Air quality: climate, health, and equity

Background

Poor air quality is the largest environmental risk to public health in the UK. Air quality is defined by how polluted the air people breathe is. Poorer air quality may be more detrimental to general population health, and particularly hazardous to those with existing lung or heart conditions. Health harms may be because of gaseous or particulate matter, most of which have been emitted directly into the air from a variety of sources. Other pollutants may be formed through further chemical reactions in the atmosphere. As much of the population spend a significant amount of their time indoors, good indoor air quality is also important for human health.

Some pollutants will impact health through interaction with the human body, and by contributing to climate change. There are therefore several co-benefits from improving air quality. In developing mitigation to climate change policies can seek to support a choice of lifestyle changes. For example, promoting walkable neighbourhoods and renewable energy provide health co-benefits through cleaner air and a choice to use active and more sustainable mobility. The co-benefits from air quality improvement also include prevention of premature deaths, chronic diseases, and damage to food crops. The benefits to human health will outweigh the mitigation costs.

Air quality and human health

Poor air quality and air pollution is associated with several adverse health impacts including heart disease, diabetes, cancer, and mental health. Additionally, air pollution particularly affects the most vulnerable in society and differing populations inequitably. There are, for example, strong correlations with poor air quality and less affluent areas[i] [ii]. Living in more polluted areas has been associated with poorer mental wellbeing, which may be attributable to effects on the central nervous system, inflammatory response, anxiety, and observable pollution[iii]. There appear to be intersectional and environmental influences on susceptibility to air pollutants. Socioeconomic situation, age, ethnicity, education, housing condition, pre-existing comorbidities, smoking, living environment, as well as seasonal variations may influence exposure and impacts[iv]. The exposure to pollutants will also be dependent on work and travel environments. Commuting by car for example may increase pathways to respiratory disease, including cancers[v].

Fraction of mortality attributable to particulate air pollution
(new method)

Area	%
South West region	5.1
East Devon	4.7
Exeter	5.0
Mid Devon	4.8
North Devon	4.5
Teignbridge	4.8
Torridge	4.3
South Hams	4.4
West Devon	4.3

Table 1 (Public Health Profiles, 2023)[1]

[1] Source: Background annual average PM2.5 concentrations for the year of interest are modelled on a 1km x 1km grid using an air dispersion model, and calibrated using measured concentrations taken from background sites in Defra's Automatic Urban and Rural Network (https://uk-air.defra.gov.uk/interactive-map). By approximating LA boundaries to the 1km by 1km grid, and using census population data, population weighted background $PM_{2.5}$ concentrations for each lower tier LA are calculated. This work is

