5, 6]. The prevalence of smoking varies from high (e.g. Spain and Hungary) to low (e.g. the UK and the Netherlands) [7].

Joossens and Raw developed the Tobacco Control Scale (TCS) that quantifies the implementation of tobacco control policies at the country level and is based on the six strands of cost-effective tobacco control interventions: price increase through taxation, ban of smoking in public and work places, mass media, advertising bans, health warnings, cessation services [8]. A country can be scored on each strand (price [max=30]; public place bans [max=22]; public info campaign spending [max=15]; advertising bans [max=13]; health warnings [max=10]; treatment [max=10]), and then the scores are added to get the total (max=100). The TCS scale published in 2013 showed that in implementing evidence-based tobacco control:

- There are four leaders—UK (74), Ireland (70), Iceland (66), Norway (61)
- Six countries doing reasonably well—Turkey (57), France (57), Spain (56), Malta (56), Finland (55), Ukraine (53)
- Twenty-four that don't even reach 50 points (out of 100) and need to do much more

In what way do the four leaders differ from others in this context? This data offers a strong indication that countries that invest significantly in evidence-based tobacco control interventions (the six strands) are likely to come up as the winners in this league table. Translation of cost-effectiveness evidence into real-world policymaking has made significant impact in reducing smoking prevalence in those countries. As a result, more lives and healthcare resources have been saved, more productivity gains have been realised for the local economy and quality of life of the population has increased. Making sure the evidence got into policy was the most significant pathway to this impact.

Based on Joossens and Raw (2014). The Tobacco Control Scale 2013 [8].

8.1 ROI Analysis: Determinants of Uptake

Our work with stakeholders as described in Chap. 1, coupled with the body of work conducted elsewhere [9, 10], has provided us with several insights on the suboptimal use of research evidence in policymaking. Barriers to evidence uptake do exist and include poor access to good quality, relevant

research (remember George's struggle in Chap. 1), lack of timely research outputs [9], lack of an explicit health technology assessment (HTA) framework for decision making and lack of institutional support for the use of HTA [10]. In fact, barriers exist on both demand and supply sides, particularly creating a "disconnect" between how and when evidence is produced and how and when evidence is consumed [11]. Therefore, the most important facilitator of the uptake of evidence in policymaking appears to be a strong collaboration between the researchers and policymakers, making sure that dialogues take place early on to enable researchers to understand the needs of end users and end users understand the complexity of research [9, 11]. In addition, engaging stakeholders in the design of the study is also consistent with the principle of economics (i.e. *for whom to produce?*). Not understanding who will consume the produced goods (evidence in this case) can be hugely inefficient. We will return to this in Sect. 8.3.

Once we know the likely users of the research, it is important to understand what factors may determine the likelihood of uptake. The factors can operate at different levels—individual's own characteristics including their attitudes towards the health problem and its remedy, the characteristics of the institutions including the level of support available and wider characteristics such as national commitment to practice evidence-based decision-making with formal guidelines. Particularly in public health it is important to understand how acceptable an intervention might be to the targeted population. A recent study found that one's intention to use the ROI tool was significantly influenced by who they expect would support them in using the tool in policymaking (Box 8.2).

Box 8.2 What Motivates the Use of ROI Models in Decision Making? [12–14]

Why is the uptake of model-based economic evaluations (e.g. Tobacco ROI tool) still limited in making funding decisions, despite a huge growth recently in the number of such evaluations? European-study on Quantifying Utility of Investment in Protection from Tobacco (EQUIPT) researchers [12, 13] sought to identify which factors determined decision makers' intention to use economic models. They applied a psychological framework, known as the *I-Change Model* [14], which allowed them to capture stakeholders' views on three behavioural phases: awareness, motivation and action. Through interviews with 93 stakeholders (decision makers,

purchasers of services/pharma products, professional service providers, researchers and advocates of health promotion) across five EU countries (Germany, Hungary, Netherlands, Spain and the UK), they were able to collect data on phase-specific determinants.

The results were fascinating: 73% stakeholders were classified as "intenders", that is, someone who is likely to use an ROI tool in decision making or information gathering. "If such high proportion of stakeholders intended to use the ROI tool—the researchers wondered—why was it that the actual uptake would be limited?" Further analyses showed that significant differences in beliefs existed between non-intenders and intenders which included their perception about tobacco (e.g. smoking epidemic is severe), their positive attitudes towards likely advantages of the economic model in decision making (e.g. it would provide sufficient financial justification to make the case and it is easy to use), expected social support (e.g. from people and organisations around them—see Table below) in using the model and self-efficacy (i.e. the belief that one is able to change their behaviour). Regression analyses showed that country of residence, attitude towards economic models and social support were significant predictors of the intention to use the ROI tool.

Social support expected from	*Mean score (SD)*		*p-value*
	Non-intenders	*Intenders*	
My boss	4.14 (2.08)	6.00 (1.23)	<0.01
My other colleagues	4.23 (2.02)	5.98 (1.15)	<0.01
My organisation	4.05 (2.06)	5.94 (1.25)	<0.01
Reimbursement agencies	3.77 (1.82)	5.23 (1.42)	<0.01
My Ministry of Health	4.36 (1.79)	5.40 (1.51)	0.01
Health professionals	4.27 (1.61)	5.32 (1.25)	<0.01
I would encounter resistance	3.32 (2.01)	2.85 (2.07)	0.37

Note: Respondents agreed to statements on a Likert scale (1 = strongly disagree to 7 = strongly agree). The figures represent the mean score (standard deviation in the parentheses)

The researchers concluded that the level of social support and the perception that ROI models are helpful predicted the likelihood of uptake of the tool. The implication is whilst producing

methodologically robust economic models is a necessary condition for its use, communication strategies to promote likely benefits of the models will also be needed. Finally, the need for training opportunities on how to use the tool and evidence cannot be understated.

