

Gardens and health

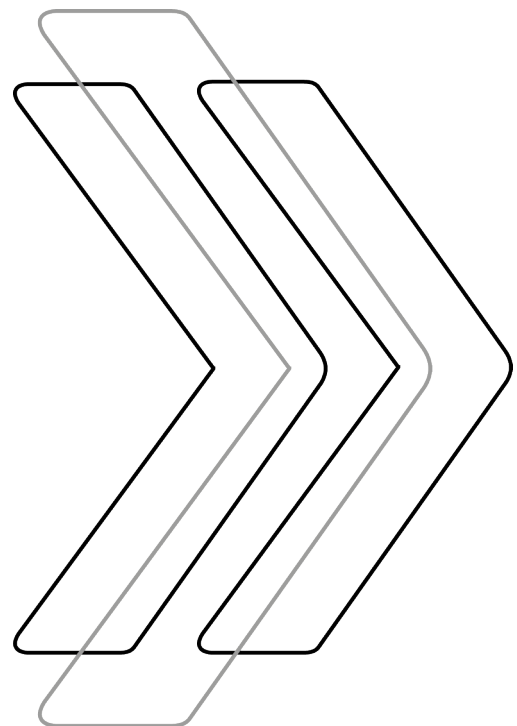
Implications for policy and practice

Author

David Buck

May 2016

This report was commissioned by the National Gardens Scheme



This report was commissioned by the National Gardens Scheme in 2015. Its intention is to contribute to the understanding, assessment and development of the links between gardens, gardening and health. It sets out the evidence base on how gardens and gardening relate to health across the life-course. It highlights how, at different points in the health and social care system, gardens and gardening can make a strong contribution to keeping us well and independent.

This report is entirely editorially independent and all views are those of the author. However, it has benefited from advice, conversations and the research and work of many people, including: Sarah Waller, Carl Petrokovsky, Dominic Harrison, Ed Rosen, Greg Fell, Alistair Griffiths, Charlotte Clarke, Chris Neild, Paul Ogden, Ruth Garside, Simon Maxwell, Sam Everington and Richard Murray. Special thanks to George Plumtre for his vision and forbearance and to Rebecca Lovell for sharing insights and evidence, including on the cultural history of gardens.

The King's Fund is an independent charity working to improve health and care in England. We help to shape policy and practice through research and analysis; develop individuals, teams and organisations; promote understanding of the health and social care system; and bring people together to learn, share knowledge and debate. Our vision is that the best possible care is available to all.

www.kingsfund.org.uk  **@TheKingsFund**

©The King's Fund

Contents

Executive summary	5
What this report is about	5
The evidence on the impact of gardens and gardening on health across our lives	6
Gardening and its place within the health and care system	7
A menu of recommendations	8
1 Gardens and gardening: some key statistics	10
Introduction	10
Some key statistics	10
2 Defining our terms: the scope of gardening, its mechanisms and effects	13
3 The evidence on the benefits of gardens and gardening for health and wellbeing	15
Green space and health	16
What counts as evidence in gardens, gardening and health?	19
4 Interventions in gardening and health: evidence and potential across the life-course	21
Gardening in early life	21
Gardening as families and adults	24
Gardening and mental health	26
Gardening as we get older: a changing relationship and a role in prevention	27
5 Gardening and its place within the health and care system	30
Gardening and social prescribing	30
Community gardens, volunteering and recovery from illness	32
Gardening and dementia care	35
Gardening and end-of-life care in the NHS	37

6	The business case for gardens, gardening and health	40
7	Implications for policy and recommendations	42
	Influencing policy at the strategic level	43
	Influencing policy at the local level	46
	Implementing and developing the evidence base	49
	References	50
	Appendix: Research strategy	63
	Search strategy	63
	About the author	65

Executive summary

What this report is about

This report looks at the impact of gardens and gardening on health and wellbeing, and explores what the NHS and the wider health and social care system can do to maximise this impact.

Gardens are often thought of as intimate private spaces attached to private households but they can also be large private or formal gardens open to the public, or part of hospitals, care homes or hospices. Gardens serve many purposes: they can be cultivated for flowers or growing food; used as spaces for exercise, relaxation, solace and recovery; used as places to play, meet and volunteer; and can be part of wider environmental, planning or sustainability policies.

Half of the adult population in England report being involved in gardening, and it is an important activity throughout our lives, reaching a peak just after retirement and declining as we age further. However, as we age it becomes relatively more important as other pastimes and activities reduce more quickly.

Gardens are therefore important to our health due to the numbers of people who engage with them in many different ways and for different reasons.

This report has three aims:

- to bring together in one place and make sense of the wide range of literature on gardens and wellbeing, demonstrating how gardens and gardening are related to health across the life-course, from schools to family life and into older age
- to demonstrate how gardening interventions have an important place in the NHS and wider health and care system, particularly given the focus on greater integration of health services, social care and prevention, and on working with people as citizens within communities rather than just as patients
- to place ‘gardens and health’ within the current strategic health policy context, proposing recommendations on how gardening – if brought into the mainstream – can be an important mechanism for reaching health policy goals, nationally and locally.

The evidence on the impact of gardens and gardening on health across our lives

Evidence on the impact of gardens and gardening on health is closely related to the wide array of evidence on ‘green spaces and health’ more generally. Much of this, although not specific to gardens and gardening, will apply to some degree. Increasing people’s exposure to, and use of, green spaces has been linked to long-term reductions in overall reported health problems (including heart disease, cancer and musculoskeletal conditions); it has also been linked to reduced levels of obesity and high physical activity, and higher self-rated mental health. Living in areas with green spaces also seems to weaken the effect of income inequalities on health. Gardens can provide other important environmental functions, such as reducing flood risk and moderating climate and pollution, which have knock-on benefits for health.

The more specific evidence on gardens and gardening and their impact on health is diverse and complex. There have been relatively few randomised controlled trials (RCTs) that could prove cause and effect, but many observational and qualitative studies are consistent with a wide range of health impacts across mental and physical health and health behaviours across the life-course.

Well-designed studies of school gardening suggest that children’s fruit and vegetable intake can be significantly increased combined with efforts to improve parental support; a further range of studies points to increased knowledge, and preferences for fruit and vegetables. Teachers report positive wellbeing effects, personal achievement and pride in ‘growing’ and, where volunteers are involved, gardening can be a way to break down social boundaries inherent in academic settings. For children with learning difficulties or behavioural problems, gardening as a non-academic task and the garden as a place of peace and meditation are particularly valuable.

Parents value gardens as play and discovery spaces for their children, with just 2 per cent in a survey saying they would ‘swap a bigger house for no garden’, but increasing numbers of younger adults also want to grow food. This is one reason for excess demand for allotments. In well-designed studies, allotment gardening has been found to improve mood, self-esteem and physiological measures such as cortisol (associated with acute stress) compared with matched controls.

The mental health benefits of gardening are broad and diverse. Studies have shown significant reductions in depression and anxiety, improved social functioning and wider effects, including opportunities for vocational development. Nonetheless, there remains a need for better-designed studies that would allow a deeper understanding of the mechanisms through which health and wellbeing benefits accrue.

As we get older, our relationship with gardens and gardening changes. Surveys suggest they become much more important to us as a source of physical activity, but also in terms of our identity and independence, and in ameliorating loneliness. There is emerging evidence that gardening may also be important in falls prevention (helping to maintain good gait and balance) and also in dementia prevention and cognitive decline. Not all is ‘rosy in the garden’ as we age, though; for example, lower back pain among gardeners is common, and gardens can become a psychological burden.

Gardening and its place within the health and care system

Gardens are intimately connected to our health and wellbeing across the life-course. There is much more that the health and social care system can do to take advantage of our love affair with gardening, but there are four specific areas of good practice: in social prescribing; community gardens, volunteering and recovery from illness; dementia care; and end-of-life care.

The NHS is increasingly using social prescribing and community referral schemes to refer patients to a range of local non-clinical services and support in local communities, in the knowledge that much of what determines and supports our health is rooted in social and economic factors. There are an increasing number of community garden schemes – for example, the Lambeth GP Food Co-op covers 11 practices in south London, where patients with long-term conditions work together to grow food, which is sold to King’s College Hospital, enabling one set of patients to provide food for others. Other examples include ‘reciprocal’ gardening schemes, which connect isolated older people with untended gardens with those who have no garden but want to garden and grow things. These have been shown to lead to improvements in self-rated health, mobility and independence, with indications of savings to the NHS. Other well-designed studies have shown physical benefits among those taking part, including reductions in body mass index (BMI).

Gardens are also important to support recovery from illness. There are some well-known examples, such as Horatio’s Garden, which provides beautiful gardens as part of therapy for patients with spinal injuries. The effects of gardens in care homes and hospices have been particularly well studied, particularly in dementia care. Most dementia studies report that exposure to gardens reduces agitation, aggression and other symptoms. Qualitative studies point to improvements in concentration, connection with past memories, and access to natural light. The King’s Fund programme, Enhancing the Healing Environment, worked with almost 30 hospitals and 35 hospices to support the design of healing environments, many with a strong focus on gardens.

The case for gardens should not be reduced solely to ‘the business case’. However, there are many examples – from increasing access to parks and the impact on obesity, to reducing mental health admissions, the impact of ‘green gyms’ and community referral schemes – where gardening is seen to reduce demand on services and improve outcomes.

A menu of recommendations

In this section we set out a wide range of recommendations that we believe will help to integrate the benefits of gardens into the mainstream of health policy. This is a menu, since they need to be prioritised over time. The recommendations fall into three groups: those at the strategic level; those at the local level; and those concerned with implementing and developing the evidence base.

At the strategic level:

- The Department of Health, the Department for Environment, Food and Rural Affairs (Defra) and the Department for Communities and Local Government should align their policies that impact on gardening and gardens. They should identify gaps in evidence and make it easier for their delivery chains to support gardening and its positive health impacts.
- The *NHS five year forward view* (NHS England *et al* 2014) is the future plan for the NHS. The role of gardening in supporting health should be considered as part of three of its key programmes: New Models of Care; Healthy New Towns; and Social Movements for Health.
- Other strategic enablers – including the planning system, the Public Services (Social Value) Act 2012 and Public Health England’s role in evidence collation and dissemination – can and should be used to support the role of gardening in improving and maintaining health.
- Key influencers in the health, environment and gardening and horticulture sectors need to develop a joint strategy to better influence policy on gardens and health and help ensure their sustainability.

At the local level:

- Directors of public health, health and wellbeing boards and local government should use the evidence in this report to support and develop their public health plans and actions.
- Clinical commissioning groups (CCGs) should include gardening as one of many opportunities for patients in social prescribing projects, and together with other stakeholders (including the third sector and local councils) explore the case for reciprocal gardening schemes in their localities.

- The role of gardens and gardening in supporting health should be considered as part of place-based population health systems, particularly as local approaches to public services devolution and NHS sustainability and transformation plans mature over time.
- The Local Government Association should work with partners to ensure the sustainability and therefore continued health benefits of high-quality public gardens through, for example:
 - innovative funding models
 - helping to create access to private gardens with others
 - developing access to allotments
 - supporting reciprocal gardening schemes.
- Consideration should be given to developing excess unused and unloved public sector land for community gardening schemes where appropriate and where there is demand.

Implementing and developing the evidence base:

- The existing evidence base should be assembled, maintained and disseminated in ways that decision-makers can act on. This should include evidence from the full range of methodologies and not solely from RCTs, with a focus on what works, in what circumstances and for whom. Public Health England and the National Institute for Health and Care Excellence (NICE) will have an important role to play in this, alongside the Local Government Association and NHS England.
- Further research on RCTs, complex public health evaluations and economic evaluations is needed to better establish the mechanism through which gardens and gardening impact on health for different populations across the life-course. There should be a focus on equity, which is rarely considered in existing research despite the evidence that some groups have less access to gardens, gardening and green space than others.

1 Gardens and gardening: some key statistics

Introduction

The Oxford English Dictionary defines a garden as ‘a piece of ground adjoining a house, used for growing flowers, fruits, or vegetables’, or as a term that can represent ‘ornamental grounds laid out for public enjoyment and recreation’. It is also an activity; one can become an active participant by working in a garden as a ‘gardener’ or by having ‘gardened’ (Oxford University Press 2016).

But beyond this, gardening is a broad and complex activity. The definition of gardens and gardening differs widely in terms of scale, function and activity. Gardens are often thought of as intimate private spaces attached to private households but they can also be large private or formal gardens open to the public, or part of hospitals, care homes or hospices. Gardens can be cultivated for flowers or growing food, used as spaces for exercise, relaxation, solace and recovery, as places to play, meet and volunteer, and as one part of wider environmental, planning or sustainability policies. In short, gardens have many and varied functions – some individual, some community, some directed and some indirect or incidental.

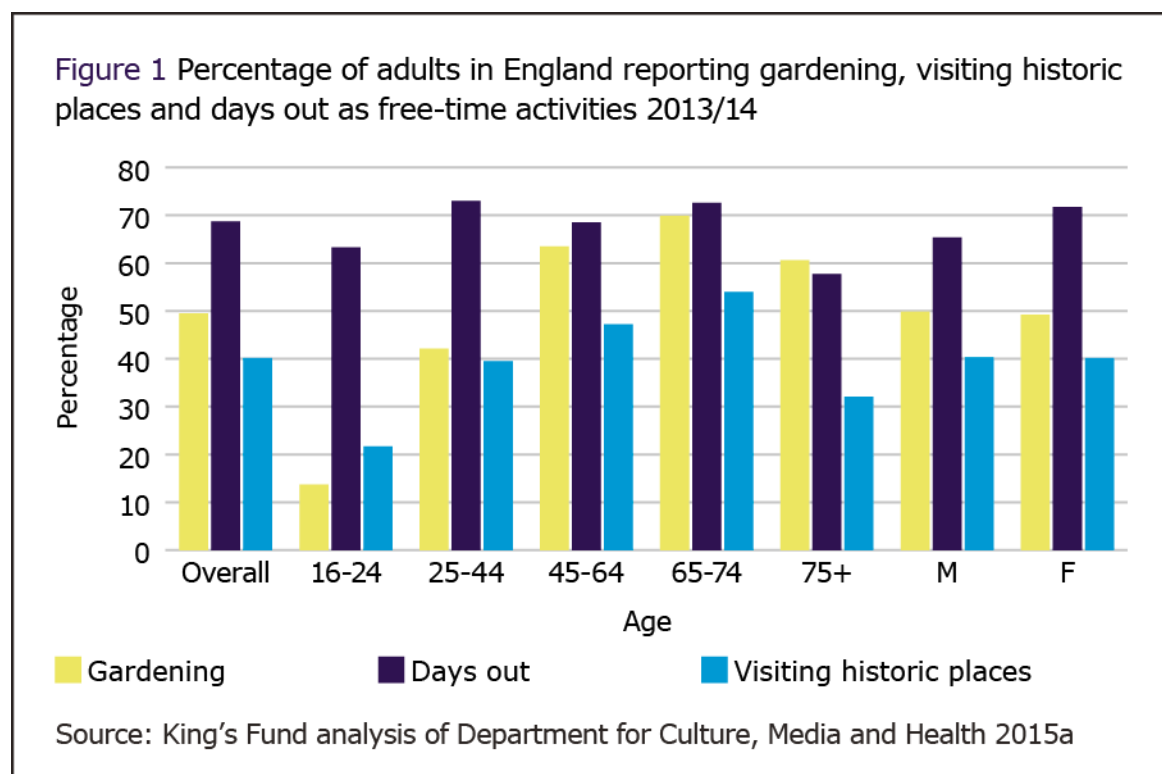
Gardens are also deeply rooted in our culture and history, including that of science and medicine – for example, see various works by Hickman (2014a, 2014b, 2013). But the focus of this report is on today’s gardens and the act of gardening, and their impact on health and wellbeing. It first reviews the high-level evidence on the link between green spaces and health before focusing on gardening more specifically. It then goes on to show how gardening interventions can support health across the life-course, and how gardens and gardening have an important place in the health and care system. Finally, it discusses the business case for gardening and develops implications for policy and recommendations.