Where air pollutants go in our bodies and what they do

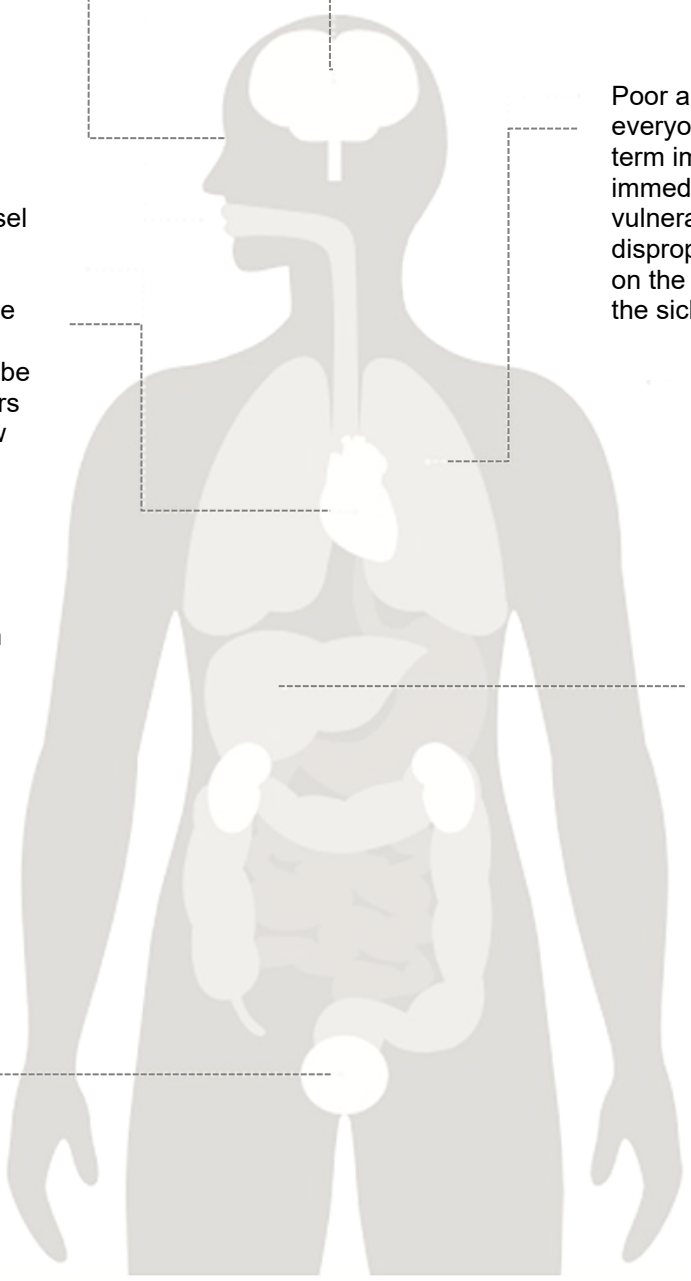

Figure 1 Adapted from 'Air Quality – a briefing for Directors of Public Health (Defra/PHE, 2017)

completed under contract to Defra, as a small extension of its obligations under the Ambient Air Quality Directive (2008/50/EC). Concentrations of total $PM_{2.5}$ are used for estimating the mortality burden attributable to particulate air pollution (COMEAP, 2022). fingertips.phe.org.uk

Figure 1 shows some of the impacts of air pollution on the body. These impacts can range from eye irritation, to strokes, from general nuisance, significant long-term health impacts, and to earlier mortality. Table 1 shows that 1 in 20 deaths within Exeter may be attributable to particulate air pollution, whilst slightly less in other areas of Devon. Of note is the reference to particulate matter, where the nature of particles has changed in the recent past due to shift from types of industry, and predominance of combustion engines. Evidence suggests that current populations have been exposed to higher levels of fine particulates than previous generations[vi]; these particulates can sit deeper in the lungs and move into the blood stream. Air pollutants have been linked through such mechanisms to cancers, including breast cancer[vii] and problems during pregnancy[viii]. The lungs are obviously the initial site of particulate deposition, which can lead to airway inflammation, impaired immune response, and other lung cell functions. Interactions may also be found in other organs and linked to development of diabetes, impaired cardiac functions, and more recently links to some Alzheimer's disease amongst others[ix].

Costs to NHS and Social Care

Although the costs of air pollution are wider than those experienced within the NHS and Social Care, these costs are highlighted as under the influence of the Health and Wellbeing Board. The total NHS and social care cost due to $PM_{2.5}$ and NO_2 combined in 2017 was estimated to be £42.88 million (based on data where there is more robust evidence for an association), increasing to £157 million when diseases are included where there is currently less robust or emerging evidence for an association.

Total healthcare cost of air pollution in England

Particulate Matter ($PM_{2.5}$)	Nitrogen dioxide (NO^2)
Total cost due to $PM_{2.5}$ to the NHS and social care in 2017 was estimated to be **£41.2million** This rises to **£76.1million** when diseases are included where there is less robust evidence for an association	Total cost due to NO^2 to the NHS and social care in 2017 is estimated to be **£1.7million** This rises to **£81.1million** when diseases are included where there is less robust evidence for an association.
Total cost due to $PM_{2.5}$ to the NHS and social care is estimated to be £1.5billion by 2025, and **£5.1billion by 2035**. This increases to £2.8billion and **£9.4billion** respectively when diseases with less robust evidence are included.	Total cost due to NO^2 to the NHS and social care is estimated to be £60.8million by 2025, and **£230million by 2035**. This increases to £2.7billion and **£9.2billion** respectively when diseases with less robust evidence are included.
The highest cost burden in England due to $PM_{2.5}$ was for **secondary care**.	The highest cost burden due to NO^2 was for **social care**

Table 2 (PHE, 2018)[x]