Based on Cheung et al. (2016); Health Policy 120: 46–54 [12]. *An earlier version of this case study featured in the draft report (unpublished) of RAHEE (Research Agenda for Health Economic Evaluation project report).*

The actual use of ROI tools in policymaking is hard to track. A study explored through a key stakeholder workshop the extent to which NICE Tobacco ROI tools [15] were being used in the UK decision-making context [16]. Ten decision makers and wider stakeholders stated their experience of using the NICE Tobacco ROI tool since its inception in 2012 via a pre-workshop online survey and workshop discussions. This represented a reasonable cross section of central government, charitable organisations, health advocacy organisations, local government, an arm's length body and the health service. Inputting to policy proposals, writing reports and writing business cases were most frequently reported usage. The facilitators of uptake were granularity in ROI metrics offered by the tool and the provision of up-to-date data present in the tool. Half of the respondents viewed the tool to be too complex and too time-consuming to use. The consensus reached via the workshop deliberations suggested that despite the usefulness of the ROI tool in making a business case, its use had been limited. In the post-workshop survey, three-quarters of participants agreed that the NICE ROI tool could be effectively used for policymaking at a local level. The study concluded that "locally relevant ROI evidence has the potential to feed into local policy making" [16].

The EQUIPT study [16] also corroborated some of the issues raised by earlier studies around likely facilitators of uptake of evidence in policymaking. When 22 stakeholders representing 11 European countries were asked about facilitators of uptake in the context of the EQUIPT ROI tool, a large majority (95%) agreed that availability of guidelines for the use of HTA in coverage decisions would facilitate the adoption of the EQUIPT ROI Tool (Fig. 8.1). There was a high level of agreement with the policy proposals based on the ROI Tool having the potential to be implemented at country levels and internationally. However, training needs were highlighted by almost every respondent [16].

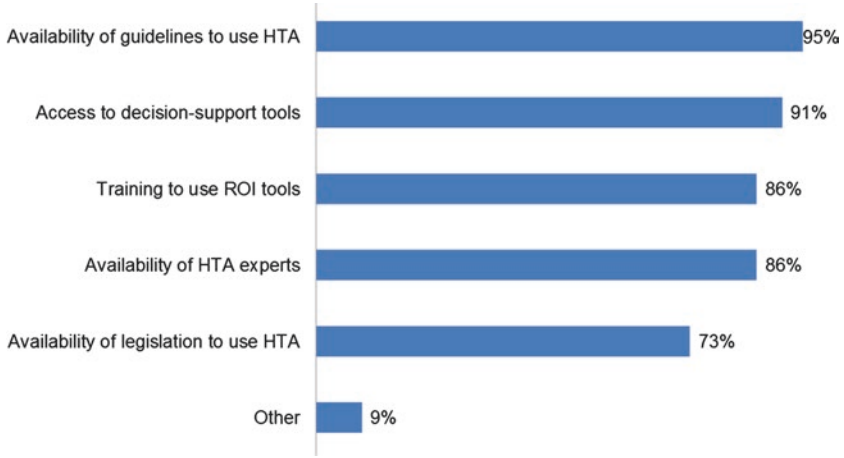

Fig. 8.1 Proportion of respondents agreeing to specific facilitator of evidence uptake in the EQUIPT study [16]

8.2 Understanding Decision Contexts

In exploring further the question—*for whom to produce the ROI tool and evidence*—understanding the attributes of a given decision context to identify what end users (decision makers) actually value is critical. Most often, those in academic ivory towers tend to assume that high-quality evidence is the answer. They are not entirely wrong—high-quality evidence is a necessary condition of any knowledge translation (the pathway from evidence to policy) activities. However, it turns out that it is not sufficient; there may be several other attributes which may be equally important if not more. Had that not been the case, one would have expected a rather uniform implementation of evidence-based services and programmes at least in economically similar countries (Box 8.1). What could those additional attributes be and how do we identify them?

Our work in this area (Box 1.1 in Chap. 1) suggest that the decision complexity that arises from which perspectives one takes has a bearing on what type/form of cost-effectiveness evidence the decision makers would value. Most experts agree that the incremental cost-effectiveness ratio (ICER), commonly known as cost/QALY, is the most appropriate metric that allows one to explicitly consider the decision choices [17]. However, as discussed in Chap. 1, most decision makers at the local levels do not necessarily think it is; rather, they seem to be more interested in other metrics

that would "resonate" more to their current decision contexts. For example, being able to show the reduction in the number of hospital admissions (hence cost savings) in the next budget as well as increased productivity to the local economy as a result of their investment would be preferred to saying that the intervention in question is cost-effective based on its incremental cost/QALY. It's wrong to conclude, however, that decision makers do not value long-term benefits of an intervention (and hence cost/QALY); they still do. The message is that they value a lot of other metrics in addition to cost/QALY [18]. In public health, decision making is often complex due to cross-sectoral inputs and having this granularity in the information would help all stakeholders identify where the costs and benefits would fall if they were to make a decision. For example, the Health and Social Care Act 2012 [19] in England put local authorities, not healthcare services, at the forefront of prevention. It was not surprising to see the growing perception that investment responsibility fell on local authorities but most of the benefits (reduction in healthcare costs) would be reaped by the NHS. In the NICE ROI tools [15], the prominence that productivity gains to the local economy received (in addition to healthcare cost savings) is just one reflection of that. It's important to acknowledge that public health decision making can be highly political [4].

The other useful insight coming out from our work with the stakeholders is the role of time horizons in public health decision making. Whilst it is less desirable to see most stakeholders taking short-term perspectives (precisely, it is a myopia), it is very important to understand the decision context in which those stakeholders operate to fully appreciate why this was so. In the austere funding climate, it is not uncommon for politicians and other decision makers to consider benefits of their investment in the short run. Therefore, ignoring the demand for different forms/types (granularity) of cost-effectiveness evidence is less helpful here. Instead, presenting that evidence from the short-, medium- and long-term perspectives may lead the decision makers to consider the full spectrum of costs and benefits. More importantly, the information that one's investment would generate benefits worth less than the costs in two years but can pay for itself from ten years onwards is much more useful for decision making (hence, more preferable to) than the information that the investment is cost-effective from a lifetime perspective.