Some key statistics

A few key statistics show how important gardening is – as a pastime, as an activity and as a geographical, economic and social phenomenon. Around 87 per cent of UK households have a garden and estimates suggest that private gardens cover an area about the size of one-fifth of Wales. One-quarter of a typical city comprises private gardens, half its green space (Thompson and Head, no date). For example, around 23 per cent of Sheffield is private gardens (Gaston *et al* 2005).

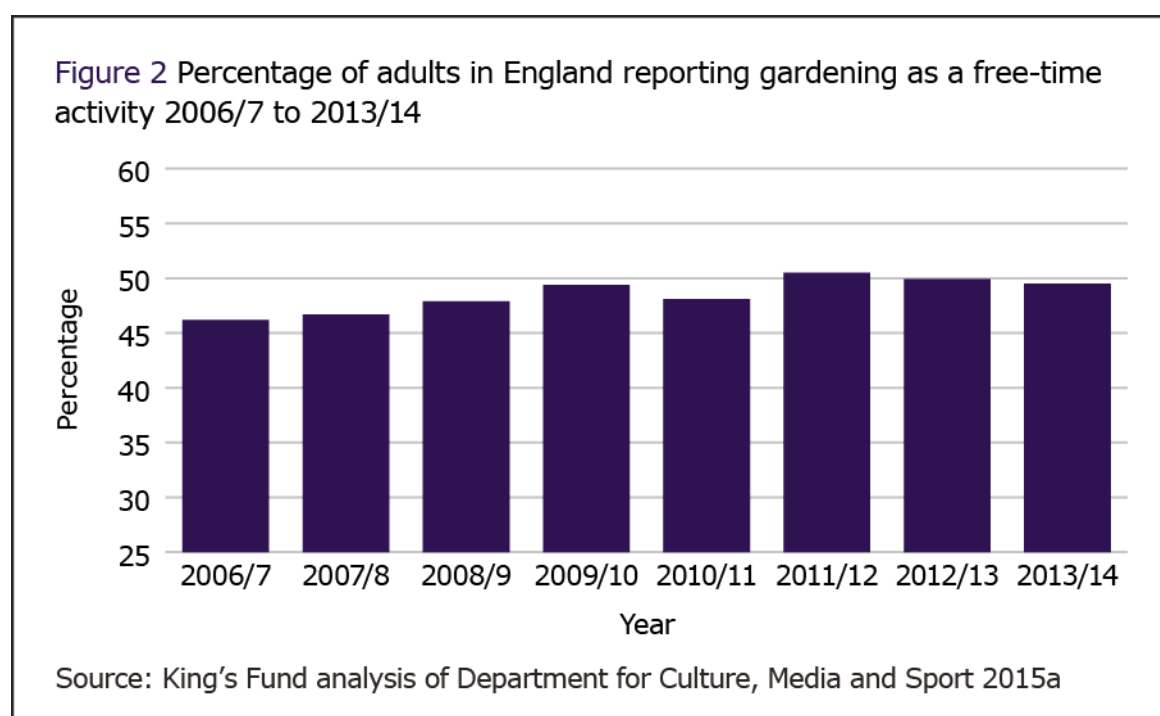
The latest statistics (from April 2013 to March 2014) on how adults use their free time (Department for Culture, Media and Sport 2015b) show that half of adults (49.5 per cent) report gardening as a free-time activity, far less than watching television (90.4 per cent) but far more than playing a musical instrument (10.4 per cent). We also visit gardens as part of visiting historic sites (40.2 per cent) or taking ‘days out’ (68.7 per cent). But, even when we are watching television, we are often watching or learning about gardens and gardening (Titchmarsh 2010).

Figure 1 shows how gardening and visits to historic places (which includes visits to gardens) differ by age. Gardening is relatively rare up to the age of 24, but beyond this it rises sharply through the age ranges from slightly more than 40 per cent among 25–44-year-olds, to around 70 per cent among 65–74-year-olds, before declining slightly to around 60 per cent among those aged 75 and over; there is little difference between the sexes when it comes to gardening. Visiting historic places follows a similar pattern (though at a lower level), while ‘days out’ (again, which include gardens) is the most popular activity of all. This shows less of a pattern with age, although again declines among the 75 and older age group.



However, although gardening declines in terms of overall prevalence as people age, it is important to note that it becomes relatively more important as an activity, given that other activities also decline with age. Among 30 activities, gardening is ranked 12th overall in terms of prevalence among adults, but 7th for those aged 75 and over, and 8th and 9th respectively for those aged 65–74 and 45–64. In short, as we reduce our range of activities as we get older, gardening becomes relatively more important to us. Indeed, it is one of the most active things we do, given that ahead of it are listening to music (6th), eating out (5th), reading (4th), shopping (3rd), spending time with family and friends (2nd) and watching television (1st).

Moreover, among the population at large, there has been a statistically significant increase in gardening (and days out and visiting historic places) since 2006/7, as Figure 2 shows.



Visiting gardens also has important spin-off benefits. For example, the National Gardens Scheme (NGS), which commissioned this report, is a charity that raises income for other health charities by organising the opening of private gardens for a small fee throughout the year. Other organisations such as the National Trust and English Heritage also raise large amounts of income from visits to gardens and houses, most of which are set in gardens.

All these factors therefore come together in the concept of gardens and gardening. This makes studying the link between gardening and health fascinating and diverse but also complex and sometimes hard to pin down. The intention of this report is to make sense of the large and diverse body of literature on gardening and its impact on health, and to develop policy recommendations on the basis of it. We hope this will lead to better understanding and better use of gardening 'as health policy'.

2 Defining our terms: the scope of gardening, its mechanisms and effects

A strong evidence base on gardens and gardening (and, in a broader context, green space) is an important building block to strengthen their role in health policy and practice. As part of that it is important to define terms as far as possible, including the mechanisms through which gardens ‘act’ and the health effects these mechanisms have.

Figure 3 sets out – at a high level – what ‘a garden’ is or can be, what its uses and purposes are, and the key effects that gardens can have on health. This simple conceptual framework is important in defining the possible scope of the evidence on gardens and health.

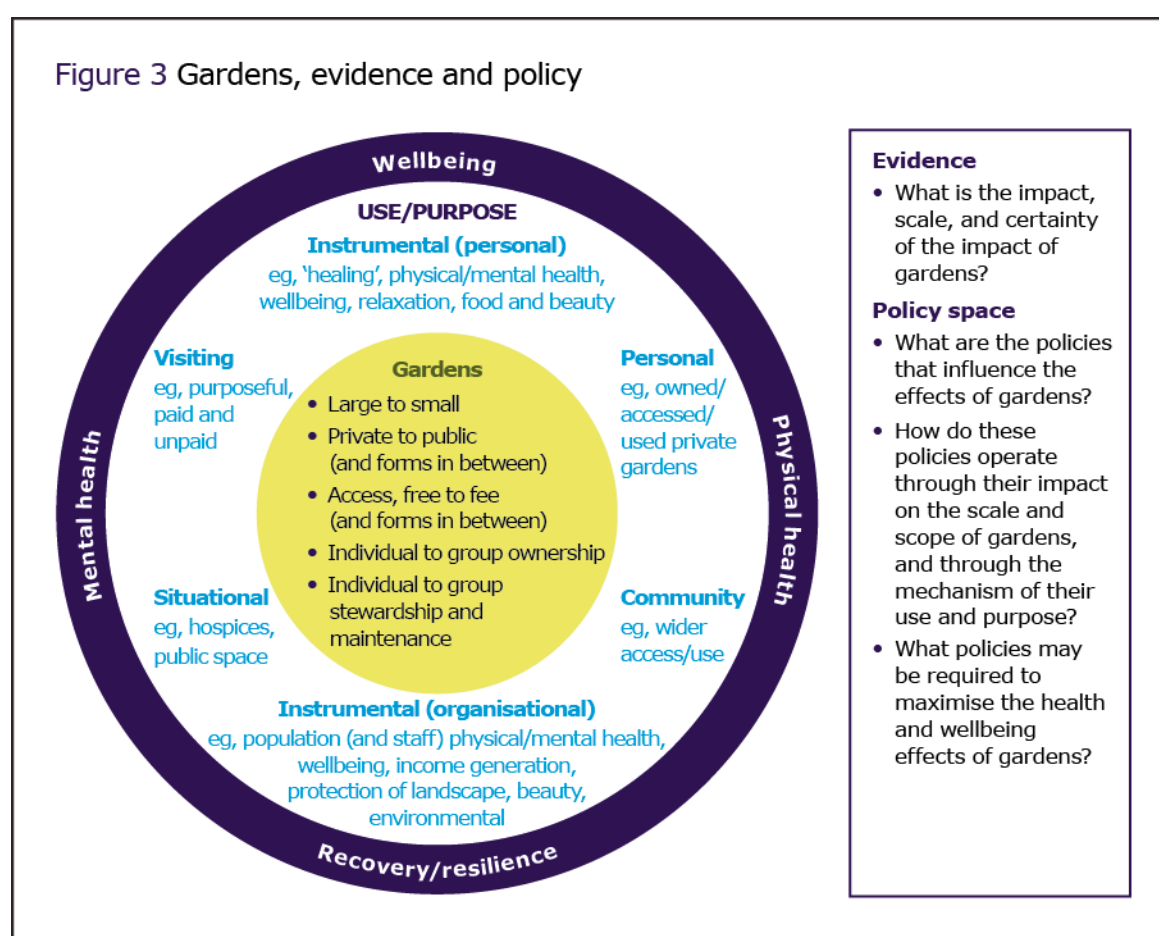


Figure 3 is a guide, not a straitjacket for what follows. But it is clear that the definition of what constitutes a garden can differ widely in terms of scale, from intimate small spaces to large gardens of many hundreds of acres. Gardens may also be private, communal or public in terms of ownership, access and maintenance, contribution and other forms of stewardship (including volunteering and financial support).

The uses and purposes of gardens also vary widely. For many, they are intimate private spaces attached to owned or rented private, family households and used for leisure and sometimes food cultivation. These are often sacred and preserved spaces for select families and friends and not open to more public access or view. Other gardens are more ‘open’, and visited on a fee-paying or free basis, linked to but not determined by ownership by public and private bodies. Others such as allotments have forms of common or joint ownership (or leasing) and in that sense are community concerns in terms of access and maintenance.

Gardens, and the act of gardening, can have a specific or instrumental purpose for individuals or organisations. For example, businesses keep gardens to attract staff, and increasingly general practices ‘prescribe’ gardening for patients as part of social prescriptions. Gardens can also be important environmentally as part of planned responses to air pollution, flood risk or climate control, and therefore indirectly for population health and wellbeing.

However, it is clear that use and purpose are not easy to disentangle neatly. One good example of this is the NGS. Its ultimate purpose is to improve health; it does this through raising funds for health charities, which it achieves in turn through the mechanism of volunteers opening their private gardens to the fee-paying public. The scheme therefore contributes to health through several mechanisms, directly (in terms of the effects on visitors’ health and wellbeing) and indirectly (through the funds raised from those visits). In that sense, the NGS and similar schemes perform an important matching function, helping to bring people together through the mechanism of gardens to improve health in multiple ways.

Finally, these diverse gardens and mechanisms can have wide effects on various forms of health, from physical health (due to the labour and effort involved, which includes walking in large public gardens), mental health and wellbeing (possibly through relaxation, reflection and stress reduction) to resilience and recovery from illness and palliative care (for example, via hospice and hospital gardens). These effects can accrue directly or indirectly, and to individuals or wider populations.

3 The evidence on the benefits of gardens and gardening for health and wellbeing

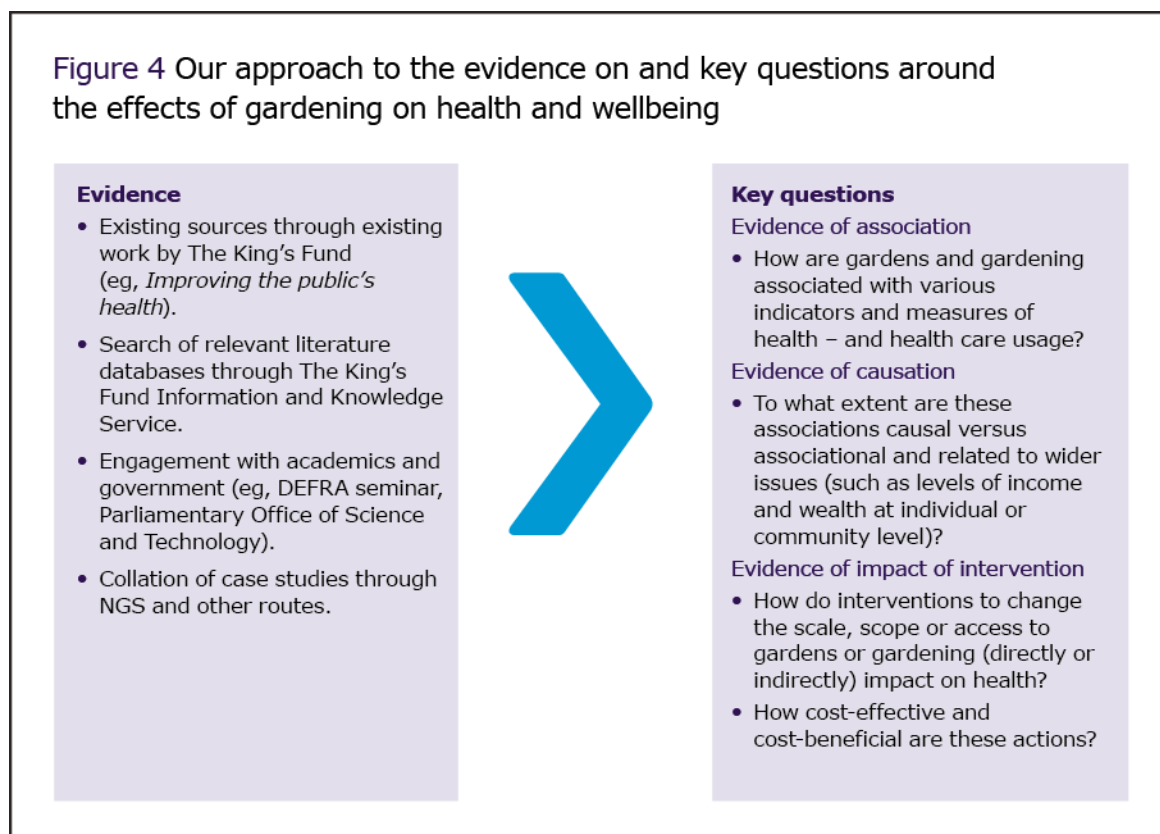
The potential mechanisms through which gardens and gardening impact on health are many and diverse. While this is clearly a good thing, it also means that it is not straightforward to measure, evaluate and aggregate the threads of that impact. This will be a recurring theme throughout this report.

For this report, our approach to the evidence and the questions we ask of it are multiple and pragmatic (*see* Figure 4). Our existing work, including that which supports local authorities in relation to public health, has produced relevant evidence, and we have undertaken a literature search through The King's Fund's Knowledge and Information Services. Further, we have engaged with academics and others through relationships with the Department for Environment, Food and Rural Affairs (Defra) and the Parliamentary Office of Science and Technology (POST). Finally, we have collated a series of case studies through the NGS, our previous work and our wider relationships. Our research strategy is set out in more detail in the Appendix.