Climate mitigation and air quality

The UK is legally committed to reduce 'greenhouse gas' emissions to net zero by 2050. In Devon the 'Devon Carbon Plan' sets out goals and actions to achieve net-zero. This includes seeking to make behaviours to reduce greenhouse gas emissions easier to adopt and promote the benefits to people's health. A key part of the plan sets out the importance of

'anchor institutions', such as local authorities, the NHS, universities, and large businesses. As large-scale employers and purchasers with a relatively fixed position within the local economy we have significant influence. In tackling climate change we can seek opportunities where there are co-benefits to health, such as sustainable and active travel, or better insulated homes (from heat and cold), both of which should improve air quality through reduced fossil fuel use[xi]. Enhanced air quality from the switch to active travel and EVs can reduce the risk of heart attacks, strokes, asthma, and various types of cancer[xii]. By making it easier and more attractive for everybody to use sustainable transport we will enable populations to be more active, which will help address the obesity crisis, and air quality will be improved, helping reduce rates of respiratory and cardiovascular disease[xiii].

The UK Climate Change Committee has set out actions around power supply, transport, housing, and agriculture through a 'Balanced Pathway', and a 'Widespread Engagement Pathway' (more ambitious rates of behaviour change). Both pathways result in reductions in $PM_{2.5}$ with modest increases around active travel (walking and cycling). A primary improvement includes switching domestic fuels from gas, solid, and biofuels, with assumptions around home energy efficiency assuming appropriate ventilation. Net zero greenhouse gas emissions for electricity supply, land transport, housing, and diets has potential for substantial net positive impacts on the health of the population[xiv]. Traffic emissions may only be reduced if car journeys are reduced (EV's will still emit PM's, though at a lower level), and non-communicable disease reduced by increased activity. Increasing physical activity through walking and cycling could save the NHS £17billion within 20 years by reducing prevalence of type-2 diabetes, dementia, heart disease, cerebrovascular disease, and cancer[xv].

Working in partnership

The One Devon Partnership Integrated Care Strategy found in a comparison of the indoor (decent home standard and central heating availability) and outdoor (air quality and pedestrian/cyclist accidents) environment domains, in the Indices of Deprivation, the significant challenges that exist in Devon. Many areas were in the top 10% or 25% nationally for the indoor environment deprivation domain. In relation to climate change the strategy identifies air pollution, where excess heat and excess cold have a significant impact on health, particularly in relation to increases in cases of and deaths from respiratory and circulatory conditions like Asthma, Heart Disease and Stroke. An increase in severe weather events also leads to further direct risks to human health, e.g. heatwave resulting in moorland fires. The strategy places air pollution in the top ten modifiable risk factors in Devon[xvi].

Working as an integrated system we can seek to provide co-benefits to climate mitigation and population health, with improvements to population health reducing further impacts to health and social care services. As part of our ongoing Carbon Plan, we will be seeking to retrofit properties with the most appropriate technology to reduce both carbon footprint and improve air quality. This means not only considering CO_2, but other factors such as NO_x and PM_x. By focusing on carbon reduction, we need to seek co-benefits for public health whilst avoiding unintended negative consequences for health or climate resilience.

In a recent response to Government with regards a revised Air Quality Strategy (Appendix 2) it was highlighted the need to work in a regional context, given the transboundary influence of pollutants. As One Devon is formed of significant 'anchor institutions' the day-to-day business of partners can reduce pollution via encouraging supply chains to respond to low-carbon economies. In addition, the authorities can support and stimulate local infrastructure that supports low-carbon measures.

With the inclusion of county councils in the Environment Act 2021 there is further scope to work with district partners in improving local air quality. Devon County Council has, for example, worked alongside Exeter City in improving an Air Quality Management Area through transport planning measures. Planners at all levels also seek to improve air quality through the existing provisions of the National Planning Policy Framework, with additional Supplemental Planning Documents specifically relating to air quality.

Local authorities, including Public Health, can seek to share up-to-date information in digestible audience tailored ways. One approach would be to ensure the Joint Strategic Needs Assessment includes specific links between climate and health, including air quality. In taking a Health in all Policy approach this may reach across to incorporate and inform a range of policy areas.

John Amosford
Public Health Specialist, Health in All Policies
20th July 2023

Glossary and abbreviations

PM_x	Particulate Matter, primarily particles smaller than 0.1, 2.5, and 10µm. These are represented as $PM_{0.1}$, $PM_{2.5}$, and PM_{10} respectively. The smallest particles can enter the bloodstream and affect different organs, whilst larger particles may lodge within the lungs.