Decision makers, in particular the ones responsible for local areas, are rightly concerned about the relevance of evidence presented as population averages in local policymaking. Figure 8.2 illustrates this issue using

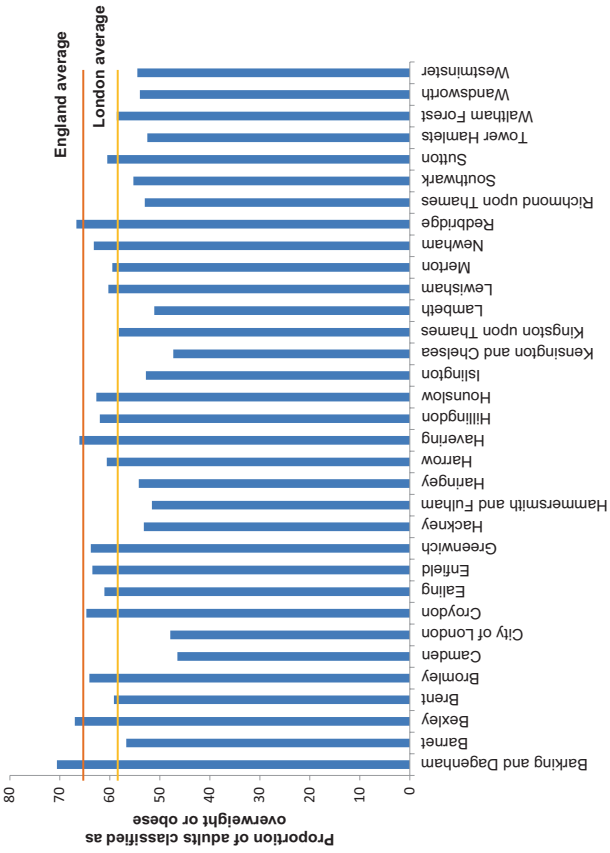

Fig. 8.2 Excess weight in adults (16+ years), London, 2013–2015 [21]

prevalence of overweight as an example. As seen in the figure, the proportion of adults (16+ years) who were classified as overweight or obese between 2013 and 2015 in London varied across the local authorities (LAs)—the highest in Barking and Dagenham (70.6%) and lowest in Camden (46.5). The London average is 58.8% and the national average is 64.8% [20]. In considering what policy response would be more relevant to address the issue of overweight and obesity, it is reasonable to expect local authorities to have different responses as the variation in the prevalence of overweight adults might mean their decision contexts might differ significantly from each other. In Barking and Dagenham, for example, less than half (46%) adults (16+ years) achieve at least 150 minutes of physical activity per week as recommended by the UK Chief Medical Officer (CMO) where in Camden a significant 18% more adults meet the CMOs' recommended guidelines on physical activity (64%) [21]. Likewise, other behaviours that may lead to overweight also vary across the LAs. Therefore, policy responses based on the national level average or even subnational (London) level average may not reflect appropriately local needs. Some LAs may have to provide more (or less) of one intervention compared with the others. What would be the optimal mix of interventions to get a favourable ROI then? More precisely, how would we know the ROI of such a mix if we know one?

When service commissioners or decision makers look into the cost-effectiveness evidence of an intervention as it was evaluated by a RCT or other robust design, they are also interested in understanding the extent to which such evidence is relevant to their own population (decision context). So, if encouraging people to cycle works, how much they should invest in cycling promotion, in building infrastructure, in cycling training, in the provision of cycling loans, and so on? Likewise, the cost-effectiveness evidence on pharmacotherapy, behavioural support, mix of the two and wider tobacco control measures is robust [22]. However, decision makers would like to know the ROI of those interventions offered collectively (e.g. the current mix of those interventions as being delivered in the real-world practice or a potential change in this mix). It is not appropriate to assume that a decision maker would be able to offer the most cost-effective single intervention (e.g. varenicline for smoking cessation) to the entire population in order to maximise the population health benefits given the budget. Service users have different preferences (as measured by different uptake rates of different methods to quit) and this preference needs to be considered in decision making.

Thus, we see that understanding decision context is at the heart of ROI research but the question is how. Is there a realistic but robust way to engage with stakeholders to understand the decision context in which the ROI analysis should evolve? The next section discusses one such method.

8.3 Engaging Wider Stakeholders

A pragmatic approach to stakeholder engagement was used to study the transferability of ROI concepts, tools and evidence from England to other European jurisdictions [13, 23]. As promoters of this international collaboration, we felt the need to formalise many informal ways in which we had been engaging with the stakeholders in the last several years before this study started. From the perspective of our ROI research, we needed to collect robust and systematic "data" that would enable us to understand the decision context better as we were fully convinced by then how important that understanding was, as discussed above. We also appreciated that decision contexts were fluid and this required one to have an open, flexible approach to refine study design as the work advances.

The EQUIPT study defined stakeholders into five categories—policymakers, purchasers of services/pharmacotherapy products including financial authorities, professional service providers including clinicians and those specialising in tobacco control, evidence generators (academic and researchers) and advocates of health promotion [13, 23]. Stakeholders were identified at the beginning of the study and provided key inputs to all stages of the research as it evolved. Specifically, the stages where stakeholders' inputs were sought included the needs identification phase, piloting and testing (of ROI concepts and tools in the local setting) phase and the dissemination phase (drawing policy implications, testing transferability assumptions and creating effective dissemination plan) [23].

The method of stakeholder engagement was driven by pragmatism, rather than any specific existing theory around engagement. Figure 8.3 summarises the three components of this pragmatic approach. Several methods of data collection were employed to elicit stakeholders' needs—interviews (to learn about the local needs and how ROI tools could help address those), consensus workshops (to discuss and agree on findings and devise a set of recommendations), piloting of the ROI tool (to test underlying assumptions of the tool), exploratory workshops (to understand the use of existing similar tools and their transferability to other contexts) and usability assessments and heuristics evaluations (to test the functionality of