The key questions to ask of this evidence (in its selection and interrogation) are threefold as they relate to Figure 4. First, what does the evidence tell us about the association between gardens and gardening and health and usage of health care? Second, what does it tell us about causation? Finally, what does it tell us about 'what to do'? In particular, which interventions – from policy change to practical changes in the NHS, local councils or more broadly – are more effective in improving health and wellbeing, and how cost effective or cost beneficial are they likely to be compared with other uses of resources?

The answers to these questions are important to commissioners, providers, health policy-makers and a wider set of stakeholders, including local authorities, given their public health and planning roles. While this is a big ask of any evidence base – particularly as we progress from the first set of questions to the last – insights from the evidence we review here can be used to develop plausible cases for policy and practice.

Figure 4 Our approach to the evidence on and key questions around the effects of gardening on health and wellbeing



Green space and health

Green spaces are usually defined as ‘natural or semi-natural areas partially or completely covered by vegetation, including parks, woodlands and allotments, which provide habitat for wildlife and can be used for recreation’ (Parliamentary Office of Science and Technology 2016). They therefore may include, but are not limited to, gardens.

A report by The King's Fund summarised the literature on the link between ‘green spaces’ and health (Buck and Gregory 2013). There is strong evidence of association, linking access to, living nearby or being exposed to green space with a wide array of indicators of physical and mental health and for many population groups.

- **Health problems.** For example, a study in the Netherlands showed that every 10 per cent increase in exposure to green space translated into an improvement in health equivalent to being five years younger (de Vries *et al* 2003), with similar benefits found by studies in Canada (Villeneuve *et al* 2012) and Japan (Takano 2002).

Obesity and physical activity. Green space has been linked with reduced levels of obesity in children and young people in America (Liu *et al* 2007). There is also strong evidence that access to open spaces and sports facilities is associated with higher levels of physical activity (Lee and Maheswaran 2011; Coombes *et al* 2010) and reductions in a number of long-term conditions such as heart disease, cancer and musculoskeletal conditions (Department of Health 2012).

- **Self-rated health and mental health.** Further, the proportion of green and open space is linked to self-reported levels of health and mental health (Barton and Pretty 2010) for all ages and socio-economic groups (Maas 2006), through improving companionship, a sense of identity and belonging (Pinder *et al* 2009) and happiness (White *et al* 2013).
- **The effects of other drivers of inequalities in health.** Living in areas with green spaces is associated with significantly less income-related health inequality, weakening the effect of deprivation on health (Mitchell and Popham 2008). In greener areas, all-cause mortality rates are only 43 per cent higher for deprived groups, compared with rates that are 93 per cent higher in less green areas.
- **Access in deprived areas.** Children in deprived areas are nine times less likely to have access to green space and places to play (National Children's Bureau 2013).

Other work has also shown strong links between residential greenness and birth outcomes (Dzhambov *et al* 2014; Dadvand *et al* 2012) and experience of nature and mental health (Bratman *et al* 2012). Some of these studies are included in a growing range of in-depth systematic and other reviews of a wide range of issues:

- the natural environment and health (Hartig *et al* 2014)
- green space and obesity (Lachowycz and Jones 2011)
- the benefits of urban green spaces (Lee and Maheswaran 2011)
- green spaces as 'the natural health service' (Faculty of Public Health 2010)
- residential green space and mortality (Gascon *et al* 2016)
- mental health (Gascon *et al* 2015)
- health inequalities and green space (Allen and Balfour 2014)
- how environmental enhancement and conservation activities could affect health (Lovell *et al* 2015).

Very recently, too, POST has looked at the evidence on green space and health (Parliamentary Office of Science and Technology 2016). Its report suggests that there is some evidence linking green space, physical health and physical activity, although the quality of green space is important in mediating any effect (eg, perceived safety, accessibility and how it is used). However, it states that there is little evidence suggesting that outdoor exercise is intrinsically better than indoor exercise in terms of the impact on physical health. This is disputed though, and there is some evidence that people enjoy activities more in greener environments (Thompson Coon *et al* 2011), that such activity may be more beneficial to physical health than mental health (Roe and Aspinall 2011) and that this may be more important to certain groups than others – for example, boys in urban settings in particular (Wheeler *et al* 2010). Many public surveys and other studies indicate that living near or having access to green space is linked to better mental wellbeing and lower stress levels.

Studies looking at ‘movers’ also suggest that moving close to areas of green space is associated with better childhood cognition and adult mental wellbeing, and exercising in green space has been linked to improved mental wellbeing. Some evidence suggests that the health impacts of moving to a greener environment (after controlling for potential confounding factors) are sustained (see Alcock *et al* 2014; Astell-Burt *et al* 2014; White *et al* 2013).

Whatever the health effects of access to green spaces, there are clear issues with who accesses them, and therefore who benefits from those effects. Data from the *Monitor of Engagement with the Natural Environment* (Natural England 2015), which surveys around 45,000 people from across England each year, shows that some population groups – minority ethnic groups, urban deprived populations, more disadvantaged social groups, those over the age of 65 and disabled people – are all less likely to visit green spaces than the national average. Stated reasons for this include poor maintenance, inadequate facilities and fears over safety. Recent work on measuring stress levels suggests that urban design may compensate for this to some degree.

Roe *et al* (2013) show that high salivary cortisol levels (a stress marker) are related to levels of lower green space and vice versa in deprived urban Scottish neighbourhoods, with greater effects on women than on men. This is a major issue given that access and proximity to green space are unequally distributed across the population: the most affluent 20 per cent of wards in England have five times the amount of green space compared with the most deprived 10 per cent of wards. People who live in the most deprived communities are 10 times less likely to live in the greenest areas than people who live in the least deprived communities (Balfour and Allen 2014).

Finally, POST and others argue that more green space and urban vegetation, including domestic gardens (see Cameron *et al* 2012), are linked with many other environmental effects that *indirectly* affect people's health. This includes reducing the risk of flooding, noise pollution (borders of shrubs and trees can reduce, by half, sound levels at a distance of 30 metres) and air pollution. They can also reduce the 'urban heat island' effect (Bowler *et al* 2010) through reducing radiation and creating shade.

What counts as evidence in gardens, gardening and health?

Green space and health (Parliamentary Office of Science and Technology 2016) and the other systematic and wider reviews stress that while many studies are all *consistent* with the finding that green space is important for health, none of them prove it in the way that many health care interventions are expected to be evaluated in terms of their impact on health. This is primarily because it is difficult to test for *causal effects* between green space and health and wellbeing. Most studies are either observational or 'before and after' studies. For example, observing that living near or moving close to a high-quality park in the centre of London is associated with better health could be due to the fact that only wealthy people can afford to do so and the wealthy are more likely to be healthy. Similarly, improvement in self-reported health after a social prescription for gardening may be part of the natural healing process and not in fact be due to gardening.

It may be possible to control for these issues statistically in observational studies (the 'mover' studies cited above do) and through stronger study designs – particularly RCTs where otherwise similar people are randomly selected to receive either 'gardening' or no intervention, with the results compared over time. In practice, however, these are harder to carry out than for health care interventions and are very expensive; as a result, they are few and far between, although we do review some below and in later sections of this report.

While there is definite scope for more RCTs and better statistical control, as we shall see in the more specific review of the evidence on gardening and health, the benefits of the act of gardening (or visiting gardens) are, by their nature, broad, holistic and often hard to measure quantitatively. Further, gardening is usually a voluntary, chosen act. The gold standard of RCTs is arguably less well suited, or at least difficult to design and expensive to undertake, for interventions that have broad and varied impacts, or for those that are voluntary decisions (Cupitt 2015). All these clearly apply to the act of gardening.

Within their details, systematic reviews on gardening and health, which we turn to in the next section on gardening across the life-course, reveal many convincing examples of where gardens and gardening are associated with a very broad range of wellbeing, physical and health outcomes, and with factors such as confidence, self-esteem and resilience, which are known to influence health. Moreover, many of these effects are reported to occur concurrently for the same intervention. The evidence shows that gardens and gardening are particularly important for mental health. Furthermore, they seem to become more important as we age in terms of ‘who we are’ and as we become more dependent on health services and social care. Gardens may help to keep us physically and socially active, may help to prevent falls and may form a key component of dementia care. Some of these insights come from RCTs, others do not, but they are compelling nonetheless.

Finally, it is important to recognise that the lack of RCTs in evidence is not something unique to green space or gardening – many accepted interventions in health and other policy fields are not based on RCT evidence. So while there is always room for stronger study designs, we have to ask the practical question: how much and what type and strength of evidence is ‘enough’ to guide action and policy? This tension will be a recurring theme throughout the report, and we return to it in our recommendations in Section 7.

4 Interventions in gardening and health: evidence and potential across the life-course

Gardening in early life

Being ‘in touch’ with the natural environment has traditionally been seen as a key aspect of childhood, yet recent surveys and reports suggest that fewer children are engaging with nature in the broadest sense. For example, a survey by Natural England (2016) showed that 1 in 10 children in England had not been to a natural environment in the past 12 months. Children from low-income families and black, Asian and minority ethnic households were also much less likely than white children and those from higher-income households to frequently visit urban or rural wild places. There were regional differences too: children in the north east had the best access to natural environments – 78 per cent visiting at least once a week – compared with 64 per cent of children in the West Midlands and 62 per cent in London.

However, as Pitt (2016) has pointed out, while this is cause for concern, the flipside is that 7 in 10 children do visit the countryside at least once a week. More tellingly, Pitt also argues that what matters is knowing what features and characteristics of green places have positive effects. Also, of course, nature is all around us, not just ‘in the countryside’, and the focus on making special trips as the only source is to narrow and undervalue other forms of experience. However, to know what to encourage, we need to be more specific about why green space – including gardens at school and at home – is beneficial for children.

School gardening and growing are popular activities. Christian *et al* (2014) report the results of two RCTs on the Royal Horticultural Society (RHS) Campaign for School Gardening and its impact on young children’s fruit and vegetable intake. These studies randomised 54 primary schools across London to one of three groups receiving different interventions (RHS-led, teacher-led or no intervention) and recorded various measures of consumption and knowledge. Although the mean change in intake was higher in the RHS-led group (32g) than the teacher-led group (8g), this just failed to reach statistical significance; similarly, the mean increase in the teacher-led group compared with the control group was 15g – again, not statistically significant. All schools were assessed on their gardening through an ‘RHS gardening score’; in those schools (irrespective of group allocation) where this score increased

by three levels, children did have a significantly higher intake (81g more) compared with schools where there was no change in gardening score.

The authors conclude that these trials provide little evidence that school gardening alone can improve children's fruit and vegetable intake; they need to be combined with efforts to improve parental support in the home. However, when the gardening intervention was implemented at the highest intensities, there was a suggestion that it could improve children's fruit and vegetable intake by a portion. This is an excellently designed study but arguably it focuses on a single, narrow measure of impact – fruit and vegetable intake. There are many other reasons for gardening at school, and during the early years of life.

The Christian *et al* (2014) paper was included in an up-to-date systematic review of 40 quantitative and qualitative studies (Ohly *et al* 2016) on the impacts of school gardening (all educational settings up to 18 years old). This sought to answer a broader set of questions on impact and sustainability, as follows.

- What are the health and wellbeing impacts of school gardens?
- Are there different impacts for different age groups?
- What are the effects on other family and community members?
- What do school gardens mean to those who use them?
- Are there any factors that help or hinder the successful development, use or sustainability of school gardens?

Most of the quantitative studies were judged to have weak study design due to self-selection and lack of control for confounders; some of the qualitative studies were relatively strong though. There was a wide range of outcomes across the studies. For example, 2 of 13 quantitative studies showed significant increases in fruit and vegetable consumption; 4 of 6 showed increases in nutrients; 8 of 13 showed increases in preferences for fruit and vegetables; and 7 of 10 showed mostly positive significant changes in knowledge. There was little sign of effects on BMI or other physical measures.

Many studies reported positive comments from children, teachers or administrators, particularly on connection to the food grown and preferences for fruit and vegetables. Most qualitative studies reported positive wellbeing effects on children or teachers, including in terms of personal achievement, pride and empowerment through growing food and being involved in gardening. For children with learning or behavioural difficulties, fulfilling non-academic tasks and roles seemed to be particular sources of achievement and worth. They also found gardens to be 'peaceful places' and places conducive to meditation.

Teachers and volunteers also found gardening a valuable way to break down social boundaries inherent in academic settings, and it gave some volunteers a sense of purpose and ‘giving back’ to children’s education. The personal and social wellbeing impacts of gardening are therefore inter-related and contribute to a sense of motivation and purpose. These findings are consistent with reports from school gardens, especially primary school gardens that open to visitors as part of the NGS, which develop a sense of community built around the inter-relation between teachers, children, their families and other visitors.

The educational impact of gardening was not the focus of the review and there were no quantitative studies on this topic, but qualitative studies indicated reduced levels of stress and increased levels of engagement and motivation among children who participated in school gardening. However, this did not apply to all children, and some did not work well in gardens; teachers found some children difficult to control in open spaces, possibly due to repetitive tasks, leading to disengagement.

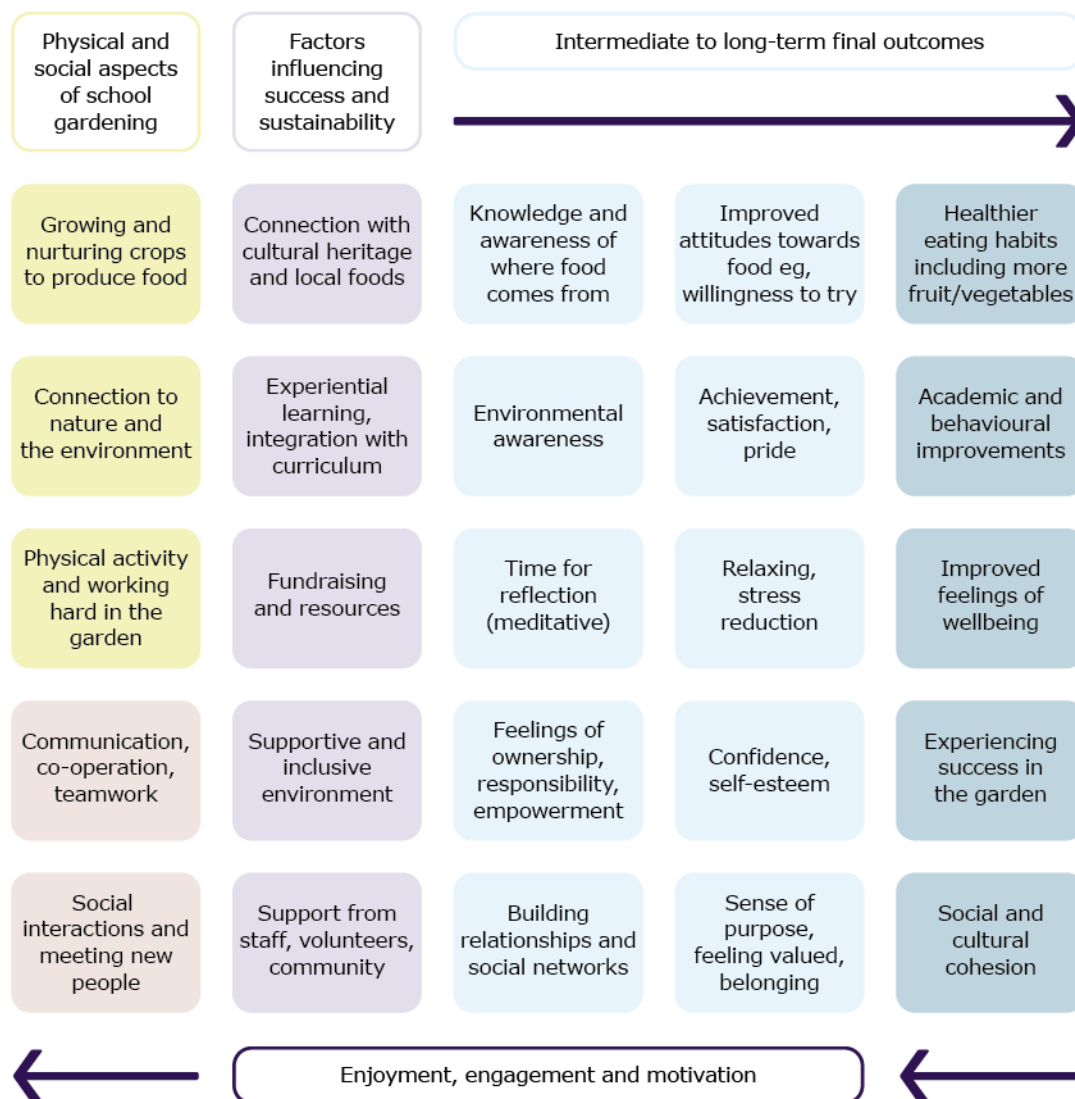
Schools suggested several success factors for a sustainable approach to gardening, including:

- strategically integrating gardening into the wider curriculum
- linking gardening to children’s cultural heritage
- making strong connections with local community groups and volunteers
- linking continuing professional development (CPD) to gardening for staff
- linking to local garden retailers, clubs and public gardens.