Appendix 1

Some policy background

Active travel: local authority toolkit
https://www.gov.uk/government/publications/active-travel-local-authority-toolkit/active-travel-local-authority-toolkit

"Local authorities can play an important role in increasing walking, wheeling and cycling. Through influencing planning and taking a wider, strategic view of travel infrastructure across their area, authorities can ensure that active travel infrastructure connects residents to services. As local leaders, authorities have a wide sphere of influence and can lead by example in adopting, promoting and providing infrastructure to enable and encourage active travel with their staff."

Air Quality A Briefing for Directors of Public Health
https://www.local.gov.uk/publications/air-quality-briefing-directors-public-health

"Directors of Public Health have a crucial role to play as leaders and influencers, shaping how local approaches can help clean up air in their area most effectively. This briefing provides the information to help Directors of Public Health consider the appropriate public health response to air pollution in their area."

Air quality strategy: framework for local authority delivery
https://www.gov.uk/government/publications/the-air-quality-strategy-for-england/air-quality-strategy-framework-for-local-authority-delivery

"All local authorities in England, including upper tier authorities… must have regard to this document (Air Quality Strategy). This reflects the fact that where there are two tier authorities, county councils are expected to contribute to district council air quality plans and strategies. In particular, we expect this strategy to be relevant where local authorities are preparing Air Quality Action Plans to address local exceedances"

Clean Air Strategy
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf

"…progressively cut public exposure to particulate matter pollution as suggested by the World Health Organization. We will set a new, ambitious, long-term target to reduce people's exposure to PM2.5 and will publish evidence early in 2019 to examine what action would be needed to meet the WHO annual mean guideline limit of 10 µg/m3."

National Planning Policy Framework
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

"105 Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health."

Environment Act 2021
https://www.legislation.gov.uk/ukpga/2021/30/enacted

Various provisions now include County in processes with regards air quality. "The following persons must have regard to the strategy when exercising any function of a public nature that could affect the quality of air… county councils for areas in England for which there are district councils… Where a district council of a district in England for which there is a county council intends to prepare an action plan it must notify the county council that it intends to do so…"

Appendix 2

Consultation on the draft revised Air Quality Strategy
Response from Public Health Devon with contribution by Climate Change, Environment, and Transport

https://www.gov.uk/government/consultations/revised-national-air-quality-strategy
This consultation closed at 11:30pm on 21 April 2023.

Questions

Introduction

1. What is your name? Steve Brown, Director of Public Health, Communities, and Prosperity
2. What is your email address? steve.brown@devon.gov.uk
3. What is your organisation? Devon County Council

Confidentiality Question

4. Would you like your response to be confidential?

o Yes
✓ No

(If you answered Yes, please give your reason)

Chapter 4: Framework for action

5. To what extent do you agree or disagree with our commitment to better align air quality reporting zones with local government boundaries?

o Strongly agree
✓ Somewhat agree
o Neither agree or disagree
o Somewhat disagree
o Strongly disagree
o Don't know or no opinion

Any other information:

Given the transboundary transportation and creation of pollutants the appropriate tier of local government and government agencies needs to be coordinated within the regional context. As agriculture, industry, and transport are significant contributors relevant agencies need to be involved in coordinating efforts. For example, the expanded duty for National Highways, given their influence on the strategic road network, that significantly impacts on air quality. Local authorities are best placed to coordinate local actions in relation to local transportation, planning, and as anchor institutions.

Chapter 5: Summary of powers available to local authorities

6. What more could local authorities do within the existing regulatory framework to reduce pollution from inappropriate domestic burning?

Our Trading Standards already have powers, including those under the Air Quality (Domestic Solid Fuels Standards) Regulations 2020, and take steps to educate and enforce where appropriate. We will continue to review the impact of domestic burning in view of recently

revised DEFRA figures, the nature of local communities, building stock, and housing density, within the wider context of pollutants and polluters. As part of Devon's ongoing Carbon Plan and partnership we will be seeking to facilitate the retrofitting of properties with the most appropriate technology to reduce both carbon footprint, improve air quality, and improve energy efficiently. This means not only considering CO2, but other factors such as NOx and PMx.