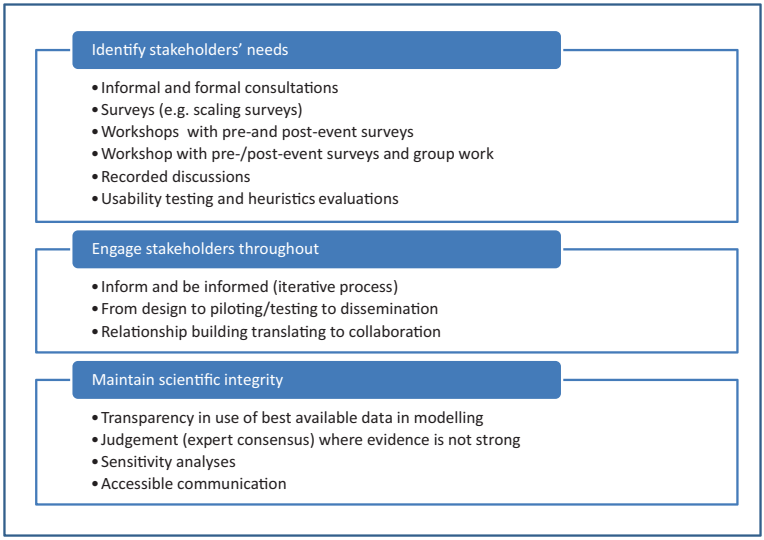

Fig. 8.3 The EQUIPT model of stakeholder engagement [23]

the ROI tool). This was complemented by an up-to-date project website from where stakeholders could download all relevant materials [23].

A major part of this engagement was the surveys (face-to-face and online) in which stakeholders (n = 93) were asked about a number of questions relating to decision contexts—(a) their perceptions around the use of evidence in policymaking; (b) their views on their own local needs; (c) the importance they would give to various evidence-based tobacco control interventions; (d) and their intention to use an ROI tool should it be available. The survey results are published elsewhere [12, 13]. Likewise, substantive work went into understanding how useful the ROI concepts, tools and evidence had been and/or would be to the local stakeholders and how could one ensure the tool's transferability beyond the study countries. These were achieved via a number of workshops with pre- and post-event surveys and group works [16].

The various methods applied to collect data from stakeholders provided extensive insights to the complex world of local decision contexts, feeding into the final deliverables of the study [24]. This turned out to be an iterative process in which the study design informed and was informed by stakeholder inputs, leading to a fully transferable ROI tool. This reinforced the idea that most proponents of stakeholder engagement have put

forward: that "representing their [stakeholders'] needs and interests throughout the process is fundamental to good program evaluation" [25] and "researchers should be encouraged to identify and actively engage relevant users of research and stakeholders … articulate a clear understanding of the context and needs of users and consider ways for the proposed research to meet these needs or impact upon understandings of these needs" [1]. If those recommendations were followed, as observed in the case of the EQUIPT study, this engagement would have the potential to move away from just the relationship building (during research) to strong collaborations beyond the study. The International Panel of EQUIPT Stakeholders (http://equipt.eu/panel) is one such example where further research would be expected to receive continued support and insights from the stakeholders involved in the original study.

A relatively unseen but very important component of the pragmatic engagement model is the importance it had attached to scientific integrity. Criticisms that academics and researchers should not buy into the "wish list" of politicians, professionals and decision makers in not uncommon to hear. Whilst the EQUIPT stakeholder engagement model did incorporate their views, the model integrated the understanding from stakeholder engagement to advance the science of ROI analyses. This was achieved through transparency and detailed reporting of the methods and data underpinning the final ROI tool. Despite systematic reviews of existing evidence and extensive engagement process, gaps in data and methods underpinning several aspects of the ROI tool did exist. Judgement (expert consensus) was therefore inevitable where the evidence was not strong. This was complemented by sensitivity analyses where appropriate. Above all, accessible communication enabled the researchers to maintain the scientific integrity at the highest standard required for such a large international collaboration.

8.4 Communication: Role of Policy Briefs and Infographics

Communicating the results from the ROI analysis in an accessible way is an art. Here, we discuss the role of two potential presentation methods—policy briefs and infographics—based on a case study on smoking cessation in England [16].

Unlike scientific publications (journal papers), policy briefs are a high-level summary of the main analysis: the context identifying underlying

issues, the available policy options, the new evidence and the recommendation for new policies [26]. They are very short but look presentable. Policy briefs are aimed at policymakers, usually the government ministers and other stakeholders that are interested in devising policy. Sometimes they are also aimed at those interested in influencing a policy change, for example, health promotion advocates or service commissioners.

In Chap. 1, we discussed the diary of a policymaker, particularly how busy they can be and the importance of providing policymakers and wider stakeholders with relevant information in the format appropriate enough to support their intended policy/change. To this end, policy briefs can be very helpful. Box 8.3 provides an example to support the continued funding of the Local Stop Smoking Services in England in the context of austerity (potential budget cuts).

Box 8.3 Example Policy Brief: Investing in Stop Smoking Services in England [27]

What are the issues?

In England, 7.3 million adults (18%) currently smoke and 78,000 deaths are attributable to tobacco smoking [28]. This level of prevalence is still high, and the annual costs of tobacco use £4.43 billion [29]. Offering current smokers enough support to quit has been a key policy strand advocated by the World Health Organisation's MPOWER model [30]. In England, Local Stop Smoking Services (LSSS) have played an important role in reducing smoking prevalence. However, as local authorities are under pressure to find savings, it is important to know what implications disinvesting from the services would have for the country's health and economy.

What options are available?

Top-level interventions and policies (e.g. GP brief advice, smoke-free legislation and mass media campaigns) encourage current smokers to make quit attempts. Cessation services (e.g. pharmacotherapy and behavioural support) assist quitting in those smokers who are motivated to make a quit attempt in the next 12 months. LSSS offer evidence-based treatments to those motivated to quit [31]. Behavioural support and pharmacotherapies have been found to be key cost-effective life-saving interventions [32].

What does the evidence say?	*What recommendations are made?*
If behavioural support and prescription pharmacotherapies were entirely abolished from the current provision of tobacco control programmes in England [29], • There would be 39,000 fewer quitters each year. The NHS and local economy would lose £73 million annually. • Society would lose 42,629 quality adjusted life years (lifetime). • In the long run, the net impact of disinvestment would be a loss of £104 per smoker. • The benefit–cost ratio of LSSS compared with no-LSSS is 2.80.	• Investing in behavioural support and pharmacotherapies provide positive return on investment to local authorities. • If disinvestment in LSSS prevails, the EQUIPT ROI Tool could be used to explore the value for money of alternative policy approaches (e.g. spending the money available for LSSS more efficiently).

Source: The EQUIPT Study Group (2016) [27].