The authors conclude that the majority of the quantitative evidence for school gardening is currently weak due to poor study design. They cite ‘substantial qualitative evidence on a wide range of health and well-being impacts but these were rarely supported by the quantitative evidence, either because these outcomes were not measured, or because few studies identified significant impacts’(p 32). Further, they note that: ‘School gardens are complex interventions, yet few studies articulated a logic model to show how it was believed that school gardens might have an impact on health and wellbeing’ (p 35).

However, they also argue that ‘the qualitative research suggests holistic effects that may be difficult to quantify, as well as suggesting that impacts may be felt in the medium to long term, whereas included studies only report short term follow up’. They go on to develop a broad and convincing conceptual framework for summarising the wide array of mechanisms for the effects of school gardening based on their review (*see* Figure 5).

Figure 5 Conceptual model showing potential health and wellbeing effects of school gardening



Source: Derived from Ohly *et al* 2016

Gardening as families and adults

Figures 1 (*see p 11*) and 2 (*see p 12*) show that gardening is popular among adults of all ages, not just older people. In fact, younger adults, and especially those with children, are increasingly seeing the garden as an important space. A recent report (Lloyds Bank 2015) of 2,000 homeowners showed that parents with children under 18 spent significantly more money on their gardens than those without, including on play equipment such as slides, sandpits and swings. Almost 1 in 4 parents thought that their children did not spend enough time outdoors, and only 1 in 7 thought that their children spent more time outdoors than they

themselves did when they were young. This partly reflects concerns about the development and use of technology. More than 4 in 10 thought that ‘children are inside playing computer games instead’. Homeowners, and particularly parents, value their gardens highly – just 2 per cent said they would swap a bigger house for no garden, while 35 per cent of parents would consider moving house for a bigger garden compared with 14 per cent of all homeowners.

Pressure on green space and a reduction in the number of people with access to gardens are two reasons behind the increasing demand for allotments (McVeigh 2015) and debates over the size of allotments and whether they should be sub-divided to allow more people to grow their own food. Sales of vegetable seeds are exceeding sales of flower seeds in the United Kingdom (UK) for the first time since the Second World War, accounting for almost 80 per cent of sales of seeds and plants now compared with 30 per cent in the 1990s.

Recent surveys of local authorities and their allotments confirm this excess demand (Priestly 2015). More than 30 per cent of local authorities that responded said they had between 100 and 400 people waiting for plots, while 8.5 per cent had more than 1,000 people waiting.

But what is the evidence that allotment gardening is related to health? Wood *et al* (2015) undertook a UK case-control study of allotment gardening comparing pre- and post-session moods and wellbeing for regular allotment gardeners against a matched control of non-gardeners recruited as volunteers from a local supermarket. Findings suggested that benefits to mood, self-esteem and other indicators of wellbeing improved significantly for the allotment gardeners between pre- and post-session measurement (as measured by the General Health Questionnaire and other validated indicators). Moreover, they were not dependent on how long they had been allotment holders (ie, the improvements were sustained). Their overall wellbeing was also higher than the matched controls.

A similar study (Berg *et al* 2010) was conducted in the Netherlands with allotment gardeners and controls living next door. After adjustment for baseline characteristics (such as income, education, gender, other physical activity and stressful life events), older allotment gardeners (aged 62 and above) reported better outcomes on all levels of health on all measures than the controls, whereas measures did not differ for younger neighbours. The authors conclude that having an allotment garden may promote an active lifestyle and contribute to healthy ageing, but the findings may be limited by self-selection. In a further study, the same lead author (Berg and Custers 2011) showed that allotment gardening was linked to decreases in measured cortisol levels and increases in positive mood, arguing that these findings were the first experimental evidence that gardening can promote relief from acute stress.

Gardening and mental health

As Clatworthy *et al* (2013) state, horticultural activities featured in the early psychiatric institutions in Europe and the United States in the 1800s. The authors reviewed the main theories that have been suggested to link gardening (and contact with natural environments more generally) with mental health, as follows.

- **Attention restoration.** Gardens can provide ‘fascination’ (non-goal-orientated and effortless attention) in order to provide relief to directed attention (problem-solving, which is a limited resource, and overloading). Gardens can therefore provide restorative effects to mental functioning by providing non-directed attention.
- **Stress reduction.** There is considerable evidence that physiological functioning (eg, heart rate, skin conductance) returns to normal faster following a stressful event when exposed to natural stimuli.
- **Social connections and exercise.** Gardening interventions are usually social; engaging with others in a meaningful activity, and developing knowledge and skills as well as physical exercise, are linked to improvements in mental health.

The review by Clatworthy *et al* identified 10 studies that met their criteria: they involved an empirical evaluation of an intervention involving active horticulture (gardening); participants were adults experiencing functional mental health difficulties; the studies were published in a peer-reviewed journal; and they were written in English.

Their summary findings point out that there have been no RCTs in this field, but the review has shown that gardening-based interventions can have a variety of benefits for people as an adjunct to existing treatment. In particular, some quantitative studies found significant reductions in symptoms of depression and anxiety while qualitative studies found enhanced emotional wellbeing, improved social functioning, improved physical health and opportunities for vocational development.

However, there was wide variation in the types of gardening intervention evaluated (eg, short-term versus long-term, led by qualified staff members versus volunteer/user-led and horticultural therapy versus therapeutic horticulture). Furthermore, while participants appeared to benefit while engaged in the interventions, there was less follow-up evidence that this was maintained over time. Clatworthy *et al* argue that a gardening-based mental health intervention may therefore be best conceptualised as a longer-term therapeutic option for the long haul, which can, over time, facilitate recovery and social inclusion among people experiencing mental health difficulties.

Clatworthy *et al* conclude that while there has been a marked improvement in the quality of research on the topic since an earlier review, there remains a dearth of well-designed, controlled trials to help establish causality and identify the active components of the interventions (ie, what is it specifically about a gardening-based mental health intervention that makes it effective?). Given that a survey of projects registered with Thrive – a charity that promotes and supports the use of therapeutic horticulture – has shown that there were more than 900 mental health projects by the mid-2000s, Clatworthy *et al* argue that ‘at this time when an unprecedented number of “green” interventions are being set up, it is of vital importance that they are appropriately evaluated in order to develop the existing evidence base’.

Bragg and Atkins (2016) also reviewed a large number of nature-based interventions (also called green care and ecotherapy), which include the role of gardens. They argue that these could be part of a new solution for mental health care, but conclude that ‘awareness and access to these interventions is challenging given the number of organisations delivering nature-based projects and services, the variety of terms and language used to describe their activity and benefits and the variation in delivery models which use different impact measures’.

Gardening as we get older: a changing relationship and a role in prevention

As we have seen, gardening is not just for older people but it does become relatively more important to us the older we get. And the nature of its importance seems to change too. Wright and Wadsworth (2014) reviewed a large literature from the arts and sciences on the effects of gardening. As they summarise, gardening impacts instrumentally, in terms of its effects on specific elements of physical and wider health, but ‘there is the added dimension of what the garden symbolizes psychologically as a meaningful reason for existence, or as one older adult expressed it, “when I’m in the garden I can create my own paradise”’ (Wright and Wadsworth 2014, p 8).

Within this ‘paradise’ (from the ancient Persian, meaning ‘enclosed gardens’ or ‘orchards’ (Ward Thompson 2011)), there are many reasons for gardening as we age. In their work on gardening in areas of low-income housing, Wang and Glicksman (2013) looked at the self-reported motivational factors for gardening. These were:

- mental health benefits
- growing fruit and vegetables
- continuation of a past life
- something to have a responsibility for

- beauty
- connection to others
- learning something new
- ‘helping each other out’.

This myriad of reasons shows the multiple (and scientifically hard-to-pin-down) benefits of gardening as we age. Pettigrew and Roberts (2008), in a small-scale qualitative study, found gardening to be one of the activities that can ameliorate loneliness in older age – something we increasingly understand to be as damaging to health for older people as behaviours such as smoking (Holt-Lunstad *et al* 2010).

Gardening may also be helpful as it can contribute to prevention, particularly of dementia (through physical activity) and falls. More broadly, there are surprisingly few studies of gardening as a form of physical activity in older people. Nicklett *et al*'s (2014) review summarises what is known but most of the studies are limited to small samples and focused on container or indoor gardening and on calculating energy expenditure. There are few consistent findings across the studies.

Around 13 per cent of Alzheimer's disease worldwide may be due to sedentary behaviour (Raji *et al* 2016). Although the evidence is in its early stages, is contested and is still developing, there are increasing numbers of clinical studies that seem to show that physical activity may be important in preventing forms of dementia or at least ameliorating its impact. For example, one six-month RCT of home-based physical activity for people with memory impairment seemed to show reduced cognitive decline over the subsequent 18 months. Other studies show how physical activity improves cognitive function and memory.

In addition to dementia prevention, one area where gardening may be helpful is in falls prevention. Falls have been estimated to cost the NHS more than £2 billion annually, with potentially greater but much less recognised costs for social care (Tian *et al* 2014). Falls among older people are hard to prevent – the best predictor by far of a future fall remains a previous one.

There is some evidence that moderate-intensity exercise such as tai chi, yoga and dance can help to reduce the incidence of falls among older adults. One of the reasons for this is that at least some elements of these activities focus on balance. However, data from the free-time survey (*see* Figure 1, p 11, and Figure 2, p 12) shows that gardening is one of the most common activities that older adults engage in.

Chen and Janke's (2012) research on the participants in the Health and Retirement Study in the United States is one of the first studies to look at gardening and its relationship with falls among older people. It retrieved data on 3,237 individuals aged 65 and over, with background sociodemographic data associated with falling (age, gender, ethnicity and educational attainment), and data on existing presence of chronic conditions and functional limitations. In addition, participants undertook three tests of balance, a test of gait and were asked whether they had had any falls in the previous two years (a third of the sample responded yes). Finally, participants were categorised into whether they gardened less than one hour per week (non-gardeners) or more (gardeners).

Gardeners were significantly more likely to have better balance and gait, and as a group were 30 per cent less likely to report falls. These relationships were confirmed in multiple regression; gardeners were essentially healthier. In particular, being a gardener, controlling for other factors (such as age, gender, education and functional limitations), was related to a higher chance of passing the gait tests and two out of three balance tests. Taking into account all these factors, *including* scores on the balance and gait tests, gardening was not a significant predictor of falls. The authors argue that this is because the relationship is modulated through gardening improving gait and balance – themselves risk factors for falls – which *were* significantly related to gardening.

However, not all is rosy in the garden, particularly for very old people. Studies have shown that gardeners often suffer lower back pain. While gardens can confer many benefits on physical health, they can also become problematic under some circumstances. For instance, for older adults, taking care of gardens can be 'a considerable practical burden and was something that bothered old people's minds'. Fänge and Ivanoff (2009) and Nicklett *et al* (2014) report that up to 60 per cent of participants in one study reported low-to-moderate lower back pain associated with gardening.

5 Gardening and its place within the health and care system

As we have seen, gardens are closely related to health and wellbeing across the life-course. We would expect that gardens are recognised as important by, and in, the health and social care system, and to some extent this is true. This section explores four specific areas where there has been more experience and concerted effort by the NHS and care system to include gardening as an intervention: social prescribing; community gardens, volunteering and recovery from illness; dementia care; and end-of-life care.

Gardening and social prescribing

Social prescribing is ‘a formal means of enabling primary care services to refer patients with social, emotional or practical needs to a range of local non-clinical services and provides a framework for developing alternative responses to need’ (Brandling and House 2007, p 3).

It is an area that is attracting increasing interest both inside and outside the NHS. Well-known and highly successful organisations such as the Bromley by Bow Centre in London are largely built on the notion of social prescribing, including a gardening offer (Bromley by Bow Centre, no date). Parts of the country are investing in this more social approach to health at primary care level – for instance, in Bradford and Rotherham (Dayson and Bashir 2014).

This move to social prescribing is driven by the increasing knowledge and understanding that health is determined primarily by the range of social and economic factors that people are exposed to, and that social prescribing can help to address some of these by linking patients with sources of support in the community. Estimates also suggest that up to 20 per cent of general practitioners’ (GPs’) time is spent on problems with social causes (Caper and Plunkett 2015); social prescribing may also therefore be a way to manage increasing demands on the NHS, including pressures on GPs’ time.

Social prescribing schemes, by their nature, vary considerably but generally provide a way for GPs and other primary care professionals to offer or signpost to non-clinical referral options instead of, or alongside, clinical ones. Many of these schemes are provided by local voluntary sector organisations. Schemes often focus on mental health and wellbeing as much as physical health, including through reducing social isolation and strengthening community bonds; they may lead to reductions in the use of NHS clinical services, though this is not usually the prime

intention. We know that many health problems, particularly those involving mental health, have social problems as their root cause (for instance, debt, homelessness and loneliness). So social prescribing holds out the promise of helping to tackle that root cause, or at least alleviating the symptoms.

One evaluation study in Rotherham showed that for more than 8 in 10 patients who were followed up three to four months later, there were reductions in NHS use in terms of accident and emergency (A&E) attendance, outpatient appointments and inpatient admissions, and increases in wellbeing. Exploratory economic analysis suggested that the scheme could pay for itself over 18–24 months in terms of reduced NHS use (Dayson and Bashir 2014). Another study in Bristol (Kimberlee 2013) showed improvements in various measures of wellbeing and reductions in general practice attendance rates for the majority of beneficiaries.

However, most studies of social prescribing to date have been poorly documented, have not used control groups and do not state what interventions were actually received by patients (Centre for Reviews and Dissemination, University of York 2015; Kilgarriff-Foster and O’Cathain 2015; Kinsella 2015; Thomson *et al* 2015). Many social prescribing ‘studies’ are, in fact, progress reports rather than evaluations, giving ‘the illusion that there are many, effective initiatives, supported by a large body of literature, when in reality, few schemes are supported by robust research evidence, but those that are, are widely publicised’ (Kinsella (2015). Kinsella (2015), however, also notes that many of the individual components of social prescribing have been shown to be effective. These include exercise referral schemes (of which there are now at least 600 in the UK), although Pavey and colleagues (2011) thought that the benefits tend to be in terms of improvements in depression, not necessarily fitness or exercise.

