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MIDAS

Joining up data and action to improve musculoskeletal health for all

Multi-level Integrated Data for musculoskeletal intelligence and ActionS (MIDAS)

Final Report

17 November 2025

The MIDAS project has been funded by the Nuffield Foundation's Oliver Bird Fund and Arthritis UK (OBF/43990).

The Nuffield Foundation is an independent charitable trust with a mission to advance social well-being. It funds research that informs social policy, primarily in Education, Welfare, and Justice. The Nuffield Foundation is the founder and co-funder of the Nuffield Council on Bioethics, the Ada Lovelace Institute and the Nuffield Family Justice Observatory. The Foundation has funded this project, but the views expressed are those of the authors and not necessarily the Foundation.

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Over 10 million adults, young people and children in the UK live with arthritis. That's one in six of us living with the pain, fatigue, disability, mental and financial strain it can cause. Many more live with arthritis but remain undiagnosed, untreated and unsupported. We know the impact of arthritis can be huge, affecting the ability to work, care for family, move free from pain and live independently. Yet for a condition affecting so many, it's poorly understood and far too little is done. That's why we invest in life-changing research into better treatments, support people through the daily challenges of life with arthritis, and campaign on the issues that matter most to people living with it. At Arthritis UK, we won't rest until everyone with arthritis has access to the treatments and support they need to live the life they choose, with real hope of a cure in the future.

Find out more at: www.arthritis-uk.org

Arthritis UK. For a future free from arthritis.

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Executive Summary

Musculoskeletal (MSK) conditions are major causes of disability in most countries and regions worldwide, including in the UK. In the UK they account for 20% of total years lived with disability, 8 million working days lost each year, and a significant proportion of all primary care consultations. Better collection, linkage, and use of data has the potential to improve musculoskeletal health and care. However, several obstacles need to be overcome to realise that potential. Some of these are unique to musculoskeletal health and care but many are not. And this in the context of “frequently changing organisational labels, structures, strategies and policies”(1).

The MIDAS research programme, hosted at Keele University, was funded by the Nuffield Foundation and Arthritis UK as a Local Data Integration Pilot in North Staffordshire and Stoke-on-Trent designed to provide scalable solutions to improve understanding of those living with musculoskeletal pain conditions.

The focus was on co-ordinated collection of patient-reported measures in general population, primary and community care settings, linkage to routine electronic health records and open source data on neighbourhoods and healthcare organisations, and a series of exemplar analyses with stakeholder engagement. A dedicated Patient Advisory Group met regularly and was involved across the lifecycle of the programme.

The programme succeeded in collecting core patient-reported measures from over 5000 patients and members of the public. Based on individual consent, these patient-reported data were linked with individual-level data from primary care electronic health records, hospital records, and neighbourhood and health organisation data to create rich multi-level datasets to interrogate musculoskeletal health and care across different settings within the same geographical area.

Analyses of these data illustrated a range of applications with potential to improve musculoskeletal health and care in populations:

- producing granular neighbourhood-level maps of musculoskeletal pain revealing substantial geographical variation and levels of high need within the same Integrated Care System, a ‘first in the UK’ finding
- detecting changes in the prevalence of chronic pain between 2016/2017 and 2022/2023
- documenting socioeconomic inequalities in the outcomes, care, and patient experience of adults presenting to primary care with a musculoskeletal pain condition
- exploring patterns of care and identifying high overall healthcare utilisation
- relating consultation rates for musculoskeletal pain conditions with underlying estimates of pain prevalence in the population to
- generating preliminary estimates of the distribution of costs and carbon outputs associated with NHS care of musculoskeletal pain conditions
- informing the evaluation of a new digital self-management intervention offered by first contact practitioners
- collecting, extracting, and analysing data from community musculoskeletal services that have informed a nascent national musculoskeletal audit project and database

In the process of this work, and as deliberate by-products, MIDAS has produced a range of accessible tools and datasets for future musculoskeletal health intelligence and research.

These insights, outputs, and activities have helped shape conversations beyond academia on how to improve musculoskeletal health and care in defined local populations.

Key learning arising from this programme touches on:

- the relative cost and efficiency of data collection methods
- continuing challenges with inclusion and bias
- responding to the information needs and preferences of stakeholders
- the value and contribution of public involvement in data integration research

Plain Language Summary

Musculoskeletal (MSK) conditions such as back pain, arthritis, and joint problems are a leading cause of long-term pain and disability. In the UK, they account for a significant number of GP visits, lost working days, and reduced quality of life.

The MIDAS research programme, based at Keele University and funded by the Nuffield Foundation and Arthritis UK, set out to improve how we understand and support people living with MSK pain. The project focused on North Staffordshire and Stoke-on-Trent, but its findings have wider relevance across the UK.