7. How do you feel local authorities can most effectively reduce pollution from industrial sources they are responsible for?

The day-to-day business of local authorities can reduce pollution via encouraging supply chains to respond to low-carbon economies. In addition, the authorities can support and stimulate local infrastructure that supports low-carbon measures. Developing circular economies as part of an overall carbon reduction plan should have co-benefits for air quality. In their role as an anchor institution Local Authorities can specify, in their procurement of goods and services, the need for low carbon delivery, and reporting on emissions. Through embedding low carbon planning and transport policies and programmes they can promote the development of infrastructure that will lead to the improvement of air quality.

8. How do you feel local authorities can most effectively reduce pollution from transport and non-road mobile machinery (NRMM)?

Local authorities such as our own are already reducing impacts on air quality, that benefit public health, and improve local economies. Within city we have developed strategic active travel networks, whilst improving links to these for surrounding communities with a choice of multi-model interfacing networks. We need to offer people a choice of travel and rebalance road use based on accessibility, e.g. residential streets accessible and usable by all people, whatever mode of transport. In designing approaches, we are seeking to improve levels of activity and air quality together to improve public health, whilst enhancing the transport environment.

The National Planning Policy Framework (NPPF) already supports focusing on locations that are sustainable through limiting travel and consider air quality (e.g. para 105/186). However, with percentage allocations areas within rural settings are sometimes pressured into increasing housing when this is not supported by employment nor infrastructure. In working with planners at all levels tools such as the Defra Air quality appraisal damage costs toolkit may be used to offset longer-term costs resulting from developments, whilst also using supplemental planning documents (or the replacement) to put in place mitigations and improvements at the outset. The NPPF proposals should align some policy timelines to make effecting mitigations more aligned between various processes, and reinforce sustainable development considering social determinists, such as access to nearby employment.

9. How do you feel local authorities can most effectively reduce pollution from agriculture?

Working with local farmers and strategic partnerships, such as our local food partnership, seeking to balance competing needs of agriculture, forestry, and other land use. Again a number of cobenefits may be achieved in supporting demand and production of nutritious and sustainable food. This not only supports local farming, but not to exclusion of other food supply chains when more sustainable, but seeks to improve population diet and health. Reducing impacts on pollution through reduced meat and dairy consumption needs to be counterbalanced in certain rural economies. This means making the Environmental Land Management Schemes effective and viable. We have already started restoring upland peat bogs in our County which have potential to reabsorb vast quantities of carbon, though this needs to be balanced with a sustainable land management programme to maintain this into the future.

Consideration will need to be given to providing strategic infrastructure plans to balance competing needs of house building, farming, landscape restoration and preservation. Land use pressure needs to support sustainable farming business practices. In Devon there are

already a number of programmes to support our farmers transition towards more sustainable forms of farming: e.g. the Devon Agri-tech Alliance and the Future Farming Resilience programme.

As some farm types are already included in the scope of environmental permitting it would appear to be reasonable to include intensive beef and intensive dairy farms. The evidence for bringing all dairy farms into this scope will need to be made clear in any future consultation. There remains a question as to how this may be phased in and any additional pressures on Environment Agency, local planning, environmental health, and farmers (particularly those with smaller herds).

10. How do you feel local authorities can most effectively improve indoor air quality?

As part of our retrofit programme we can seek to educate around various volatile organic compounds and sources of indoor pollution. The removal of gas appliance, especially cookers, will go some way to improving indoor air quality. In applying retrofit natural ventilation may be considered in relation to VOC, or where applicable other gases such as Radon. We can also increase knowledge of various consumer products that may harm health, if not also the environment.

Building regulations and enforcement can seek to improve construction materials used, and encourage less harmful and more sustainable products. This is an area of work where local public health can work with the UKHSA and other bodies such as the Buildings Research Establishment to inform work with local planners and builders.

11. How do you feel local authorities can most effectively communicate air quality information?

Local authorities, including Public Health, can seek to share up-to-date information in digestible audience tailored ways. This goes beyond just sharing mortality burden estimates; we need to look at local data, including Hospital Episode Statistics, at a range of diseases connected directly with air pollution and methods of reducing the burden. Public health have a range of health promotion techniques, however, the greatest strength is when these are combined with infrastructure projects. We need to demonstrate that infrastructure changes are there to give people choice, enable them to improve their health, to select cheaper modes of travel, to heat their home more efficiently and sustainably. However information alone will not create change, we need to be a able to instigate and support system change, with cobenefits to the individual, and wider society. In working with our own and partners' frontline practitioners who can help give brief advice and signposting to information about how air quality can be improved by individuals and communities.