There are few, if any, specific studies on gardening or gardens as a social prescription. For example, a search for ‘garden’ in Bagnall *et al’s* (2015) *Bibliography and map of community-centred interventions for health and wellbeing* returns no hits. However, there are some media reports (for example, Chan 2015) and they are likely to be included as part of wider social prescription schemes, especially those with exercise components.

However, one reason for this seeming lack of gardening as social prescription in the literature is confusing terminology (see Bragg and Atkins 2016; South 2015). There are other reviews and studies of ‘community referrals’ and, as Thomson *et al* (2015) point out, these include green gyms, which can be seen as social prescriptions if some participants are referred in. Thomson *et al* reviewed the evidence for green gyms, also known as ‘ecotherapy’ or ‘green activity’, where participants are referred or self-volunteer to some activity in a wide variety of green environments, from community gardening to woodland conservation activities. A national evaluation of green gym projects (Yerrell 2008) found that the greatest impact

was on those with poorest health on joining. Another review of case studies found particular benefits to mood and self-esteem (Pretty *et al* 2007).

Finally, as in other areas, academic reviews of social prescribing have argued that the current evidence is limited, with few studies being subject to RCT-type analysis. But gardening is, in theory, a strong area for social prescribing. Although there are few specific studies, gardening is often one part of larger exercise referral programmes and is also part of social prescribing for wider nature-based interventions such as green gyms or ecotherapy and community gardening. As Lovell *et al* (2015) have argued, there is good evidence for many components of these interventions, and further work is under way (South West Peninsula CLAHRC 2016).

Community gardens, volunteering and recovery from illness

One area that could, in some circumstances, be described as social prescribing is community gardens and growing projects. There is an increasing number of these around the country, some with the active involvement of GPs and other parts of the NHS, including those commissioned by CCGs. Many of these are brought together on Sustain's Growing for Health website (Sustain 2016).

One particularly interesting example is Garden Partners (Jackson *et al*, no date) the first scheme in the United Kingdom to link older people who need help with their garden with volunteer gardeners who would like more growing space to garden-share and grow together. As we have seen, one of the stresses of gardening for people as they age is their sense of losing control over something that has been important for many years, leading to anxiety and a sense of loss. The aim of this and similar schemes is twofold: to enable older people with gardens to remain involved by planning what to grow and gardening with the volunteer. This may enable older people to stay in their homes for longer, retain their independence and increase their social contact.

In 2008 there was an average waiting time of three years for an allotment in Wandsworth, London, and at the same time Age UK Wandsworth received an average of 15 calls a week from people seeking help with their garden. Putting these two demands together led to the creation of Garden Partners. The 'partners' plan the garden, decide together what they grow and share in the produce. An evaluation using components of the EQ-5D health questionnaire revealed the following results.

- More than half of garden owners felt less anxious through having the garden tended.
- One-third said their mobility and ability to carry out everyday activities had improved or remained stable.
- Older people felt more able to maintain their independence, delaying the need for intensive home care or a move to residential care.

- Using standard health service costings for a range of interventions, researchers estimated the potential savings to the NHS in one year to be £113,748, making assumptions about how those who reported an improvement in their health would change health service use. When widened to include those who reported that their condition was no worse, this gave a potential saving of £500,223.
- The contribution made by volunteers equated to £131,795, based on the value of time donated compared with the cost of a paid-for gardener.

Garden Partners was run by Age UK Wandsworth and funded by NHS Wandsworth, the CCG in Wandsworth to March 2014 (at the time of writing the case study) when funding ceased due to pressures on budgets.

Another example is the Lambeth GP Food Co-op (Lambeth GP Food Co-op, no date). This is an innovative co-operative of patients, doctors, nurses and Lambeth people who have created a network of food-growing gardens across the NHS in Lambeth. The Co-op has built gardens at 11 GP surgeries and other sites, including King's College Hospital, where patients (especially those with long-term conditions) learn how to grow food in a safe and secure environment. Groups are led by nurses who are trained and experienced master gardeners.

The Co-op began in spring 2013, with support from Lambeth Council and NHS Lambeth CCG. It was awarded Best Sustainable Food Initiative in the NHS by Public Health England and the NHS Sustainable Development Unit in the same year. The Co-op also works with the Malnutrition Project in Lambeth and Southwark, a relationship that enables hospital-based nutritionists and dietitians to work alongside patients across its sites and provide informal advice on diet and nutrition. It now sells healthy food, grown by NHS patients to support the nutrition of other patients in King's College Hospital.

Since April 2015, it has welcomed King's College London undergraduate and postgraduate dietitians on placement. The Co-op plans to expand (Bawden 2016) although this is dependent on being able to secure ongoing funding; a community share issue will be undertaken in May 2016. One of the GPs involved, Dr Vikesh Sharma, said the food co-op will:

... make us more accessible and encourage us doctors to leave our rooms. And that can only be a good thing... It provides the only platform for me as a GP to see my patients outside the physical walls of my surgery, reinforces the idea of community doctors and reminds me of the wider context of what being healthy actually means. It allows patients a more relaxed way to engage with their GP surgery (as opposed to a hurried 10-minute appointment or waiting half an hour on the phone). It helps build trust and relationships between the doctor and patient that is so vital to the way a GP provides continuity of care.

Sustain has undertaken a review study of community gardens, food-growing and the demonstrable link to health effects (see Davies *et al* 2014). Davies *et al* include some of the studies mentioned throughout this report but state at the outset that: ‘Studies on the impact of community gardening on direct health outcomes are, however, rare.’

One well-designed study mentioned in Davies *et al*’s review that did look directly at the benefits of community gardening was that of Zick *et al* (2013), who compared three different groups to assess the potential weight-control benefits of community gardening in a study from Salt Lake City, Utah. The comparisons were adjusted for gender, age and year of BMI measurement. Results showed that both female and male community gardeners had a significantly lower BMI than their neighbours who were not in the community gardening programme and in comparison with siblings. Comparison with spouses showed no statistically significant differences; the authors hypothesise that spouses would likely enjoy the dietary advantages of the community garden and might also help with the physical demands of gardening. According to the authors, this is the first study published worldwide comparing health benefits of community gardeners with non-gardeners in a robust sample. But, as ever, future research with randomised controlled field studies across a range of communities is needed to advance the understanding of gardening and healthy lives. A systematic academic review is planned (Lovell *et al* 2014).

Ulrich’s (1984) study of patients who had received gall bladder surgery was the first to show that patients who had a view of nature from their hospital beds had shorter post-operative stays and less consumption of painkillers than matched patients who had no such views. Davies *et al* (2014) also looked at gardens and their importance for recovery from specific diseases, including cancer. In the United Kingdom the charity Macmillan Cancer Support has offered gardening packs to encourage people to ease into physical activity after cancer treatment. The initiative was part of the charity’s Move More campaign (Macmillan Cancer Support 2012). It had carried out research among 148 NGS gardeners, showing that 75 per cent of gardeners living with cancer said that gardening during and after treatment helped them to manage feelings of depression and sadness.

Thrive (Thrive 2016) is another example of a charity that uses gardening with the intention of improving the lives of people living with disabilities or ill health, or are isolated, disadvantaged or vulnerable. Thrive runs gardening programmes for people in Berkshire and London and now operates in Birmingham and Gateshead. *Incredible edible* (Incredible Edible Network, no date) is another inspiring example, a grass-roots community network with more than 100 groups in the UK and more elsewhere in the world, which are committed to growing healthy food.

Finally, Horatio's Garden is a national charity that has designed gardens at Salisbury Hospital to help in the rehabilitation of spinal injury patients. A garden is soon to be opened at The Queen Elizabeth University Hospital in Glasgow and shortly Stoke Mandeville Hospital, as part of a nationwide plan for all 11 spinal injury units. The principal aim is to promote the wellbeing of patients with spinal cord injury as well as their family and friends. Beautifully designed and maintained gardens are accessible for patients in beds and wheelchairs.

The first Horatio's Garden opened in September 2012 at the Duke of Cornwall Spinal Treatment Centre at Salisbury Hospital (*see* Figure 6). The garden is maintained by a head gardener who co-ordinates a team of volunteers. The volunteers, some of whom are people living with paralysis, are crucial to the success of Horatio's Garden, and the vast majority of surveyed patients reported that they and access to the gardens have improved their happiness and health during their stay. The charity organises events and activities, including garden therapy, music and art for patients, offering the gentle side of rehabilitation in beautiful garden settings.

Figure 6 Horatio's Garden



Source: Horatio's Garden 2015

Gardening and dementia care

As life expectancy continues to increase, more and more people are likely to experience dementia as well as the physical health problems associated with ageing. Recent estimates suggest that there were 850,000 people in the UK with dementia in 2015, which may rise to more than 1 million by 2025 (Alzheimer's Society 2014; Whear *et al* 2014), although estimates vary.

There has therefore been increasing interest in the use of non-pharmacological interventions to support the wellbeing of people with dementia and their families and carers in their own homes and communities. Launched in February 2013 by the Alzheimer's Society, there are now 1 million Dementia Friends – people with some understanding of dementia and the small things they can do to help people affected by it. Increasingly, communities, places, businesses and the public sector are recognising their role. For example, Marks & Spencer created 80,000 Dementia Friends among its staff.

Already, more than half of all care home residents have dementia, rising to three-quarters of residents of nursing homes. Whear *et al* (2014) have recently undertaken a systematic review on how outdoor spaces and gardens may alleviate symptoms in these settings. They sought to address two questions:

- What is the impact of gardens and outdoor spaces on the mental and physical wellbeing of people with dementia who are resident in care homes?
- What are the views of people with dementia, their carers and care home staff on the value of gardens and outdoor spaces?

The review identified nine quantitative studies, seven qualitative studies and one mixed-methods approach. As ever, the authors caution about the lack of RCTs and inconsistencies in study design. In particular, the studies were very mixed, with some in which residents were free to use the garden, others with time-limited supervision, and others still where horticultural therapy was part of the intervention, including seeding, planting and flower-arranging. Most studies were of US origin, with one from the United Kingdom. Most of the quantitative studies were pre- and post-intervention designs but two were RCTs; the qualitative studies were well-designed.

Most of the quantitative studies reported a reduction in agitation due to the interventions and a trend towards reduction in verbal and physical aggression, as well as other symptoms such as pacing and exit-seeking behaviour. One study comparing behaviours in sites with and without gardens observed a 19 per cent reduction in violence in the garden sites and a sevenfold increase in violence in the non-garden sites during a year of observation. In comparison, there were mixed findings for differences in emotional outcomes and in terms of outcomes such as good sleeping patterns. There was some limited evidence that use of antidepressants was reduced in those with access to gardens.

The qualitative studies were mostly addressed to staff and family members rather than the residents directly. Staff and family members enjoyed gardening and being outside, and there were testimonies of improved concentration and enjoyment on the part of their loved ones. For example:

He can't concentrate on anything for very long. So, television is not effective for him because he can't follow the storyline... But gardening is something that he can still do and enjoy very much. (Family member)

Many studies suggest that the garden changes how residents, staff and visitors interact in the long term, and can help people to reconnect with their previous interests at 'a time before dementia'. This was found even in relation to having views of the garden, as well as physically being in a garden. The qualitative studies reinforced the quantitative studies in reporting reductions in agitation:

We are taking residents from the dementia unit out into the garden in the afternoon and this is preventing them becoming agitated later in the day. (Member of staff)

Gardens also appeal to the senses – particularly touch and smell – which are important for people with dementia. Gardens and outside spaces also give people living with dementia access to natural light, which is important for the maintenance of circadian rhythms. Indeed, staff often report that people sleep better if they have had access to natural light.

Just how the gardens appear to have these effects – the mechanisms through which they work – was not tested in detail, though staff testimonies suggested that gardens variously 'keep their senses alive', offering a connection with life and reigniting memories (especially from childhood), and giving a sense of purpose and ownership, and freedom from the institutional rules of the care home itself. However, there were concerns from staff, particularly about level ground, the risk of falls and the level of supervision required, especially in homes with low staff-to-patient ratios.

Finally, Rendell and Carroll (2013) have explored, through detailed observation with 17 care homes, how garden design interacts with dementia residents' experience of the garden. They set out a diagnostic tool to improve garden design, from the perspective of improving activity and engagement rather than 'appearance'. They argue that in some of these gardens, beautiful design should take second place to encouraging engagement.

Gardening and end-of-life care in the NHS

Half a million people die in England each year. While around 7 in 10 would like to die at home, around half currently die in hospital (Dying Matters 2011). Given that so many of us die in hospitals, and spend time in care homes and hospices before death, it is important that the environment we are in is as good as it can be – for us and our families and those who care for us.

A place to die with dignity (NHS Estates 2005) made a number of recommendations in relation to death and dying in the hospital environment. At that time, work was already under

way at The King’s Fund to develop a programme called Enhancing the Healing Environment (EHE) (Waller and Finn 2011) to support improvements in end-of-life care services.

The King’s Fund commissioned a literature search to inform the development of the EHE programme. This found that there were a large number of research studies and evidence from the UK and abroad showing the effects the environment has on patients’ wellbeing, but there had been little research on the effects of the environment on people who are dying, their relatives and the recently bereaved. Among other design elements (including home-like environments, natural light and facilities for family members), the literature proposed access to outside spaces and gardens as important elements in end-of-life care in NHS institutions.

The Environments for Care at End of Life (ECELE) programme (Waller and Finn 2011), part of EHE, ran from 2008 to 2010, funding 28 pilot schemes through Department of Health grants and the contributions of the pilot sites themselves. Many of these pilots focused on gardens (indoors and outdoors) and outdoor spaces, including (the then) Frimley Park Hospital NHS Foundation Trust, which has a national award-winning garden.

Examples of EHE garden projects, including at the end of life and in different care settings, are shown in Figure 7.

Figure 7 The EHE gardens: case studies of garden design in acute and mental health care settings



Source: The King’s Fund 2012

The ECEL programme also supported 35 hospices as they undertook projects to improve their environment of care. Working with patients, staff and volunteers from a number of hospices, workshops were held to develop a set of design principles (The King's Fund 2011), a key part of which was access to outside spaces and gardens and the need to have contact with nature. These principles then formed the basis of an architectural design competition, which has led to the development of an Environmental Design Audit Tool for residential and day care homes and hospices. For more examples of hospices and their gardens, see The King's Fund (2011).

Given the importance of gardens in care homes, hospitals and hospices, it is surprising that there are no rights to accessing outdoor space or gardens. Sarah Waller, leader of the EHE and ECEL programmes and now at the Association for Dementia Studies at the University of Worcester, made this observation:

When we were working with the prisons it always struck me that prisoners have a right to a period of time in the open air each day but we don't, as an NHS or social care system, make sure our patients or residents have the same privileges! I remember meeting a service user who had not left a mental health ward for over six months until the day we opened a garden in Sussex. (Personal communication)

6 The business case for gardens, gardening and health

Increasingly, health interventions of all sorts – particularly those that are non-traditional in approach – are expected to demonstrate their value for money in terms of health and broader outcomes. There are techniques to do this (see Buck 2014 for a review) but studies of ‘the business case’ for gardening from a health perspective are rare. For example, a simple search in Google Scholar reveals that where ‘gardening’ and ‘economic evaluation’ are searched for, most studies report the financial value of fruit and vegetables that have been grown by gardeners.