What the Research Involved

- Over 5,000 people took part by sharing information about their pain, health, and experiences.
- With their consent, this information was securely linked to their NHS records, including GP and hospital data.
- Researchers also used publicly available data about local areas and health services to build a more complete picture of MSK health in the community.

Key Findings

The research showed how better use of data can lead to better care. Highlights include:

- **Detailed local maps** showing where MSK pain is most common, helping to identify areas with the greatest need for support.
- **Tracking changes over time**, including how chronic pain levels have shifted between 2016 and 2023.
- **Highlighting inequalities**, showing that people from more deprived backgrounds often experience worse outcomes and care.
- **Understanding NHS use**, including how often people with MSK pain access services and how this relates to their needs.
- **Estimating costs and environmental impact** of MSK care within the NHS.

Contributing to national efforts, by helping shape a new national MSK audit and data infrastructure.

Why This Matters

This work shows that when patients, the public, and the NHS work together and share information safely, we can:

- Better understand who needs help and where
- Improve services and reduce health inequalities
- Support people to manage their pain more effectively

The project also demonstrated the importance of involving the public in research, using data responsibly, and making sure research meets the needs of real people and communities.

What Happens Next

The MIDAS programme has laid the groundwork for future improvements in MSK care. Next steps include:

- **Expanding the use of the tools and datasets** developed through MIDAS to support ongoing research and service planning.
- **Sharing findings with NHS organisations and policymakers** to inform decisions about MSK services.
- **Continuing to involve patients and the public** in shaping future research and data use.
- **Building on this work nationally**, including contributing to a new national MSK audit and supporting integrated care systems to use local data more effectively.

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Preface

The MIDAS research programme was a programme of research that ran from October 2020 to September 2025 supported by funding from the Nuffield Foundation's Oliver Bird Fund and Arthritis UK in response to a call for Local Data Integration Pilots. The funding call sought to support interdisciplinary research in creating new knowledge from available data resources, including research on integrating data and identification of new data needed to improve understanding of those living with MSK conditions.

The MIDAS programme was hosted at Keele University and focussed on the surrounding population and services in North Staffordshire and Stoke-on-Trent. (see Section 2 for more detail).

Our **overall aim** of MIDAS was to develop and implement a place-based system of musculoskeletal health intelligence in the population of North Staffordshire & Stoke-on-Trent that provided useful, timely, sustainable, trustworthy evidence for policymakers, practitioners, and the public. The programme comprised three main workstreams:

Workstream 1. Getting Better Person-Centred Data on Musculoskeletal Health and Care

To be achieved by undertaking a cross-sectional survey of a random sample of the general adult population in North Staffordshire & Stoke-on-Trent and point-of-care cohort studies of consecutive patients consulting general practice and community musculoskeletal services

Workstream 2. Creating Multi-Level Datasets Through Extensive Linkage

Based on written informed consent from Workstream 1 participants, we aimed to link the above individual-level patient-reported datasets to primary care electronic health records, hospital records, neighbourhood-level and service-level characteristics, and patient-reported data from a previous population survey

Workstream 3. Produce Musculoskeletal Health Intelligence for Better Decisions

Using Workstream 2 datasets and stakeholder engagement we sought to undertake exemplar analyses to understand whether such data could provide useful information on local inequalities in musculoskeletal health and care, variation in care and episode outcomes, the effects of introducing new services, and the needs of practitioners, service managers, and local policymakers

Throughout, the ambition was to find solutions that worked locally and might be scalable and sustainable.

Section 1. Why we need better MSK health intelligence for local populations

Musculoskeletal (MSK) conditions are major causes of disability in most countries and regions worldwide, including in the UK. In the UK they account for an estimated 20% of total years lived with disability(2), 8 million working days lost each year(3), and a significant proportion of all primary care consultations and overall budget for NHS healthcare expenditure. MSK pain conditions like low back pain, neck pain, osteoarthritis, and others are the most common sources of long-term pain and disability.

Yet despite the enormous burden of musculoskeletal conditions to health systems, economies, and communities, they have often been overlooked in national and local policies on noncommunicable disease that focus on cancers, diabetes, chronic respiratory disorders, cardiovascular diseases, and mental disorders(4).