The use of infographics in delivering key messages to policymakers and wider stakeholders (including academics and researchers) has grown significantly for the last few years. The word "infographics" combines two words—"information" and "graphics"—to mean visual representations of data that could be research findings or any other new knowledge or information that one is interested in communicating to stakeholders. Infographics usually present the information utilising some kind of visual pattern—this enhances the process of acquiring knowledge (cognition) so that the key messages get across clearly and very quickly.

Two infographics are presented here as exemplars of how one could present the key messages coming out of the ROI analyses. The first infographic makes the economic case for continued investment in the English Local Stop Smoking Services (Fig. 8.4) and the second infographic (Fig. 8.5) shows how the ROI increases over time if GP brief advice is scaled up at realistic targets. In this example, the target was a 4 percentage point increase (from the current levels) in the uptake of GP brief advice in England, Spain and the Netherlands; a 3 percentage point increase in Hungary and a 3.42 percentage point increase in Germany [27, 33].

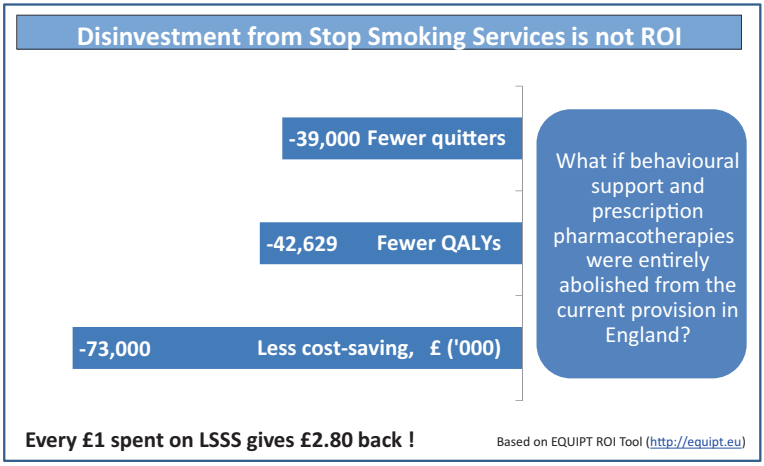

Fig. 8.4 An infographic showing the economic case for investing in smoking cessation, based on EQUIPT study [27]

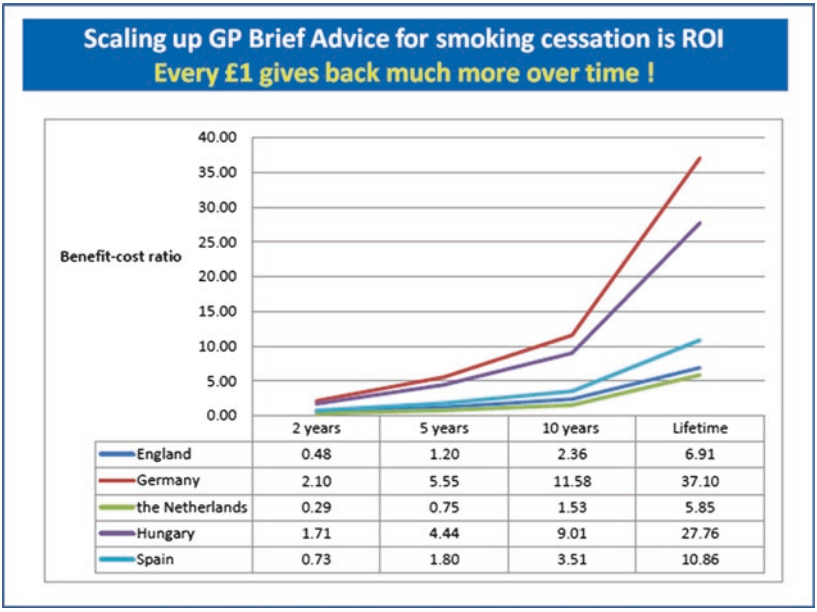

Fig. 8.5 An infographic showing the ROI of increased rates of GP brief advice uptake, based on the EQUIPT study [27]

Key Points

- In order for the ROI analysis to make an impact on health outcomes and the wider economy, the findings must be used in policymaking.
- Uptake of ROI concepts, tools and evidence are determined by several factors, such as the end users' attitude, their expectation on social support and training needs.
- Stakeholder engagement in ROI research is essential to make policy impact—this engagement should be throughout, from the design of the study to dissemination and beyond.
- Stakeholder engagement helps one to understand the decision context so that the ROI analysis can be meaningful to decision makers.
- Policy briefs and infographics are effective means to communicating ROI findings to government policymakers and wider stakeholders.

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CHAPTER 9

Where's Next for Public Health ROI Research?

Abstract The return on investment (ROI) research in public health is evolving as a useful ingredient to the decision-making process, but a number of challenges exist currently. This chapter surveys these challenges. The barriers to use ROI tools are around commissioning contexts, local needs, target population and types of users. Like any other model, ROI models are not free from limitations. Methodological research for the future could look at the ways in which more accurate data around effects (health, quality of life and wider) of behaviour change could be collected. Also, more accurate modelling techniques such as the one allowing individual user-level variation may be required. Transferring a well-established ROI model to other jurisdictions or other areas of public health may save research resources.

Keywords Decision making • Return on investment • ROI • Impact • Stakeholder

As seen in the previous chapters, the public health ROI concepts, tools and evidence can be helpful for policymakers and wider stakeholders in supporting their investment decisions. In particular, ROI analyses seem to have a clear advantage when an investment portfolio (i.e. package of interventions) is being evaluated. However, the field itself is relatively new in the context that most cost-effectiveness evidence is still presented in the traditional cost/QALY metrics. Recent efforts to synthesise evidence in

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this area is commendable [1] but what's next for ROI analyses relevant to public health practice? In this chapter, we discuss four potential areas where future research could improve our current understanding: (a) implementation of the ROI concepts, tools and evidence in the real-world practice, (b) advancing the ROI methodology, (c) transferability of such endeavours, and (d) measuring the actual use of ROI tools in decision making for wider policy impacts.