The previous sections of this report have revealed some indication of the business case for gardening from a health perspective and previous work by The King’s Fund has reviewed the wider literature. For example:

- Increasing access to parks and open spaces could reduce NHS costs of treating obesity by more than £2 billion (Groundwork, no date).
- Green walls and trees could remove some air pollution from streets; trees are the better option though the overall effects are low, but factoring in the noise pollution impact reductions could improve the return on investment to health (Kilbane-Dawe 2012). For example, London’s tree-cover (which includes gardens) provides a wide range of benefits linked to health including carbon storage, flood alleviation and amenity value, valued in total at more than £130 billion (Kenton *et al* 2015).
- Access to green space can reduce mental health admissions, resulting in additional savings for the NHS (Wheater *et al* 2007). The New Economics Foundation estimated the value of the Ecominds programme (a programme supported by Mind to offer outdoor experiences including gardening for those with mental health problems) for five participants to be around £7,000 each through reduced NHS costs, welfare benefit reductions and increased tax contributions (New Economics Foundation 2014).
- The national evaluation of the British Trust for Conservation Volunteers (BTCV) Green Gym project (Yerrell 2008) between 2005 and 2009 estimated that for every £1 invested in green gyms, £2.55 would be saved in treating illness related to physical inactivity. Social prescriptions for woodland activities for those with mental health problems in the Scottish Branching Out programme suggest a cost of £8,600 per

quality-adjusted life-year (QALY) – highly cost effective by NICE benchmarks (Willis *et al* 2016).

- Community gardening has been shown to lead to possible NHS savings. For example, Garden Partners in Wandsworth (Jackson *et al*, no date) suggested an estimated potential saving to the NHS in one year of the project to be £113,748 for those who reported an improvement in their health. When widened to include those who reported that their condition was no worse, this gave a potential saving of £500,223.
- Greenspace Scotland (2011) has collated a wide range of social return on investment studies, including on community-growing initiatives.

More broadly, gardening is part of social prescribing or community referrals. There are some examples, such as in Rotherham, where social prescribing – which included gardening – has reduced A&E attendance, outpatient appointments and inpatient admissions and led to increases in wellbeing. The Rotherham scheme was estimated to be able to pay for itself over 18–24 months in terms of reduced NHS use.

However, each of the above studies, while useful, is very specific and uses a different methodology. There is no simple general case that can be made to *prove* the business case for gardening. Rather, we need more specific examples of the types above, with the recognition that the benefits of gardening are broad, holistic and diverse by nature, such that any business case is likely to underestimate its effects.

Gardens also do not exist in isolation from the wider landscape or environment. Part of their ‘value’ can be assessed or at least approximated in their contribution to that environment. For example, the Town and Country Planning Association and Public Health England (Ross and Chang 2014) cite evidence that in the design of healthier places, designers and developers could create more economically thriving spaces that would add value to their schemes, as well as fulfilling national and local health policies. For example, retailers report an increase in trade of up to 40 per cent when places are made more attractive for walking, including through the use of small urban parks and greener walkways; places that are easier and more attractive to walk around (designed for so-called ‘walkability’) do better commercially, with an 80 per cent increase in retail sales, and have higher housing values; and the most valuable streets in London (as measured by rateable value per square metre) are those that have the best spatial accessibility.

Finally, the National Trust is currently undertaking a financial sustainability study (Horticulture Week 2015) of how urban parks – under pressure due to local government funding cuts – can be funded, including through ‘paying for’ the value of their impacts on health and wellbeing. This study is exploring how the case for gardening can be developed to persuade health commissioners to contribute to the long-term funding of high-quality parks. This is part of Nesta’s Rethinking Parks programme (Nesta, no date).

7 Implications for policy and recommendations

It is clear that gardens can touch every part of our lives and therefore are impacted by every part of the policy process. Since gardens are so ubiquitous, they are the elephant outside of the room, providing multiple pathways to health gain, recovery and solace through achievement, activity and social contact. Ironically, this very ubiquity creates a challenge for policy-makers, as it does for systematic reviewers and others seeking to divine the specific impacts of gardening on health and the mechanisms through which those impacts are achieved.

There is no doubt that ‘evidence’ is a part of policy-making, and this report has been about assembling, assessing and making sense of the evidence that currently exists for the link between gardens, gardening and health. But the term ‘evidence’ means different things to different people, and is used for many purposes.

If the amount of evidence was the only issue to solve in policy-making, we would be there by now. There are more than 24 million published medical papers in PubMed, the most widely used medical database, yet around 90 per cent of these are never cited by anyone else, and fewer still are probably ever used to actually inform a policy decision. Further, much research evidence is not useful to policy-makers. It is often too specific, out of context (from different countries, systems, or otherwise lacking direct relevance), and not policy-focused; in addition, much of it focuses on the nature of the problem rather than solutions, and is often only available after a decision has to be made.

We have therefore attempted to include in this review, evidence that is *relevant*. It includes a mix of information and studies on how gardens and gardening are related to health, how this is reflected across the life-course, how successful different interventions have been, and how gardens and gardening relate to service provision, particularly in the NHS. We have called on case studies, qualitative studies and quantitative studies and have been fortunate that some very recent systematic reviews have done a lot of the hard work for us. Many of the latter in particular decry the lack of stronger study designs, especially RCTs. Our own view is that while more RCTs would definitely be helpful, we also need to put into practice what we already know, and what this report and others have shown.

While we therefore have a subsection below on recommendations for building the future evidence base, the priority must be to integrate existing knowledge into policy and practice. We believe that there are three levels where this effort is best directed:

- at the strategic policy level, which includes departments of state, the planning system and the health and social care system
- at the local level, through the role of local planning and local commissioners and providers, including issues of sustainability and funding
- at the level of implementing and developing the evidence base.

Influencing policy at the strategic level

There are a range of mechanisms at the strategic policy level where the health and wellbeing impacts of gardens and gardening need to be better represented. These include the role of three key departments of state and the strategic leadership of the health and care system. To any outsider and indeed to most insiders, the policy framework for health and the structures and organisations that implement policy and practice are bewildering in their array and complexity, and are in constant flux. However, there are key touchpoints – ways in and initiatives within the NHS and wider public health system that are critical to gardening being taken more seriously as a health intervention. Many of these are related to the Forward View and the policies supporting it.

- **Department of Health, Defra and Department for Communities and Local Government.** The two departments of state that play a key role in the relationship between gardening and health are the Department of Health and Defra. They already work together in a number of areas of joint interest, including the development of the government's 25-year plan for a 'healthy natural economy' (Defra 2016; Defra 2015). To these two must be added the Department for Communities and Local Government (DCLG), given the important role of planning in the future of public gardens and the department's role as the funder and supporter of local government. Further collaboration and alignment of these government departments is essential if they are to maximise their policy lead on gardening, and on marshalling and disseminating the evidence.

We recommend that the Department of Health, Defra and the DCLG continue to work together to align policies that are likely to impact on gardens and gardening. They should also identify gaps and fund and marshal the evidence for their respective delivery chains to strengthen the case for gardening and health, and to make it easier for that case to be implemented nationally, regionally and locally.

- **The Forward View.** The Forward View is the vision of the future set out by NHS England and other key strategic health organisations. It is the direction of travel for a system with constrained funding growth and an ageing population with more complex needs, including greater numbers of people with dementia and multiple comorbidities. Those promulgating the contribution of gardens and gardening to health and wellbeing therefore need to find touchpoints with key emerging policies that sit under the Forward View.

We recommend that four key NHS England programmes that support the Forward View consider the role of gardens and gardening in their delivery.

- The New Models of Care programme (the vanguards and others) should explicitly consider the case for a greater role for gardening as part of its broader approach to improving health. This is most directly relevant, given the evidence in this report, to the streams on care homes, end-of-life care and primary and community care.
- The NHS Healthy New Towns programme continues its good work with the Town and Country Planning Association, the Local Government Association and others to support sites that include well-designed gardens in their plans. Although a relatively small initiative, this represents a serious attempt to ‘design in’ healthy environments from the start of town planning, of which gardens should be a key part. The NHS England support team should share this evidence with demonstrator sites.
- The Social Movements for Health and Realising the Value programmes and associated initiatives includes the role of gardens and gardening in its assessment of how social movements for health can be supported. Gardening is clearly an important activity for millions of people and there are opportunities to further realise its benefits through social prescribing, volunteering (including reciprocal), community gardening and other forms of social action.
- Further, NHS England and the Department of Health should explore the possibility of ‘a right to interacting with the outdoor environment, subject to clinical appropriateness’ as part of the NHS Constitution, or other guidance.

We recommend that Public Health England further supports local government and the NHS in implementing public health activities related to gardens and gardening as part of its broader approach to the provision of green and blue infrastructure more broadly.

We recommend that the Department of Health considers how access to gardens and gardening can be incorporated into its efforts to bring parity between mental health and physical health and its support for people with dementia. The evidence in this report is particularly compelling for the holistic mental health benefits of gardening and this needs to be better reflected in policy.

- **Wider strategic enablers.** Other reforms – including reform of the planning system, government support for volunteering and the application of the Public Services (Social Value) Act 2012 – are helpful strategic enablers for a greater focus on gardening for health. In *Improving the public's health* (Buck and Gregory 2013), we argued that councils should work with local communities to help them develop strategic plans for green space within broader neighbourhood plans. This would help to stimulate physical activity in local communities (Astell-Burt *et al* 2014). We also argued that access to green space – particularly for lower socio-economic groups – could be prioritised in planning developments. A good example of gardens in the planning process is set out in *Planning healthy-weight environments* (Ross and Chang 2014), which recommends that opportunities are provided for households to own or have access to space to grow food – for example, roof or communal gardens, or allotments. Further, Public Health England, the Local Government Association and the Association of Directors of Public Health have recently commissioned Leeds Beckett University to work with local councils and partners on a whole-system approach to obesity (Leeds Beckett University 2016).

We recommend that the bodies above fully recognise the role of gardens and gardening and their impact on health and develop gardening as a route to meeting their policy objectives. Within this, we recommend the following.

- Public Health England, the Association of Directors of Public Health and the Local Government Association (with the Town and Country Planning Association) should see gardens and gardening as an important and integral part of neighbourhood and town planning, as well as their work on obesity, mental health and other broader issues.
- The Cabinet Office's social action team should include a specific focus on the possibilities of gardening as volunteering (including reciprocal volunteering) and its relationship with social action as it develops policies on all workers being entitled to three days' volunteering leave.
- Public Health England and the Cabinet Office should undertake a review of how the Public Services (Social Value) Act can be used to promote the role of gardens and gardening in relation to health and wellbeing, and disseminate the results.

- **Influencing institutions.** Influencing institutions that have a stake in gardens and gardening are also widely dispersed across health, horticulture, gardening and environmental interests and do not always act together or in ways that policy-makers find easy to act on.

We recommend that the key influencers in the health, environmental, and gardening and horticulture sectors need to come together and develop a stronger joint strategy that will allow them to have a greater influence on policy on gardens and health at the strategic as well as local level, and contribute constructively to debates on sustainability

Influencing policy at the local level

The role of gardens, particularly public spaces and gardens, in health and wellbeing needs to be given greater recognition and integrated into wider approaches to public health and public services. Gardens should feature in devolution and place-based planning as part of a broad approach to improving health.

- **Public health reform/directors of public health and local government.** The coalition government's public health reforms were welcomed since they reflect the reality that most of what influences our health is outside the NHS and closely aligned with local authority functions. This gives directors of public health greater influence over policies that influence our health. Directors of public health, and their representative bodies such as the Faculty of Public Health and the Association of Directors of Public Health, are therefore important allies in promoting gardens and gardening in all its forms in relation to their effects on health and wellbeing.

We recommend that the NGS and its partners share this report with the Faculty of Public Health and the Association of Directors of Public Health to help disseminate its findings to their members.

- **Health and wellbeing boards.** Directors of public health are one of the few statutory members of health and wellbeing boards, the body where local needs assessment and planning for health and wellbeing are decided. Access to the health and wellbeing board, its needs assessment and the strategy is therefore important if strategic policies on health and wellbeing and gardening are to be developed and have traction. Currently, however, few health and wellbeing boards prioritise 'the physical environment' in their strategies.

We recommend that the NGS and its partners work with the Local Government Association to share this report with health and wellbeing board chairs to inform their future strategies, as well as its joint work with Public Health England on creating healthy-weight environments.

- **Clinical commissioning groups (CCGs).** As we have seen, gardening, growing and wider activities such as green gyms can be integral parts of social prescribing. CCGs and their GP members are also on health and wellbeing boards and can make the case for gardening in this forum.

We recommend that CCG social prescribing projects include gardening, growing and wider activities among the list of opportunities for patients. As part of this, CCGs should also work with others including councils and the voluntary sector to explore the case for reciprocal gardening schemes in their localities. CCGs should also evaluate any gardening as social prescribing schemes they operate, to contribute to the developing evidence base.

- **Place-based population health systems.** Policy towards public services, including the NHS, is going through significant change, with greater devolution of funding, more local control and a focus on ‘place’ as opposed to organisations. The devolution of wider powers over funding and decision-making is proceeding apace; it offers the opportunity to truly integrate a strategic plan for the funding, use and accessibility of green space (including public and private gardens) into the long-term future of local places – and could also include the use of excess public sector estate, such as hospital grounds. In parallel with these wider devolution trends across other local public services, the NHS is developing planning at a place-based level, currently reflected in 44 sustainability and transformation plans. In the longer term, they are likely to lead to a strengthening of the relationship between the NHS and ‘place’, including more strategic use and re-use of NHS estates and land.

We recommend that the NGS and its partners share this report with leaders of devolution and NHS sustainability and transformation plans so that they can inform those plans as they develop and mature. In particular, local directors of public health will have a key role to play in this; they can influence local devolution plans so that the role of gardening in health and wellbeing is appropriately reflected, and can help to link devolution plans with NHS sustainability and transformation plans as they develop over time.

Evidence suggests that the quality of public gardens and parks is important in maximising their use and therefore their value, particularly for those groups that are less likely to use them anyway. Many public parks are owned by councils, or at least funded through council budgets, which are under considerable pressure. Spending on parks and leisure facilities has fallen over recent years (Press Association 2014).

- The financial sustainability of high-quality public parks and gardens must be a priority. Relying solely on existing sources of funding is clearly not sufficient, and more diverse and innovative funding and maintenance models are urgently required. This could include working in new ways with the private and third sectors through

partnerships or trusts (Commission for Architecture and the Built Environment 2006). Further, there are exciting examples of social prescribing and community use of gardens, including the use of NHS estates, which require the support of the local NHS and councils to flourish.

We recommend that the Local Government Association works with its partners to ensure the sustainability of public gardens so that they continue to deliver positive health benefits. This is likely to require innovative funding models, incentive schemes and working collaboratively with the public and private sectors. It can achieve this in many ways, including the following:

- arguing that any rationalisation of the existing public parks stock ensures continued access to high-quality parks and remains equitable, particularly in areas where access is traditionally poor but where there is more to gain for health (for example, in urban, deprived communities)
- working with its members to understand and share information on how innovative councils are finding creative ways to stretch existing funding, including funding models such as those in Nesta's Rethinking Parks programme – it could also work with volunteer groups and 'Friends of Parks'
- supporting councils to work with others to create controlled public access to more high-quality private gardens to compensate for any reduction in public parks – for example, working with organisations such as the NGS and other Open Gardens schemes
- supporting councils to assess excess demand for allotments and – where appropriate and locally supported – consider reducing the plot size of allotments in order to create opportunities for more people to experiment with growing their own food
- developing the case and supporting more investment (from CCGs and others) for 'reciprocal gardening schemes', which match people who are unable to maintain their gardens with people who want to garden but have no garden, while also potentially creating social bonds and reducing social isolation
- supporting (and pump-priming where needed) the use of excess and low-quality public land and space as community gardening schemes, with the active involvement of GPs, hospital trusts and other NHS organisations as the NHS and wider public sector reviews its estate as part of consolidation and transformation programmes.