The collection, linkage, and analysis of data on MSK pain conditions must be seen as an ongoing endeavour in an ever-evolving policy context and complex data landscape but with many potential benefits:

- improving treatment of current patients
- improving the effectiveness and efficiency of the NHS and health and social care systems
- targeting effective prevention and public health
- enabling research to improve health and care
- raising awareness among a wide range of 'interest holders' and decision-makers

Context

The MIDAS programme began in the context of several encouraging national and local developments:

- ***Public Health England's 5-year musculoskeletal prevention strategy (2019)****(5)*, which prioritised work and health, evidence into practice, data and intelligence, and workforce, with research playing a key role in helping inform action on these.
- ***NHS Long Term Plan (2019)****(6)* which committed the NHS to local population health management, fully integrating local health systems and community-based health care through Integrated Care Systems and Primary Care Networks, to ensuring direct access to MSK First Contact Practitioners (FCP), to reducing health inequalities, and to improving the capture and use of data to drive NHS digital transformation. The NHS White paper (2021)(7) provided the legislative framework for Integrated Care Systems
- ***NHS England and NHS Improvement's Best MSK Health collaborative****(8)* which sought, in partnership with the Arthritis and Musculoskeletal Alliance (ARMA), Versus Arthritis (Arthritis UK), Public Health England, Health Education England and others, to *"improve and sustain the delivery of evidence informed, personalised, high quality, integrated MSK healthcare of value to all".* Of particular relevance to the MIDAS programme were workstreams on Restoration of Primary and Community MSK Provision, and Data, Validation and Coding
- ***NHSX draft strategy on digital transformation****(9)*, which laid out the intention to build on current online platforms for data and analytical professionals to share tools, methodologies and best practice; publicly available data reports such as PHE Public Health Profiles, a proposed GP Data for Planning and Research (GPDPR) collection, and trusted researcher environments for accessing de-identified data.
- ***Health Education England's First Contact Practitioners and Advanced Practitioners in Primary Care: (Musculoskeletal) A Roadmap to Practice (2021)***, which provided an educational pathway and capability framework for clinicians pursuing a career in primary care.
- Significant national investment in the foundation of **Health Data Research UK** (HDRUK) and the national **OpenSAFELY** analytic platform
- ***Keele Deal | Health***, launched in 2019, a commitment between Keele University and

local healthcare partners across Staffordshire, Stoke-on-Trent, Shropshire, Telford and Wrekin, and South Cheshire to address the region's health and care priorities in workforce development, research and innovation, and evidence-based service transformation.

- ***Transforming MSK care in Staffordshire.*** The Impact Accelerator Unit at Keele University working alongside the Chartered Society of Physiotherapy and local stakeholders across Staffordshire on implementing the NIHR Moving Forward Review(10) which summarised best evidence on MSK care and support. Activities include:
    - The establishment of a community of practice to roll out the priority evidence across Staffordshire
    - The development of a patient and public version of the Moving Forward review
    - The rollout of First Contact Practitioners (FCPs) across Staffordshire.

Key challenges

The myriad challenges to better collection, linkage, and analysis of health data have been comprehensively described in *Uniting the UK's Health Data: A Huge Opportunity for Society(1)*.

The MIDAS local data integration pilot focussed on MSK pain conditions and several, inter-related problems and challenges.

1. ***Better collection, linkage, and analysis of data from primary and community care settings is critical.*** These are the healthcare settings where the majority of assessment and management occurs for common MSK pain conditions. Better data from these settings with linkage to hospital data and beyond are therefore critical to local and national musculoskeletal health intelligence systems.

2. ***MSK pain conditions encompass a heterogeneous range of conditions, recorded in routine primary care electronic health records under a bewildering array of problem/diagnostic codes.*** Unlike some other long-term conditions there are no specific incentives in the Quality and Outcomes Framework in general practice to maintain an accurate register of patients with MSK pain conditions.

3. ***Data collection, linkages, and analysis need to go beyond the healthcare system.*** Healthcare is just one determinant of musculoskeletal health. A framework for musculoskeletal health intelligence should aim to capture, integrate, and use data on wider determinants of health, health behaviours and lifestyles, and the places and communities that people live in and with(11).

4. ***Population health management explicitly demands a commitment to knowing about health and disease in an entire defined population.*** This means not limiting musculoskeletal health intelligence to merely observing 'cases' that present to healthcare services but also seeking to 'complete the clinical picture'(12) by collecting data across the spectrum of musculoskeletal health, including from the uncomplaining, disaffected or demoralised, the symptomless, the 'at-risk', pre-clinical and 'mild' cases who are often missed in datasets of healthcare service users.

5. ***'Meaningful use' of routine electronic health record data is hampered by a lack of patient-reported outcome measures.*** Patient-reported outcome measures (PROMs) are the main way of evaluating treatment effectiveness in clinical trials in musculoskeletal pain conditions. The case for routinely collecting PROMs in disease registries has already been accepted and successfully implemented in the patient pathway for knee and hip replacement(13,14) with the result that we no longer rely solely on revision rates and death to evaluate the outcome of these procedures. It was unclear if PROMs could be routinely captured in primary and community settings. Patient-reported data extends beyond outcome measures to measures of patient experience and to self-reporting of social and behavioural determinants of health(15) and predictors that may be needed for case-mix adjustment, much of which is completely absent from the current electronic health record.