9.1 Implementation Issues

Policy impacts can be achieved once the ROI concepts, tools and evidence get implemented. The NICE ROI tools have been around since 2012. Some qualitative evidence [2], coupled with a few published policy/review documents [3, 4], suggest that these tools are being implemented to inform real-world practice to some extent. However, the users have expressed concern that the NICE tools (particularly Tobacco ROI tool) are hugely sophisticated despite being robust in both methodology and use of the best available evidence in populating the model [2]. Clearly, one has to strike a balance between scientific complexity and ease of use in developing such tools. As more and more stakeholders start using the tools, clarity about this balance will emerge. In addition, social support and training needs have been highlighted by stakeholders as an important determinant of their intention to use such tools [5]. Understanding the important barriers to and facilitators of using such evidence and tools in policymaking may facilitate the implementation process [6, 7]. More research is needed in this area, particularly when the use of ROI tools appears to affect a number of aspects in decision-making process as seen in Box 9.1.

Box 9.1 Bite-Size Information on the Aspects of Implementation (of the ROI Tools) [2]

A group of UK researchers asked a cross section of a wide range of professionals (one policy professional, two service providers, two healthcare professionals, one academic/researcher, three advocates of health promotion and one policy development specialist) to state their experience of using the NICE Tobacco ROI Tool since its inception in a workshop environment. The idea was to "understand

what people had used the ROI Tool for, what they had liked and disliked about it and the facilitators and barriers to usage" [2]. Themes emerging from the workshop deliberations were put together as bite-size information to characterise the implementation issues (examples below):

Target populations	• Subpopulations can be included in the tool • It has been used in subpopulations such as local pregnancy services • Define the population, their needs, current practice and habits
Commissioning contexts	• It [the tool] needs to be available at the commissioning level • Not clear that everyone knows such tools can inform decisions • It [the tool] could provide a rationale for a change in practice • The outcomes need to be presented in a simple format • It [the tool] needs more use in generalised commissioning • Also consider it [the tool] as a disinvestment tool
Outcomes of interest	• Consider the differences between practice and policy • Outcomes looked for depend on individuals/local councillor's interests • We need to consider the finance of the outcomes • Will it reduce the deficit • Outcome—linking to process measures such as bed days and resource use in the wider sense
Variation in users of ROI tools	• Tools are useful where funders are already positive • Not clear that everyone knows such tools exist • Lots of demand at the local authority level for ways to assess the costs of smoking • The NICE ROI tool could be used at the local level • Local government would want to know the benefits within five years

Use of ROI tools in real-world practice	• It [the tool] has been used successfully at the commissioning level • It needs more promotion and use at higher levels • A QALY is an abstract term • It [the tool] becomes a "performance management" tool • People are using it [the tool] to justify decisions • People are using the tool to prove the value of the remaining services • People are using it [the tool] to support service specification

Source: EQUIPT (2016) Tobacco Control Policy Proposals [2]

9.2 Advancement of ROI Methods

The methods underpinning the development of NICE ROI tools have evolved over time. The initial modelling was guided by the methods used by previous economic evaluation studies [8]. A recent development in this area has also extended these methods [9]. A number of other tools exist and they vary in their aims and underlying methods [3]. This also applies to a number of global tools such as the WHO OneHealth Tool developed to "link strategic objectives and targets of disease control and prevention programmes to the required investments in health systems" [10].

The methods underpinning economic evaluations in the context of public health are evolving, as there are several challenges in applying economic evaluation techniques to public health interventions at theoretical, methodological and practice levels [11]. The outcome (the ROI of the intervention being evaluated) will therefore depend on what theoretical perspective one takes, how that translates to a particular method and how that is implemented and reported. As is the case with all models, a number of assumptions are inevitable in developing ROI analyses and tools. These assumptions must be transparent to the end users of the ROI tools as it is important to ensure that the output of the tool is interpreted correctly.

From our own experience in developing ROI analyses and tools in this area, we have identified a number of limitations that may serve as methodological research questions for future research in this area. For example, in the case of Tobacco ROI tool, the underlying methods are limited mostly due to what input data is available. Cigarette smoking is one of the public

Table 9.1 Current limitations and agenda for research—NICE Tobacco Control ROI tool

Current limitations	*Agenda for research*
Mortality effects are from 1994, leading to the assumption that these rates have not changed substantially in the intervening period	Assessment of whether the magnitude of mortality effects of smoking has changed since 1994
Morbidity data (e.g. incidence of smoking-attributable lung cancer) is not adjusted for time since quitting	Assessment of how time since quitting may have different effects on disease incidence
"Disutility" (a measure of decline in quality of life) associated with being a former smoker is assumed to last for the lifetime of the person	Assessment of temporal effects on quality of life of former smokers
Disease-specific average costs are applied	Assessment of costs to reflect distribution of disease severity
Interventional impact is assumed to be only one year in duration—the cohort within the model experiences an average background quit rate after one year	Assessment of long-term effects of interventions in trials
Excess number of annual absentee days is used to model productivity effects, assuming absentee days truly are days of lost work	Assessment of accurate productivity effects of smoking

health areas with a much longer history of research compared to other areas such as physical activity. Thus, one would tend to think availability of data (e.g. on mortality and morbidity effects, intervention effect size, costs, quality of life) is of less issue. This is not the case so far as the ROI analyses are concerned (Table 9.1).

In addition to limitations on data, future ROI models will largely be informed by advancements in modelling techniques. The current NICE tools are based on cohort modelling in which a cohort of the target population (e.g. smokers in the Tobacco ROI tool) is followed for their quitting behaviours, health resource use, mortality, morbidity and quality of life. Health behaviours (and their effects) are complex to understand and they may vary significantly between individuals, making the use of group-level averages in modelling less attractive. Therefore, future ROI tools may benefit from other types of modelling such as individual-level simulations. Equally, care pathway modelling in which multiple health behaviours are modelled simultaneously may be more relevant. However, ROI tools are primarily developed to aid decision making, and the necessary condition for its wider use is the extent to which it is simplified and easy to use [5]. An optimal balance between modelling complexities and the tool's chances for real-world usage must therefore be sought.