Implementing and developing the evidence base

We believe that this review has revealed an overwhelming weight of diverse and holistic evidence that shows how important gardens and gardening are for our health throughout the life-course. This evidence is varied in nature and in the strength of its study design. Given this, we believe that a pragmatic approach is needed, putting existing knowledge into practice and disseminating it where it will be most useful, as well as generating more evidence, as explained below.

We recommend a priority programme of evidence collation and dissemination, supported by a further programme of research. This programme should be a joint effort between strategic and local bodies, with the support of institutions such as the National Institute for Health Research (NIHR), the Wellcome Trust and the RHS. It should have three focuses, as follows:

- a priority strand on assembling, maintaining and disseminating the existing evidence on gardens, gardening and health, organised and expressed in ways that decision-makers can act on, which should use a range of methodologies including observational, qualitative and case studies research, and not be restricted to RCTs – Public Health England and NICE will have an important role to play in this, alongside other partners such as the Local Government Association and NHS England
- a research strand on realist/theory-driven frameworks (what works, in what circumstances and for whom?) *and* RCTs *and* complex public health evaluation methodologies to better establish the mechanisms through which gardening and gardening interventions have impacts on health and wellbeing for different populations across the life-course
- a strand on economic evaluation, with a focus on the cost-effectiveness of alternative evaluations – this could include commissioning NICE to develop a ‘return on investment (ROI) tool’ as it has done for a range of other public health interventions.

An important focus for all this research should be the impact on equity. This is rarely considered in existing research, despite the evidence that certain groups have less access to gardens, gardening and wider green space than others.

References

Alcock I, White MP, Wheeler BW, Fleming LE, Depledge MH (2014). 'Longitudinal effects on mental health of moving to greener and less green urban areas'. *Environmental Science and Technology*, vol 48, no 2, pp 1247–55.

Allen J, Balfour R (2014). *Natural solutions for tackling health inequalities*. London: Institute for Health Equity, UCL. Available at: www.instituteofhealthequity.org/projects/natural-solutions-to-tackling-health-inequalities (accessed on 26 April 2016).

Alzheimer's Society (2014). *Dementia UK: update*. London: Alzheimer's Society. Available at: www.alzheimers.org.uk/dementiauk (accessed on 26 April 2016).

Astell-Burt T, Feng X, Kolt GS (2014). 'Greener neighborhoods, slimmer people? Evidence from 246 920 Australians'. *International Journal of Obesity*, vol 38, no 1, pp 156–9.

Bagnall AM, Southby K, Mitchell B, South J (2015). *Bibliography and map of community-centred interventions for health and wellbeing*. Available at: <http://eprints.leedsbeckett.ac.uk/1782/> (accessed on 22 April 2016).

Balfour R, Allen J (2014). *Local action on health inequalities: improving access to green spaces*. London: Public Health England. Available at: www.instituteofhealthequity.org/projects/improving-access-to-green-spaces (accessed on 4 April 2016).

Barton J, Pretty J (2010). 'What is the best dose of nature and green exercise for improving mental health? A multi-study analysis'. *Environmental Science & Technology*, vol 44, no 10, pp 3947–55.

Bawden A (2016). 'How a GP co-op is sowing the seeds of healthy eating?' *The Guardian*, 23 March. Available at: www.theguardian.com/society/2016/mar/23/gp-food-coop-healthy-eating-lambeth-south-london (accessed on 22 April 2016).

Berg AE van den, Custers MHG (2011). 'Gardening promotes neuroendocrine and affective restoration from stress'. *Journal of Health Psychology*, vol 16, no 1, pp 3–11.

Berg AE van den, Winsum-Westra M van, Vries S de, Dillen SM van (2010). 'Allotment gardening and health: a comparative survey among allotment gardeners and their neighbors without an allotment'. *Environmental Health*, vol 9, no 1, p 74.

Bowler DE, Buyung-Ali L, Knight TM, Pullin AS (2010). 'Urban greening to cool towns and cities: a systematic review of the empirical evidence'. *Landscape and Urban Planning*, vol 97, no 3, pp 147–55.

Bragg R, Atkins G (2016). *A review of nature-based interventions for mental health care – Natural England Commissioned Report 204*. London: Natural England. Available at: <http://publications.naturalengland.org.uk/publication/4513819616346112> (accessed on 24 April 2016).

Brandling J, House W (2007). *Investigation into the feasibility of a social prescribing service in primary care: a pilot project*. Available at: <http://opus.bath.ac.uk/22487/> (accessed on 22 April 2016).

Bratman GN, Hamilton JP, Daily GC (2012). 'The impacts of nature experience on human cognitive function and mental health'. *Annals of the New York Academy of Sciences*, vol 1249, pp 118–36.

Bromley by Bow Centre (no date). 'Social prescriber'. Bromley by Bow Centre website. Available at: www.bbcb.org.uk/social-prescriber (accessed on 22 April 2016).

Buck D (2014). *Understanding the economics of investments in the social determinants of health*. London: Institute for Health Equity, UCL and Public Health England. Available at: www.instituteofhealthequity.org/projects/understanding-the-economics-of-investments-in-the-social-determinants-of-health (accessed on 26 April 2016).

Buck D, Gregory S (2013). *Improving the public's health: a resource for local authorities*. London: The King's Fund. Available at: www.kingsfund.org.uk/publications/improving-publics-health (accessed on 25 April 2016).

Cameron RWF, Blanuša T, Taylor JE, Salisbury A, Halstead AJ, Henricot B, Thompson K (2012). 'The domestic garden – its contribution to urban green infrastructure'. *Urban Forestry & Urban Greening*, vol 11, no 2, pp 129–37.

Caper K, Plunkett J (2015). *A very general practice: how much time do GPs spend on issues other than health?* Available at: www.citizensadvice.org.uk/about-us/policy/policy-research-topics/health-and-care-policy-research/public-services-policy-research/a-very-general-practice-how-much-time-do-gps-spend-on-issues-other-than-health/ (accessed on 22 April 2016).

Centre for Reviews and Dissemination, University of York (2015). *Evidence to inform the commissioning of social prescribing*. York: Centre for Reviews and Dissemination, University of York. Available at: www.york.ac.uk/media/crd/Ev%20briefing_social_prescribing.pdf (accessed on 8 April 2016).

Chan S (2015). 'GPs prescribe gardening to help mental health patients'. *GP*, 26 May. Available at: www.gponline.com/gps-prescribe-gardening-help-mental-health-patients/mental-health/article/1348669 (accessed on 22 April 2016).

Chen T-Y, Janke MC (2012). 'Gardening as a potential activity to reduce falls in older adults'. *Journal of Aging and Physical Activity*, vol 20, no 1, pp 15–31.

Christian MS, Evans CE, Cade JE (2014). 'Does the Royal Horticultural Society Campaign for School Gardening increase intake of fruit and vegetables in children? Results from two randomised controlled trials'. *Public Health Research*, vol 2, no 4, pp 1–162.

Clatworthy J, Hinds JM, Camic P (2013). 'Gardening as a mental health intervention: a review'. *Mental Health Review Journal*, vol 18, no 4, pp 214–25.

Commission for Architecture and the Built Environment (2006). *Paying for parks: eight models for funding green space*. London: Commission for Architecture and the Built Environment. Available at: <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/publications/paying-for-parks> (accessed on 22 April 2016).

Coombes E, Jones AP, Hillsdon M (2010). 'The relationship of physical activity and overweight to objectively measured green space accessibility and use'. *Social Science & Medicine*, vol 70, no 6, pp 816–22.

Cupitt S (2015). 'Randomised controlled trials – gold standard or fool's gold? The role of experimental methods in voluntary sector impact assessment'. Charities Evaluation Service website. Available at: www.ces-vol.org.uk/thinkpieces/thinkpiece-archive/Randomised+controlled+trials.html (accessed on 22 April 2016).

Dadvand P, de Nazelle A, Figueras F, Basagaña X, Su J, Amoly E, Jerrett M, Vrijheid M, Sunyer J, Nieuwenhuijsen MJ (2012). 'Green space, health inequality and pregnancy'. *Environment International*, vol 40, pp 110–15.

Davies SG, Devereaux M, Lennartsson M, Schmutz U, Williams S (2014). *The benefits of gardening and food growing for health and wellbeing*. London: Garden Organic and Sustain. Available at: www.sustainweb.org/publications/the_benefits_of_gardening_and_food_growing/ (accessed on 22 April 2016).

Dayson C, Bashir N (2014). *The social and economic impact of the Rotherham Social Prescribing Pilot: main evaluation report*. Sheffield: Sheffield Hallam University. Available at: www.shu.ac.uk/research/cresr/ouexpertise/evaluation-rotherham-social-prescribing-pilot (accessed on 22 April 2016).

De Vries S, Verheij RA, Groenewegen PP, Spreeuwenberg P (2003). 'Natural environments – healthy environments? An exploratory analysis of the relationship between greenspace and health'. *Environment and Planning A*, vol 35, no 10, pp 1717–31.

Defra (Department for Environment, Food and Rural Affairs) (2016). 'DEFRA single departmental plan: 2015 to 2020'. GOV.UK website. Available at: www.gov.uk/government/publications/defra-single-departmental-plan-2015-to-2020/single-departmental-plan-2015-to-2020 (accessed on 22 April 2016).

Defra (Department for Environment, Food and Rural Affairs) (2015). *The government's response to the Natural Capital Committee's third State of Natural Capital report* [online]. GOV.UK website. Available at: www.gov.uk/government/publications/natural-capital-committees-third-state-of-natural-capital-report-government-response (accessed on 22 April 2016).

Department for Culture, Media and Sport (2015a). *Freetime activities tables* [online]. GOV.UK website. Available at: www.gov.uk/government/statistics/taking-part-201314-focus-on-reports (accessed on 26 April 2016).

Department for Culture, Media and Sport (2015b). *Taking part 2013/14: focus on: free time activities* [online]. GOV.UK website. Available at: www.gov.uk/government/statistics/taking-part-201314-focus-on-reports (accessed on 22 April 2016).

Department of Health (2012). *Resources for commissioning Let's Get Moving interventions* [online]. GOV.UK website. Available at: www.gov.uk/government/publications/let-s-get-moving-revised-commissioning-guidance (accessed on 22 April 2016).

Dying Matters (2011). 'Frequently asked questions'. Dying Matters website. Available at: www.dyingmatters.org/page/frequently-asked-questions (accessed on 22 April 2016).

Dzhambov AM, Dimitrova DD, Dimitrakova ED (2014). 'Association between residential greenness and birth weight: systematic review and meta-analysis'. *Urban Forestry & Urban Greening*, vol 13, no 4, pp 621–9.

Faculty of Public Health (ed) (2010). *Great outdoors: how our natural health service uses green space to improve wellbeing: an action report*. London: Faculty of Public Health.

Fänge A, Ivanoff SD (2009). 'The home is the hub of health in very old age: findings from the ENABLE-AGE Project'. *Archives of Gerontology and Geriatrics*, vol 48, no 3, pp 340–5.

Gascon M, Triguero-Mas M, Martínez D, Dadvand P, Fornes J, Plasència A, Nieuwenhuijsen MJ (2015). 'Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review'. *International Journal of Environmental Research and Public Health*, vol 12, no 4, pp 4354–79.

Gascon M, Triguero-Mas M, Martínez D, Dadvand P, Rojas-Rueda D, Plasència A, Nieuwenhuijsen MJ (2016). 'Residential green spaces and mortality: a systematic review'. *Environment International*, vol 86, pp 60–7.

Gaston KJ, Warren PH, Thompson K, Smith RM (2005). 'Urban domestic gardens (IV): the extent of the resource and its associated features'. *Biodiversity and Conservation*, vol 14, no 14, pp 3327–49.

Greenspace Scotland (2011). 'SROI publications'. Greenspace Scotland website. Available at: <http://greenspacescotland.org.uk/sroi.aspx> (accessed on 24 April 2016).

Groundwork (no date). *Green spaces: what are they worth?* Groundwork website. Available at: www.groundwork.org.uk/News/research-confirms-benefits-of-green-space (accessed on 25 April 2016).

Hartig T, Mitchell R, de Vries S, Frumkin H (2014). 'Nature and health'. *Annual Review of Public Health*, vol 35, no 1, pp 207–28.

Hickman C (2014a). 'Cheerfulness and tranquility: gardens in the Victorian asylum'. *The Lancet Psychiatry*, vol 1, no 7, pp 506–7.

Hickman C (2014b). 'The garden as a laboratory: the role of domestic gardens as places of scientific exploration in the long 18th century'. *Post-Medieval Archaeology*, vol 48, no 1, pp 229–47.

Hickman C (2013). "'To brighten the aspect of our streets and increase the health and enjoyment of our city": The National Health Society and urban green space in late-nineteenth century London'. *Landscape and Urban Planning*, vol 118, pp 112–9.

Holt-Lunstad J, Smith TB, Layton JB (2010). 'Social relationships and mortality risk: a meta-analytic review'. *PLoS Medicine*, vol 7, no 7, article 1000316.

Horatio's Garden (2015). *Horatio's Garden: trustees' report and financial statements for the year ended 30 April 2015*. Available at: www.horatiogarden.org.uk/wp-content/uploads/2015/12/Horatiogarden-2015.pdf (accessed on 22 April 2016).

Horatio's Garden (2013). 'Horatio's Garden'. Horatio's Garden website. Available at: www.horatiogarden.org.uk/ (accessed on 22 April 2016).

Horticulture Week (2015). 'National Trust strategy sets out to rescue urban parks facing austerity'. *Horticulture Week*, 3 April. Available at: www.hortweek.com/article/1340988 (accessed on 22 April 2016).

Incredible Edible Network (2016). Incredible Edible Network website. Available at: <http://incredibleediblenetwork.org.uk/> (accessed on 5 May 2016).

Jackson S, Harris J, Sexton S (no date). *Growing friendships: a report on the Garden Partners project, Age UK Wandsworth*. London: Age UK Wandsworth, NHS Wandsworth. Available at: www.ageuk.org.uk/brandpartnerglobal/wandsworthvpp/docs/growing%20friendships_medium.pdf (accessed on 20 April 2016).

Kenton R, Sacre K, Goodenough J, Doick K (2015). *Valuing London's urban forest. Results of the London i-Tree Eco Project*. London: Treeconomics London. Available at: www.treeconomics.co.uk/projects/londoni-tree (accessed on 5 May 2016).

Kilbane-Dawe I (2012). *14 cost effective actions to cut Central London air pollution*.

London: Par Hill Research Ltd. Available at:

www.rbkc.gov.uk/pdf/air_quality_cost_effective_actions_full_report.pdf

(accessed on 22 April 2016).

Kilgarriff-Foster A, O’Cathain A (2015). ‘Exploring the components and impact of social prescribing’. *Journal of Public Mental Health*, vol 14, no 3, pp 127–34.

Kimberlee R (2013). *Developing a social prescribing approach for Bristol: project report: Bristol Health and Wellbeing Board* [online]. Bristol: University of the West of England.

Available at: <http://eprints.uwe.ac.uk/23221> (accessed on 28 April 2016).