Section 2. About MIDAS

Setting

The MIDAS programme was a local data integration pilot set in North Staffordshire covering three local authorities—Stoke-on-Trent, Newcastle-under-Lyme, and Staffordshire Moorlands (administrative centre, Leek) - a combined area of 880 km^2 and a population of around 480,000 (**Figure 1**).

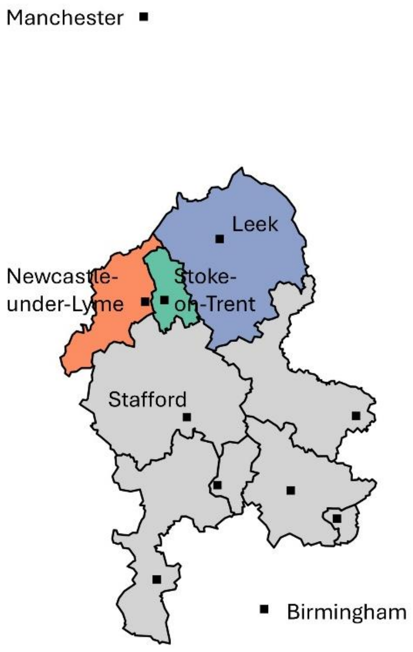


Figure 1. Map of Staffordshire (North Staffordshire covers the coloured areas representing the three local authorities of Newcastle-under-Lyme (orange), Stoke-on-Trent (green), and Staffordshire Moorlands (blue)

The area and its population cover a wide range of characteristics.

- 40% of Newcastle-under-Lyme and Staffordshire Moorlands is classed as rural or hub town living. By contrast, 99% of Stoke-on-Trent is urban.
- Of its 298 neighbourhoods, 51 are classed in the most socioeconomically deprived decile (10%) in England. 10 neighbourhoods are in the most affluent decile nationally.
- 89% of residents identify as being from White ethnic backgrounds.
- 28% of residents report a long-term physical or mental health condition.

The proportion of adults aged 16-64 years who are economically inactive is above the national average (21.4%) in Newcastle-under-Lyme (23.5%) and Stoke-on-Trent (25.8%) but lower in Staffordshire Moorlands (17.2%). Long-term sickness is the leading cause of economic inactivity in Stoke-on-Trent.

Integrated Care System

The area covers three sub-ICS locations within Staffordshire and Stoke-on-Trent Integrated Care System (ICS) which is responsible for leading the planning and commissioning of healthcare services for the entire population of Staffordshire.

General practices

At the time of the MIDAS programme, the area was served by 71 general practices organised into 13 Primary Care Networks (PCN). We purposefully sought to include GP practices that covered all 13 PCNs and practices serving the most socioeconomically deprived and ethnically diverse communities in North Staffordshire. Working with NIHR Research Delivery Network (RDN) colleagues, 30 of the 71 GP practices agreed to participate in MIDAS. Their location and catchment areas(16) are shown in **Figure 2**).

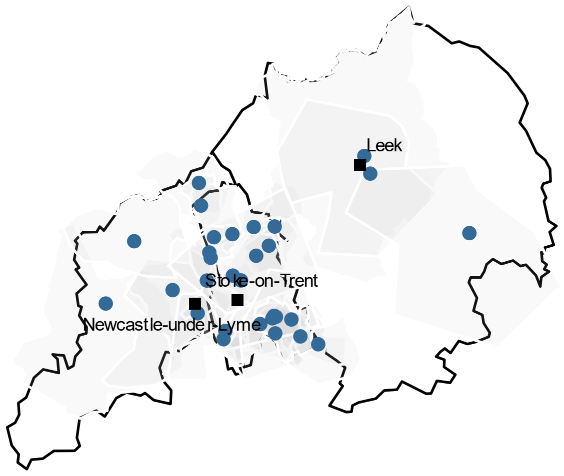


Figure 2. Location and catchment areas of 30 GP practices in North Staffordshire that took part in MIDAS

New data collection

The MIDAS programme focussed on gathering patient-reported measures of musculoskeletal health outcomes, experiences of care, and wider social determinants. This was done in three setting-specific cohorts (**Figure 3**):