12. Do you feel that there are additional powers relating to air quality which should be available to local authorities?

- ✓ Yes
- o No

If yes, please provide details.

Any powers need to be supported by the power to act. We have recently seen the active travel fund drastically reduced, the Clean Air Fund and funds to retrofit have not risen to the challenge. The YouGov and Ipsos polls show the public want us, local government and Government alike, to act on the climate crisis. Evidence from those areas that have taken steps tend to find a few noisy detractors, whilst measures, such as those we have taken, get general support.

In firming up the Environment Act and other instruments the responsibility of each agency should be clearer. Additionally we would seek for a reinforcement of the need to go wider than just AQMA's; that we need to strive to reduce air quality systemically, and look at those pollutants that matter to the area, not a select few. We would also seek for air quality to be

considered in relation to social determinants and seek to redress the imbalance between those who benefit more, and those suffer more, in the system.

The 'Duty to Cooperate' should have a set of guidance laying out working principles, e.g. similar to Gunning Principles and Wednesbury Principle. i.e. authorities and agencies should work together when air quality reports are at a formative stage with adequate time for consideration and response from respective parties. These principles and that of reasonableness may be a test at which the Secretary of State may intervene.

13. What further support could government provide to help with actions taken locally to tackle air quality?

- ✓ Increased guidance
- o Face to face teach-ins on topics
- ✓ Virtual teach-ins on topics
- o Enforcement pro-forma or templates
- o Sharing space or website for best practice examples of local working
- ✓ Knowledge hub including assets for local authorities
- ✓ Other (please specify below)

If you selected 'Other', please provide details.

Readily available more granular modelling of air pollution in format that may be used with other indicators such as collection of Hospital Episode Statistics, Indices of Multiple Deprivation, and other data sources.

Chapter 6: PM2.5 Target Implementation

14. To what extent do you agree or disagree that a new approach needs to be employed to promote consideration of the PM2.5 targets in the planning system?

- ✓ Strongly agree
- o Somewhat agree
- o Neither agree or disagree
- o Somewhat disagree
- o Strongly disagree
- o Don't know or no opinion

Please add any additional comments.

This should enable a level playing field for developers and authorities alike. In two tier authorities Public Health and others may find differing approaches to, for example, Supplemental Planning Documents (SPD) across a number of authorities. This is especially relevant at this time where we have SPDs that may no longer stand following update of the National Planning Policy Framework.

15. What do you think are the merits or drawbacks of a design-stage emission prevention approach as set out in this chapter?

In areas such as ours the housing pressure, particularly from second homes, together with design-stage emission prevention, the cost of implementation needs to be considered. We not only need 'affordable housing', which is still unaffordable for many, but housing affordable to lower paid workers. However, a well-designed home will be cheaper to heat, which is one side of the heat or eat equation.

We will need to also carefully explore the rental market, which appears to be having some change as the 'buy to let' market appear to be increasingly selling properties. Extra pressure to retrofit for heating may further influence this; if this resupply goes out of long-term rental sector there may be further pressure on rents.

16. Are there any additional assessment approaches or points we should consider when developing proposals to integrate the PM2.5 targets in the planning system?

- ✓ Yes
- o No

If yes, please provide details.

Siting and screening to protect particularly vulnerable populations e.g. primary schools. This could be included in design coding.

Consultee Feedback on the Online Survey

Thank you for taking the time to participate in this online survey. We would appreciate it if you are able provide us with an insight into how you view the tool and any area(s) you feel is in need of improvement, by completing our feedback questionnaire.

17. Overall, how satisfied are you with our online consultation tool? Please give us any comments you have on the tool, including suggestions on how we could improve it.

- o Very satisfied
- o Satisfied
- ✓ Neither satisfied nor dissatisfied Yes
- o Dissatisfied
- o Very dissatisfied
- o Don't know

Please give us any comments you have on the tool

The overall comment would be the limited amount of time given to comment on what is an extremely important area for Public Health.

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