9.3 Transferability of ROI Tools

ROI tools have evolved as a response to the lack of data and financial justification, relevant to local policymakers and public health procurers, to make the economic case for investments. Despite availability of cost/QALY information in many areas of public health (e.g. smoking), local decision makers need ROI analyses that resonate with the local needs, as we saw in Chap. 1. The development of NICE ROI tools [8] is a response to that. However, the extent to which these ROI tools are transferable to other jurisdictions as well as to other areas of public health is yet to be understood fully. One recent example to this end is the European-study on Quantifying Utility of Investment in Protection from Tobacco (EQUIPT). [12, 13]. If a well-established ROI model is transferred to other contexts, it has the potential to save enormous research resources.

"Transferability" here means moving the evidence from one context to the other and may refer to generalisability, a condition when a study becomes relevant to the decision maker's context. However, two attributes—the extent to which the intervention included in the ROI tool could be replicated in the new decision context and the extent to which the intervention would achieve similar effect to that included in the ROI model—define transferability [13]. The EQUIPT study was a rare opportunity that addressed some of the methodological challenges in cross-country modelling.

Models are theoretical constructs simplifying reality and ROI models are no different [14]. The fact that a model works in one context does not necessarily mean that it would work in another, as the underlying assumptions about what constitutes the reality might differ from one context to the other. Understanding what constitutes a model is therefore the first and the foremost step in any attempt to transfer an economic model from one context to the other. Unfortunately, this task is not as straightforward as it looks at first sight and may have implications for the end results. A logical, stepwise approach to cross-country modelling, such as the one adopted by the EQUIPT study, is therefore necessary [9].

In EQUIPT, methodological challenges in cross-country modelling were handled carefully by providing a transferability framework [12]. "Buying into" the model (i.e. relevance of included interventions and outputs) was deemed critical, and this was addressed via a validity assessment of the existing model by each new jurisdiction of interest. This exercise provided country modellers with sufficient understanding of what the model was made up of and to what extent the model depicted the ground realities of their own countries. This task was standardised across countries through the use of an

adapted version of the Philips checklist [15] for assessment of model validity and the The International Society for Pharmacoeconomics and Outcomes Research (ISPOR) algorithm [16] for assessment of appropriateness of a simple adaptation of the existing model to their local context. Next steps involved additional analyses to assess parameter importance to identify those areas that required the greatest input in model adaptation process and further validations and piloting the tools with stakeholders were carried out [9]. Despite such a rigorous framework, the EQUIPT study was not free from important limitations so far as cross-country modelling is concerned. Some questions for the future research on transferability are identified in Table 9.2.

Table 9.2 Some unanswered questions from the EQUIPT study: setting future research agenda on transferability of evidence

Theme	*Questions*
Whose views are important in determining what interventions are important to transfer	• Views of professionals—to reflect decision-making context? • Views of lay members of the public—to reflect societal context? • Views of the subjects (e.g. patients, or a certain group such as smokers)—to reflect the needs of the affected population?
Relative importance of views	• Should researchers regard professionals' views more or less important than those of the subjects?
Temporal effects of ROI research	• What benefit would ROI research provide in short, medium and long terms? • What are the pathways to such impacts?
Standardisation of data collection methods	• How do we standardise primary data collection (or, synthetic estimates from a range of data sets) across countries to minimise the extent of variability in evidence transfer from one country to the other?
Optimal sample size	• How many jurisdictions would be required for an evidence/model transfer study? • How can this sample size be calculated?
Model validation process	• How do we improve internal consistency and external validation of the model being transferred? • How do we build up empirical evidence to this end?
Reflective practice	• What would be the role of "lessons learnt" from contemporary projects on the future transferability research? • How do we document such experience in accessible ways?

9.4 Impact Evaluation

Robust and transferable evidence if implemented to devise policies around healthcare delivery can lead the health systems to being more responsive, patient-centred, safe, efficient, equitable and affordable. Use of research evidence in policymaking therefore has been advocated for a long time. However, the presence of barriers to use such evidence in policymaking [6, 7] has led researchers like us to seek answers as to how to best mitigate these barriers to exploit the huge societal benefits that investing in evidence-based interventions could generate [9]. In the previous chapters, we explored the demand and supply side barriers that stand "in the way of more systematic use of evidence and evaluation" [17]. Missing policy windows in dissemination, no or limited engagement with policymakers during evidence generation process and a lack of good usable (local) data remain supply side barriers. However, more significant barriers identified are the demand side ones—mismatch between research output and policymakers' needs, no or limited understanding as to how to mitigate the significant political risk posed by evidence-driven answers and the general lack of self-efficacy (driven by culture and/or skills) in the policymaking body [17].

Whilst addressing each barrier may require unique solutions, we took the view that in wider public health areas like tobacco control that has multifaceted effects (health and non-health), most of the above barriers could be addressed by equipping decision makers and wider stakeholders with decision support tools. Our work in the UK [8] but more recently in Europe [9] showed that co-creation of practical, user-friendly, customisable ROI tools and making them available to local stakeholders might facilitate their real-world applications [2, 5, 18]. By allowing comparative, bespoke assessment of various investment portfolios reflecting real-world practice, such tools have a potential to resonate with local decision-making needs. This characteristic alone may therefore improve the chances of the tool being used to make optimised investment decisions, thereby ensuring that implementation or scaling up of evidence-based innovations and good practice do happen.

It is not known fully, however, as to what extent decision support tools, like the ROI tools, can help transfer (research) *knowledge to* (policy) *actions*

(KTA). The KTA is essentially an implementation problem and a systems approach might be needed to translate evidence to action (real-world practice) via leadership, networks and communications [19]. Other commentators also suggest that decision support tools from a systems perspective can "offer a foundation for strengthening relationships between policy makers, stakeholders, and researchers" [20]. Therefore, future empirical research could improve our understanding of the real-world impact (health, economic and wider) that ROI tools and evidence would make. How we would measure those impacts empirically is less clear though and itself is a subject of the future research.

Key Points

- The ROI research in public health is evolving as a useful ingredient to decision-making process, but a number of challenges exist currently.
- The use of ROI concepts, tools and evidence in decision making is not optimal currently. The barriers are around commissioning contexts, local needs, target population and types of users. More empirical evidence is needed to understand those barriers.
- Like any other model, ROI models are not free from limitations. Methodological research for the future could look at the ways in which more accurate data around effects (health, quality of life and wider) of behaviour change could be collected. Also, more accurate modelling techniques such as the one allowing individual user-level variation may be required.
- Transferring a well-established ROI model to other jurisdictions or other areas of public health may save research resources.
- How one could transfer such tools is not fully understood, however. Particular areas where empirical research is needed include whose (decision makers, service providers or service users) views are important in the transfer process, how many case studies are needed to study this and how one would develop a standardised procedure to do the transfer.