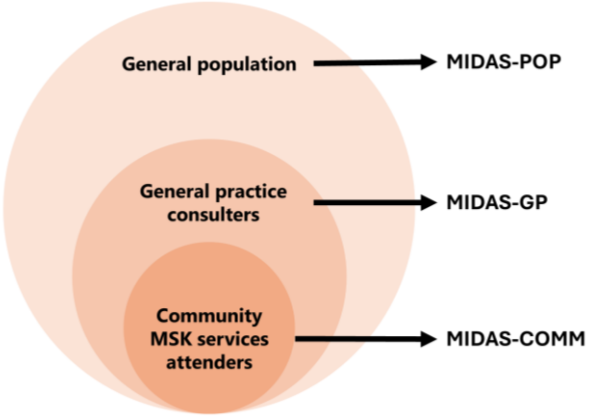


Figure 3. Schematic of the three MIDAS cohorts for new data collection and linkage

General population. Our MIDAS-POP study invited a random sample of 450 adults aged 35 years and over registered in each of the 30 GP practices (13,500 in total) to complete a questionnaire (online or pen-and-paper) and asked respondents for permission to access and link their answers to their medical records. To supplement this mailed survey, we also commissioned a doorstep interview survey in selected areas in the most socioeconomically deprived and ethnically diverse neighbourhoods. The MIDAS-POP study provided an overview of musculoskeletal health in the general population, including among people who had not sought care from their GP. We were also able to compare its findings with those from a similar survey within North Staffordshire (PRELIM) previously conducted in 2016/2017.

General practice consulters presenting with a MSK pain condition. Our MIDAS-GP study invited all patients aged 18+ years presenting to any of the 30 participating GP practices to complete a questionnaire (online or pen-and-paper) shortly after their consultation and then again 3 and 6 months later. Respondents were asked for permission to access and link their answers to their medical records. We also obtained permission to access de-identified information on all adult MSK pain consulters in these 30 GP practices. The MIDAS-GP study provided insights into the characteristics, experiences, and outcomes of care for those people who presented with a MSK pain condition to their general practice.

Attenders at local community musculoskeletal services. Our MIDAS-COMM study took a different approach. Community musculoskeletal services were routinely collecting patient outcome and experience measures. Over the course of the MIDAS project, members of our team worked with community MSK services to propose harmonised data dictionaries and methods of secure data transfer and storage as part of a proposal for a new National MSK Audit. MIDAS-COMM involved obtaining ethical approval to analyse routinely collected anonymised data from one local community MSK service in Staffordshire. All patients aged 18+ years presenting to this service with a non-inflammatory MSK pain condition were included. This provided insights into the characteristics, experiences, and outcomes of care for those people who presented with a MSK pain condition to community MSK services.

Data linkage

Survey data from consenting respondents were linked to data from a variety of sources (**Table 1**). Key linking variables, provided by consenting participants, were NHS number, postcode (converted to Lower Super Output Area), and GP practice.

Table 1. Data linkages in MIDAS

	MIDAS-GP	MIDAS-POP	MIDAS-COMM
Individual-level			
Patient-completed questionnaires	☑	☑	☑
Primary care electronic health records	☑	☑	
Community MSK service records			☑
Hospital A&E, outpatient, inpatient records	☑	☑	
General practice-level			
NHS Business Services Authority	☑	☑	
GP Patient Survey	☑	☑	
Care Quality Commission	☑	☑	
GP Workforce	☑	☑	
OHID National GP Profiles	☑	☑	
Quality and Outcomes Framework	☑	☑	
Practice Manager Survey	☑	☑	
Primary Care Network-level			
PCN Workforce	☑	☑	
Neighbourhood-level			
Index of Multiple Deprivation	☑	☑	☑

A&E Accident and emergency; **OHID** Office for Health Inequalities and Disparities; **PCN** Primary Care Network

Linkages provided:

- individual-level data on determinants, processes of care, and outcomes of MSK health and care, e.g. comorbidities, referral to specialist care
- organisation-level data on determinants of health and care, e.g. levels of staffing in GP practices, neighbourhood deprivation

Data analysis

The MIDAS linked datasets were used to construct “realistically complex” models of MSK health and care that attempted to take ‘context’ into account: specifically, healthcare services in primary and community care, wider determinants of health, and the neighbourhoods and communities that people live in, and with.

Exemplar analyses, organised under the headings of a recent Lancet commission(17) and designed to illustrate potential applications of local linked datasets, were planned and undertaken by the MIDAS research team with involvement of our Patient Advisory Group and stakeholder engagement.

Making it visible (p16-20). Can local data reveal small-area variation and inequalities in MSK health that could otherwise go unnoticed? Can local data be used to identify patterns of high healthcare utilisation?