Kinsella S (2015). *Social prescribing: a review of the evidence*. Available at:

http://info.wirral.nhs.uk/document_uploads/evidence-reviews/

[Social%20Prescribing%20literature%20review%20v5.pdf](http://info.wirral.nhs.uk/document_uploads/evidence-reviews/Social%20Prescribing%20literature%20review%20v5.pdf) (accessed on 22 April 2016).

Lachowycz K, Jones AP (2011). ‘Greenspace and obesity: a systematic review of the evidence’. *Obesity Reviews*, vol 12, no 5, pp e183-e189.

Lambeth GP Food Co-op (no date). *Lambeth GP Food Co-op*. Available at:

<http://lgpfc.co.uk/> (accessed on 22 April 2016).

Lee ACK, Maheswaran R (2011). ‘The health benefits of urban green spaces: a review of the evidence’. *Journal of Public Health*, vol 33, no 2, pp 212–22.

Leeds Beckett University (2016). ‘Obesity: a whole systems approach’. Leeds Beckett University website. Available at:

www.leedsbeckett.ac.uk/wholesystemsobesity/a-whole-systems-approach/

(accessed on 22 April 2016).

Liu GC, Wilson JS, Qi R, Ying J (2007). ‘Green neighborhoods, food retail and childhood overweight: differences by population density’. *American Journal of Health Promotion*, vol 21, no 4 suppl, pp 317–25.

Lloyds Bank (2015). *Britain at home: competing with computers – parents spruce up gardens to tempt children outdoors*. London: Lloyds Banking Group. Available at:

www.dotrythisathome.com/wp-content/uploads/2015/06/Britain-at-Home-Lloyds-Bank-Insurance-03.01.15.pdf (accessed on 22 April 2016).

Lovell R, Husk K, Bethel A, Garside R (2014). 'What are the health and well-being impacts of community gardening for adults and children: a mixed method systematic review protocol'. *Environmental Evidence*, vol 3, pp 1–13.

Lovell R, Husk K, Cooper C, Stahl-Timmins W, Garside R (2015). 'Understanding how environmental enhancement and conservation activities may benefit health and wellbeing: a systematic review'. *BMC Public Health*, vol 864, no 15, doi: 10.1186/s12889-015-2214-3.

Maas J (2006). 'Green space, urbanity, and health: how strong is the relation?'. *Journal of Epidemiology & Community Health*, vol 60, no 7, pp 587–92.

Macmillan Cancer Support (2012). 'Sowing the seeds of recovery: gardening helps cancer patients beat depression'. Macmillan Cancer Support website. Available at: www.macmillan.org.uk/aboutus/news/latest_news/sowingtheseedsofrecoverygardeninghelpscancerpatientsbeatdepression.aspx (accessed on 22 April 2016).

McVeigh T (2015). 'Losing the plot: the fight is on to save our green and pleasant allotments'. *The Guardian*, 17 May. Available at: www.theguardian.com/lifeandstyle/2015/may/17/allotments-threat-housing-cities-green-spaces (accessed on 22 April 2016).

Mitchell R, Popham F (2008). 'Effect of exposure to natural environment on health inequalities: an observational population study'. *The Lancet*, vol 372, no 9650, pp 1655–60.

National Children's Bureau (2013). 'Greater expectations: raising aspirations for our children'. National Children's Bureau website. Available at: www.ncb.org.uk/12976 (accessed on 25 April 2016).

Natural England (2016). *Monitor of Engagement with the Natural Environment pilot study: visits to the natural environment by children* [online]. GOV.UK website. Available at: www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-pilot-study-visits-to-the-natural-environment-by-children (accessed on 22 April 2016).

Natural England (2015). *Monitor of Engagement with the Natural Environment: 2013 to 2014* [online]. GOV.UK website. Available at: www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-2013-to-2014 (accessed on 22 April 2016).

Nesta (no date). 'Rethinking parks'. Nesta website. Available at: www.nesta.org.uk/project/rethinking-parks (accessed on 22 April 2016).

New Economics Foundation (2014). *Mind: the economic benefits of Ecominds*. London: NEF Consulting. Available at: www.nef-consulting.co.uk/mind-economic-benefits-ecominds/ (accessed on 24 April 2016).

NHS England, Care Quality Commission, Monitor, Health Education England, NHS Trust Development Authority, Public Health England (2014). *NHS five year forward view* [online]. London: NHS England. Available at: www.england.nhs.uk/ourwork/futurenhs/ (accessed on 22 April 2016).

NHS Estates (2005). *A place to die with dignity: creating a supportive environment* [online]. GOV.UK website. Available at: www.gov.uk/government/publications/a-place-to-de-with-dignity-creating-a-supportive-environment (accessed on 22 April 2016).

Nicklett EJ, Anderson A, Yen IH (2014). 'Gardening activities and physical health among older adults: a review of the evidence'. *Journal of Applied Gerontology*, doi: 10.1177/733464814563608.

Ohly H, Gentry S, Wigglesworth R, Bethel A, Lovell R, Garside R (2016). 'A systematic review of the health and well-being impacts of school gardening: synthesis of quantitative and qualitative evidence'. *BMC Public Health*, vol 16, no 1, p 286.

Oxford University Press (2016). 'Home'. □Oxford English Dictionary website. Available at: www.oed.com/ (accessed on 22 April 2016).

Parliamentary Office of Science and Technology (2016). *Green space and health: POSTnote*. Available at: <http://www.parliament.uk/mps-lords-and-offices/offices/bicameral/post/publications/postnotes/> (accessed on 27 April 2016).

Pavey TG, Taylor AH, Fox KR, Hillsdon M, Anokye N, Campbell JL, Foster C, Green C, Moxham T, Mutrie N, Searle J, Trueman P, Taylor RS (2011). 'Effect of exercise referral schemes in primary care on physical activity and improving health outcomes: systematic review and meta-analysis'. *BMJ*, vol 343, p d6462.

Pettigrew S, Roberts M (2008). 'Addressing loneliness in later life'. *Aging and Mental Health*, vol 12, no 3, pp 302–9.

Pinder R, Kessel A, Green J, Grundy C (2009). 'Exploring perceptions of health and the environment: a qualitative study of Thames Chase Community Forest'. *Health & Place*, vol 15, no 1, pp 349–56.

Pitt H (2016). 'Why getting children to "engage with nature" isn't all it's cracked up to be'. The Conversation website. Available at: <http://theconversation.com/why-getting-children-to-engage-with-nature-isnt-all-its-cracked-up-to-be-55181> (accessed on 8 April 2016).

Press Association (2014). 'UK parks are near crisis point because of budget cuts, say campaigners'. *The Guardian*, 26 June. Available at: www.theguardian.com/cities/2014/jun/26/uk-parks-crisis-budget-cuts-campaigners (accessed on 26 April 2016).

Pretty J, Peacock J, Hine R, Sellens M, South N, Griffin M (2007). 'Green exercise in the UK countryside: effects on health and psychological well-being, and implications for policy and planning'. *Journal of Environmental Planning and Management*, vol 50, no 2, pp 211–31.

Priestly W (2015). *State of the market survey 2015: local authority allotment services*. Available at: www.apse.org.uk/apse/index.cfm/members-area/briefings/2015/15-38-local-authority-allotment-services-state-of-the-market-survey-report-2015/ (accessed on 22 April 2016).

Raji CA, Merrill DA, Eyre H, Mallam S, Torosyan N, Erickson KI, Lopez OL, Becker JT, Carmichael OT, Gach HM, Thompson PM, Longstreth WT, Kuller LH (2016). 'Longitudinal relationships between caloric expenditure and gray matter in the Cardiovascular Health Study'. *Journal of Alzheimer's Disease*, 11 March, epub.

Rendell M, Carroll D (2013). 'Why don't we go into the garden?'. *Journal of Dementia Care*, vol 23, no 2, pp 16–8. Available at: www.careinfo.org/2015/02/ (accessed on 22 April 2016).

Roe J, Aspinall P (2011). 'The restorative benefits of walking in urban and rural settings in adults with good and poor mental health'. *Health & Place*, vol 17, no 1, pp 103–13.

Roe J, Thompson C, Aspinall P, Brewer M, Duff E, Miller D, Mitchell R, Clow A (2013). 'Green space and stress: evidence from cortisol measures in deprived urban communities'. *International Journal of Environmental Research and Public Health*, vol 10, no 9, pp 4086–103.

Ross A, Chang M (2014). *Planning healthy-weight environments*. Available at: www.tcpa.org.uk/pages/planning-out-obesity-2014.html (accessed on 22 April 2016).

South J (2015). *A guide to community-centred approaches for health and wellbeing*. London: Public Health England. Available at: www.gov.uk/government/publications/health-and-wellbeing-a-guide-to-community-centred-approaches (accessed on 22 April 2016).

South West Peninsula CLAHRC (2016). *Effective mechanisms for social prescribing: research and project*. Collaboration for Leadership in Applied Health Research and Care website. Available at: <http://clahrc-peninsula.nihr.ac.uk/research/effective-mechanisms-for-social-prescribing> (accessed on 24 April 2016).

Sustain (2016). 'Growing health'. Sustain website. Available at: www.sustainweb.org/growinghealth/ (accessed on 22 April 2016).

Takano T (2002). 'Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces'. *Journal of Epidemiology & Community Health*, vol 56, no 12, pp 913–8.

The King's Fund (2012). 'Completed EHE projects'. The King's Fund website. Available at: www.kingsfund.org.uk/projects/enhancing-healing-environment/completed-projects (accessed on 22 April 2016).

The King's Fund (2011). 'Principles of hospice design'. The King's Fund website. Available at: www.kingsfund.org.uk/projects/enhancing-healing-environment/hospice-design (accessed on 22 April 2016).

Thompson Coon J, Boddy K, Stein K, Whear R, Barton J, Depledge MH (2011). 'Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review'. *Environmental Science & Technology*, vol 45, no 5, pp 1761–72.

Thompson K, Head S (no date). *Gardens as a resource for wildlife* [online]. Available at: www.wlgf.org/linked/the_garden_resource.pdf (accessed on 24 April 2016).

Thomson LJ, Camic PM, Chatterjee HJ (2015). *A review of community referral schemes*. London: University College London. Available at: www.instituteofhealthequity.org/projects/a-mechanism-for-linking-patients-with-non-medical-sources-of-support-within-the-community/a-mechanism-for-linking-patients-with-non-medical-sources-of-support-within-the-community.pdf (accessed on 22 April 2016).

Thrive (2016). 'Thrive, using gardening to save lives'. Thrive website. Available at: www.thrive.org.uk/ (accessed on 22 April 2016).

Tian Y, Thompson J, Buck D (2014). 'The cost of falls: exploring the cost of the whole system pathway for older people in a rural community in England'. *Journal of Integrated Care*, vol 22, no 4, pp 165–73.

Titchmarsh A (2010). 'Alan Titchmarsh: a look back at 50 years of gardening shows'. *Express*, 24 February. Available at: www.express.co.uk/life-style/garden/160237/Alan-Titchmarsh-A-look-back-at-50-years-of-gardening-shows (accessed on 22 April 2016).

Ulrich R (1984). 'View through a window may influence recovery'. *Science*, vol 224, no 4647, pp 224–5.

Villeneuve PJ, Jerrett MG, Su J, Burnett RT, Chen H, Wheeler AJ, Goldberg MS (2012). 'A cohort study relating urban green space with mortality in Ontario, Canada'. *Environmental Research*, vol 115, pp 51–8.

Waller S, Finn H (2011). *Environments for care at end of life: The King's Fund's Enhancing the Healing Environment Programme, 2008-2010*. London: The King's Fund. Available at: www.kingsfund.org.uk/publications/environments-care-end-life (accessed on 25 April 2016).

Wang D, Glicksman A (2013). "'Being grounded": benefits of gardening for older adults in low-income housing'. *Journal of Housing for the Elderly*, vol 27, no 1–2, pp 89–104.

Ward Thompson C (2011). 'Linking landscape and health: the recurring theme'. *Landscape and Urban Planning*, vol 99, no 3–4, pp 187–95.

Whear R, Coon JT, Bethel A, Abbott R, Stein K, Garside R (2014). 'What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence'. *Journal of the American Medical Directors Association*, vol 15, no 10, pp 697–705.

Wheater CP, Potts E, Shaw EM, Perkins C, Smith H, Casstles H, Cook PA, Bellis M (2007). *Returning urban parks to their public health roots* [online]. Available at: www.nwph.net/Publications/ReturningUrbanParks.pdf (accessed on 22 April 2016).

Wheeler BW, Cooper AR, Page AS, Jago R (2010). 'Greenspace and children's physical activity: a GPS/GIS analysis of the PEACH project'. *Preventive Medicine*, vol 51, no 2, pp 148–52.

White MP, Alcock I, Wheeler BW, Depledge MH (2013). 'Would you be happier living in a greener urban area? A fixed-effects analysis of panel data'. *Psychological Science*, vol 24, no 6, pp 920–8.

Willis K, Crabtree B, Osman LM, Cathrine K (2016). 'Green space and health benefits: a QALY and CEA of a mental health programme'. *Journal of Environmental Economics and Policy*, vol 5, no 2, pp 163–80.

Wood CJ, Pretty J, Griffin M (2015). 'A case-control study of the health and well-being benefits of allotment gardening'. *Journal of Public Health*, pp fdv146.

Wright SD, Wadsworth AM (2014). 'Gray and green revisited: a multidisciplinary perspective of gardens, gardening, and the aging process'. *Journal of Aging Research*, vol 2014, article 283682.

Yerrell P (2008). *National evaluation of BTCV's Green Gym*. Oxford: School of Health and Social Care, Oxford Brookes University.

Zick CD, Smith KR, Kowaleski-Jones L, Uno C, Merrill BJ (2013). 'Harvesting more than vegetables: the potential weight control benefits of community gardening'. *American Journal of Public Health*, vol 103, no 6, pp 1110–15.

Appendix: Research strategy

Our research strategy included a literature search and conversations with experts from academia and policy, and drew on our existing knowledge and expertise. This report is not a systematic academic review but draws on a wide range of academic evidence, including recent systematic mixed quantitative and qualitative reviews, alongside insights from case studies, a seminar at Defra and personal conversations.

The research has therefore been undertaken to inform our policy recommendations, not primarily as an academic pursuit in its own right. However, it has been informed by a literature search and review conducted through The King's Fund's Information and Knowledge Services (IKS), supplemented by informal searching by the author through Google Scholar, ResearchGate and other sources.

The IKS search used the British Nursing Index (BNI); Cumulative Index to Nursing and Allied Health Literature (CINAHL); Excerpta Medica database (EMBASE); Health Business Elite; Health Management Information Consortium (HMIC); the Department of Health Library and Information Services database; The King's Fund's IKS database; NICE Evidence Search; ScienceDirect; and Social Care Online.

The search strategy for these databases is set out below. Results from this were selected for relevance, alongside material from the other sources. The information in these documents and wider information formed the basis of the report, alongside feedback on drafts from policy and academic experts.

Search strategy

The results span 2000–2015.

su: (landscaping or gardens or urban planning or environmental design or open spaces or therapeutic environment or public gardens or parks or physical activity)

(gardens or parks) and (public health or health benefits or open spaces)

gardens and social prescribing

gardens and (hospices or hospitals)

gardens and (long term illness or chronic disease)

Gardens and health

gardens or gardening and health and economic

gardens and gardening and health and benefits and financial

nature and health and benefits

parks and health and economic

('return on investment' AND gardens).ti,ab

(gardening AND health).ti,ab

(gardening AND initiatives).ti,ab

(garden AND policies).ti,ab

About the author

David Buck is Senior Fellow in Public Health and Inequalities at The King's Fund.

Email: d.buck@kingsfund.org.uk

 [@davidjbuck](https://twitter.com/davidjbuck)