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CHAPTER 10

The Last Word

Abstract ROI tools provide policy makers and wider stakeholders with bespoke information about the economic and wider returns that investing in evidence-based public health can generate. The various case studies presented in this book using the NICE ROI tools showed that public health interventions are good investments. They also show how the ROI tools can be used to identify which combinations of interventions are likely to offer the best value for money and help make the disinvestment case explicit too.

Keywords Decision making • Public health • Return on investment • ROI

"New Maryland has one of the lowest breastfeeding rates," declared George as soon as he was given time to pitch his economic case.

He was at the DH funding meeting organised to discuss potential allocation of the public health budget. He seemed confident in his presentation and had prepared a deck of PowerPoint slides with beautiful infographics helping him to present his case more clearly than the others.

"The most recent survey we conducted shows that less than 0.1% new mothers were breastfeeding exclusively at four months," he raised his voice slightly, "but interestingly enough, 60% of all postpartum women in New Maryland reported to have initiated breastfeeding at birth. By the 6th week, most women stop breastfeeding and switch to breast-milk substitutes. The

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women also said that they would have liked to continue breastfeeding had they received enough support," he paused for a second.

He looked around to find spellbound colleagues whose eyes were fixed on the displayed infographic that contained a downward sloping breastfeeding cessation curve. No doubt, it was very convincing evidence and was beautifully laid out too!

"On looking at the evidence and consulting women," he announced as he moved on to the next slide "we would like to offer the women a support service called 'Bio', i.e. 'Breastfeeding in Offices'. It is a plausible and *potentially* cost-effective intervention to improve breastfeeding rates in New Maryland." He had intonated—rather unconsciously—on the word "potentially".

A hand in the audience went up. "When you say, *potentially cost-effective*, what do you mean? Do you mean it may be cost-effective but you don't know yet?" George could hear some giggles in the audience. In contrast, he enjoyed this moment as he thought it was time he presented the ROI data he had collected yesterday. He couldn't help himself from visualising the reaction that the audience would have when he presented that data.

"The evidence on the health benefits of exclusive breastfeeding for four months or longer is pretty strong." He could not recollect how many times he had repeated this information in similar meetings … but this time it was different. It didn't feel at all like a well-rehearsed, robotic expression that he had felt several times before.

Colleagues who regularly attended the DH meeting were used to hearing some facts over and over again. Clearly, this statement was not new but nobody noticed it wasn't new. Perhaps, the context in which it was being presented differed this time or it was just George's newfound confidence.

"We have modelled the health and economic effects with different assumptions around how much improvement in breastfeeding 'Bio' would generate," a sense of real achievement reflected on his face as he spoke. "On a mid-level scenario, which I think is realistic, 'Bio' will generate 300 fewer hospital admissions, 25 less neonatal admissions and 1500 less GP visits among infants in the first year," he paused for a second to move on to another infographic. "This would translate to a saving of £413,650. It would cost £369,125 to implement 'Bio', giving us a return of 12% plus the original investment back by the end of the year. This return is going to be much higher from the second year onwards as we wouldn't have to pay some of the start-up costs," he concluded.

Such was the convincing nature of this presentation that no one was willing to contest the evidence. However, everyone was curious to know where George got those figures from, particularly the way he presented them. Clearly, the format of the evidence stole the show.

The next ten minutes witnessed the most interesting deliberation of the day. George was as confident answering queries from colleagues as he was in his presentation. One thing he did more during this time though was to refer to the report that Paul, his public health analyst, had handed him the day before.

The meeting finished. George couldn't have been happier! He had just been assured that "Bio" would be funded.

Soon his fingers were searching his secretary Elaine's number on his mobile.

Before Elaine answered the phone, she knew her boss had secured funding for "Bio".

* * *

Cost-effectiveness evidence is increasingly playing a greater role in decision making. National guideline bodies such as NICE require cost/QALY information as one of the ingredients guiding its decision-making process. Cost-effectiveness is not the only information that underpins healthcare decision making but it is seen as a very important one. Public health interventions, by nature, generate benefits in the distant future, but in order to generate those benefits, one has to invest in interventions now. Public health is also characterised by many attributes of "market failure". Therefore, it is legitimate that public finance is used to provide some of those interventions (e.g. vaccination, Stop Smoking Services, breastfeeding support, to name but a few).

Local decision makers often do not find the published evidence resonating well to local needs. They often find the cost/QALY metric abstract in the context of local commissioning decisions. Likewise, they want to see shorter-term costs and benefits (e.g. how many fewer hospitalisations as the result of the intervention) to align their decisions with the way public finance operates, acknowledging that long-term gains (such as QALYs) are still important health systems goals. Therefore, return on investment (ROI)-type information and tools have been in demand, as they provide policymakers and wider stakeholders with bespoke information about the

economic and wider returns that investing in evidence-based public health can generate. The various case studies presented in this book using the NICE ROI tools show that public health interventions are good investments. Where they are not, ROI tools help make the disinvestment case explicit too.

ROI analysis as applied in public health is evolving and no ROI tool to date is perfect. This is a growing area of research. A number of methodological and empirical questions will need to be explored in the future. For example:

- What are different ways in which the use of ROI tools in decision making can be encouraged?
- How can relevant data be collected to accurately capture real-world modelling complexities?
- Whose views are important in transferring such tools to different contexts (jurisdictions or different areas of public health)?
- What real-world impact (health, economic and wider) would the increased use of ROI tools make and how do we measure that?

Key Points

- Funding pressures on public services continue to increase.
- Cost-effectiveness evidence is increasingly playing a greater role in decision making.
- Local decision makers often do not find the published evidence resonating well to the local needs.
- ROI tools therefore have been in demand. This book provides a few case studies based on the NICE ROI tools.
- The method of ROI analyses and tools is evolving. This is a growing area of research.

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