Making it matter (p21-23). Can we use local data to estimate the costs and carbon output of primary care management of MSK pain conditions? (p21) Can it be used to investigate and monitor inequality gaps in outcomes, experiences and care? (p23)

Making it understood (p24). How much variation in MSK pain consultation rates is there between GP practices? Do these reflect issues in access or differences in the underlying prevalence of MSK pain in their registered populations?

Making it better (p25). Could local integrated data help target and evaluate innovations and ‘natural experiments’ in local health systems?

The Appendix includes further details on the MIDAS programme, including the overarching logic model (Appendix A), a summary of each of the cohorts (Appendix B, Appendix C, Appendix D), a listing of the patient-reported data collected in each (Appendix E), and general approach to multi-level models (Appendix F).

Section 3. Applications of local, linked data for MSK health intelligence: exemplar analyses

Revealing hidden small-area variation and disparities

What is the problem? Local population health planning for musculoskeletal health must currently rely on local authority-level information (e.g. local MSK profiles produced by DHSC available via the Fingertips tool). However, associations between pain and sociodemographic characteristics suggest that inequalities in the prevalence of MSK pain are likely between neighbourhoods within the same local authority.

What did we do? We modelled local survey data to produce neighbourhood-level estimates and maps of the prevalence of musculoskeletal pain in adults (aged 35+ years) in North Staffordshire.

What did we find? We found substantial variation in the prevalence of chronic pain, high-impact chronic pain, and a range of MSK pain conditions between neighbourhoods in North Staffordshire (**Figure 4**).

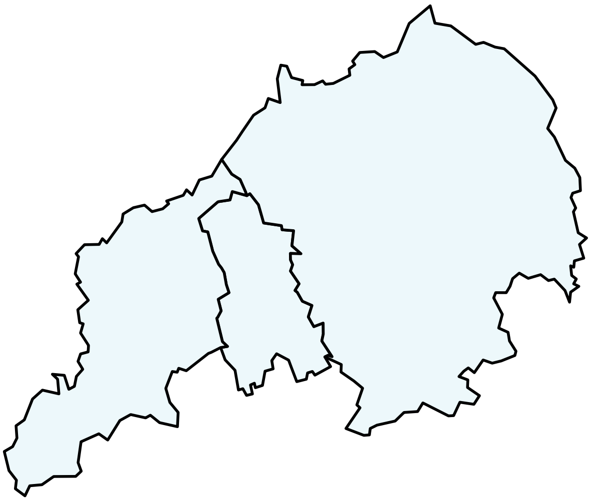
What does it mean? Modelling local data can produce a more granular view of MSK pain in the population, highlight unsuspected variation, and could help improve the targeting of effort and resources to places with the greatest need.

How could this be used? By local services to start transformation/quality improvement conversations, e.g. chronic pain services.

Research article: Lynch *et al*. *Eur J Pain*. 2023;27:1177-1186. https://doi.org/10.1002/ejp.2148

Currently available estimates from national survey data sources

Geographical level	Local authority (3)
MSK condition	Severe low back pain
Age range	All ages
Data source	National survey data
	Health Survey for England / Musculoskeletal Calculator
Year of survey	2012
Range of estimates	11.2% to 11.8%
Reference	Arthritis UK



New estimates from local survey data sources

Geographical level	Lower Super Output Area (298)
MSK condition	Moderate-to-severe low back pain
Age range	35+ years
Data source	Local survey data
	PRELIM / MIDAS
Year of survey	2016/2017
Range of estimates	6.1% to 25.0%
Reference	Health of the population - Keele University

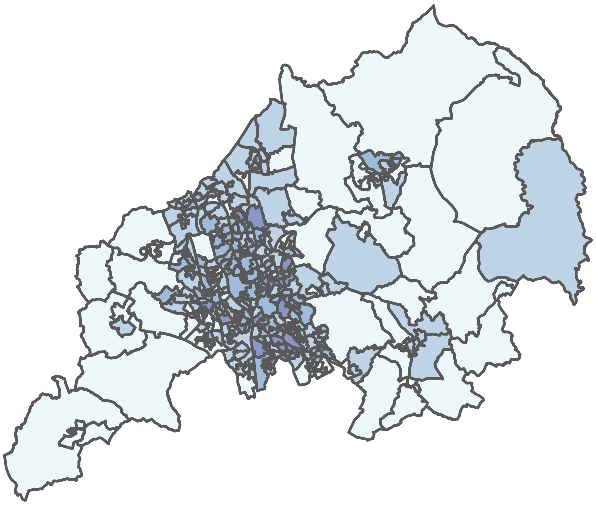


Figure 4. Comparison of existing local authority estimates of severe low back pain prevalence and new neighbourhood-level estimates (darker shade = higher prevalence of back pain). Local authority estimates suggest little local variation. Neighbourhood-level estimates reveal substantial four-fold unsuspected variation.

Transporting Local Models and Estimates to Other Regions

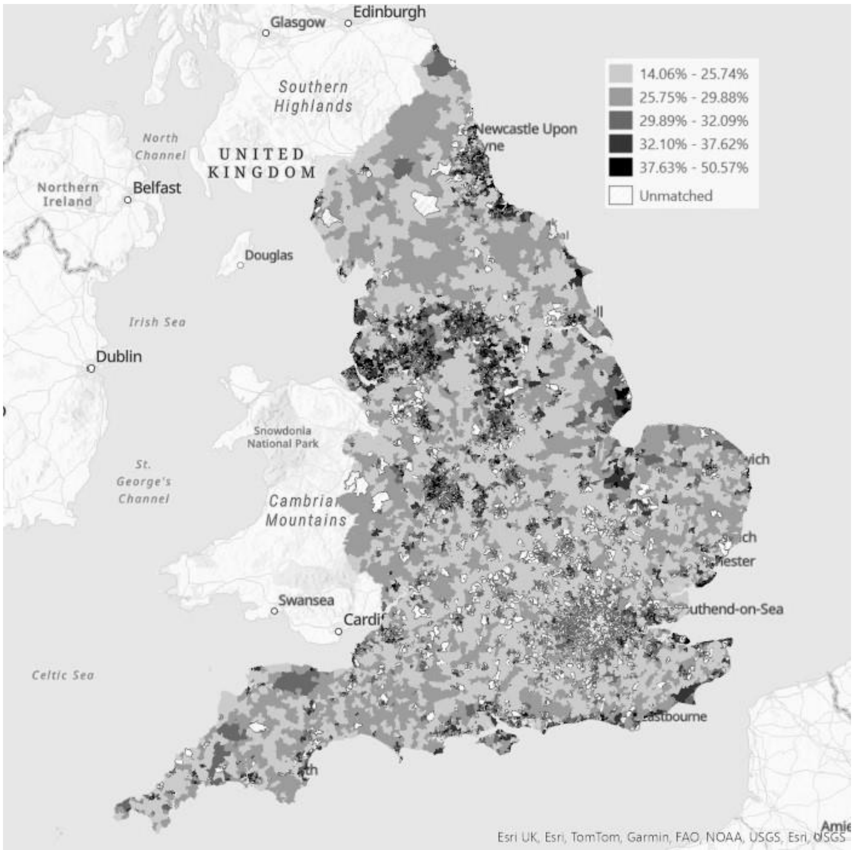
What is the problem? Can we generalize models and neighbourhood-level estimates of MSK pain from North Staffordshire and Stoke-on-Trent to other similar neighbourhoods in England.

What did we do? We applied matching methods to generalize estimates of chronic pain and high-impact chronic pain from one local survey in England to other neighbourhoods across the country with similar age, sex, ethnicity, deprivation, and rurality profiles.

What did we find? Satisfactory matching was achieved for 24,871 of 31,580 lower super output areas (LSOAs) (79%). The unmatched 6,709 LSOAs were principally inner-city neighbourhoods with younger, more ethnically diverse populations. LSOA-specific estimates of chronic pain and high impact chronic pain ranged from 14% to 52% and from 4% to 31% respectively (**Figure 5**). Integrated Care Board (ICB) estimates ranged from 27% to 38% and from 10% to 18%, respectively. Estimates for England were 31.9% and 12.6%, respectively.

What does it mean? Using matching methods we have produced the first detailed map of the distribution of chronic pain in England but with several strong assumptions (principally, no consequential unmeasured confounding). Our estimates highlight substantial variation in prevalence within ICBs.

How could this be used? By policy makers at national and regional level to highlight matched areas and explore service delivery and innovations to reduce burden of chronic pain. By local services to start transformation/quality improvement conversations.



Research article: Quinn *et al*. *J Public Health (Oxf).* 2025;47:355-363 https://doi.org/10.1093/pubmed/fdaf002

Figure 5. Map of modelled estimates of chronic pain prevalence, by LSOA, England. (unmatched LSOAs are shaded white).

Interactive Power BI maps at LSOA and ICB levels are available here

Monitoring change in population need

What is the problem? Understanding prevalence trends in chronic and high impact chronic pain helps us to understand current, and predict future, burden and plan for healthcare and public health. Population growth and ageing suggests that the number of people with chronic pain and who experience its impact will increase. In addition, factors associated with greater impact of COVID-19 (e.g. socio-economic deprivation, co-morbidities) are also associated with the incidence, prevalence and impact of chronic pain. COVID-19 can be considered both as a period effect in which national restrictions impacted on all people's daily lives and restricted the amount and mode of delivery of health care. Whilst the impact on cancer and cardiovascular disease have been reported the impact of this period on chronic pain is unclear.

What did we do? We used data from two population surveys (PRELIM (2016/17) and MIDAS (2022/23) of adults aged 35 years and over. Both surveys were done in the same geographical area of North Staffordshire and Stoke-on-Trent. We used matching techniques to control for differences in selected observed demographic and socioeconomic characteristics of respondents to both surveys.

What did we find? The prevalence of chronic pain in matched samples was 36% in 2016/17 and 43% in 2022/23. The prevalence of high impact chronic pain was also higher in 2022/2023 (16% vs 22%). Higher prevalence for both chronic and high impact chronic pain was seen particularly in women, those aged 35-54 years old, socioeconomically deprived and white ethnicity (**Figure 6**). Among those reporting chronic pain, musculoskeletal health was lower in 2022/23 (mean MSK-HQ score: 32 vs 23).

What does it mean? Over a 6-year period during which there was the COVID-19 pandemic, the prevalence of chronic pain and its impact appears to have significantly increased.

How could this be used? By service providers to understand changing population health needs and to monitor the effect of population-wide interventions.

Research article: Yu et al. *Submitted manuscript*

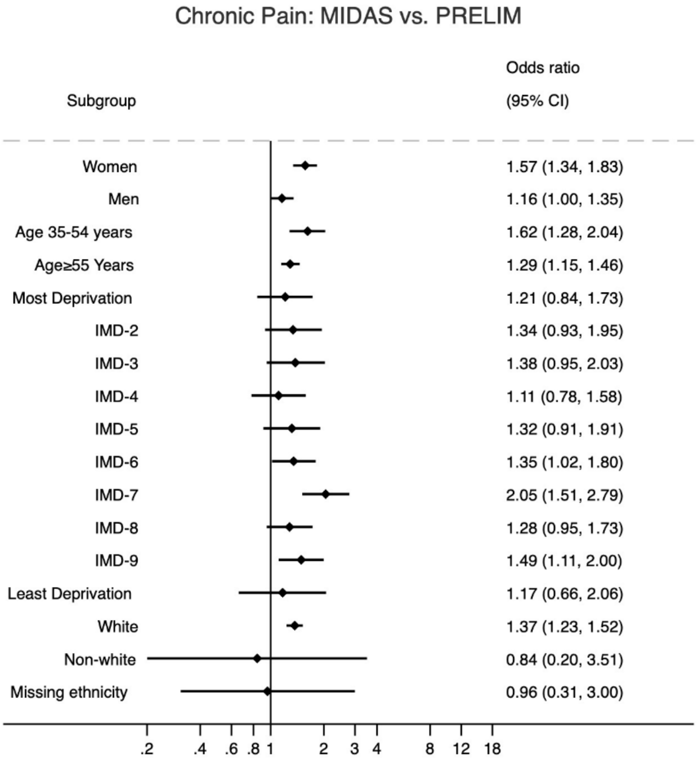


Figure 6. Risk of chronic pain in 2022/2023 (MIDAS Pop) compared with 2016/2017 (PRELIM). Odds ratios higher than 1 represent increased risk of chronic pain

Identifying patterns of high healthcare utilisation

What is the problem? Studying patterns of healthcare use and relating these to patients' self-reported outcomes can help improve resource allocation and service delivery.

What did we do? Using MIDAS-GP data we looked at participants' electronic health records over the previous five years for MSK-related consultations, prescriptions, and referrals for imaging, physiotherapy, and hospital care. We applied a technique called 'sequence analysis' to identify common patterns in these. We then looked at how the different patterns were related to patient self-reported MSK-Health Questionnaire (MSK-HQ) scores.

What did we find? We found 5 groups of healthcare use patterns among patients with MSK conditions (**Figure 7**), including "high consultation and healthcare use" (middle column, cluster 3 in Figure 7). Compared with other groups, they had the highest levels of consultations (most green in the top row of charts), highest analgesia prescriptions (most green in row 2), highest imaging referrals (row 3), physiotherapy referrals (row 4), and secondary care referrals (row 5). Patients in this group were more likely to be female, older, obese, have comorbidities and live in the most deprived areas. This group had the poorest MSK-HQ scores with little improvement following primary care consultation.

What does it mean? A small minority of patients with MSK pain conditions account for a high proportion of healthcare utilisation.

How could this be used? By healthcare commissioners and Primary Care Networks to start quality improvement conversations around MSK healthcare delivery, the variation seen and the next steps in addressing these.

Research article: Mathew S, *et al*. *Arthritis Care Res*. 2025;77:906-915. https://doi.org/10.1002/acr.25514

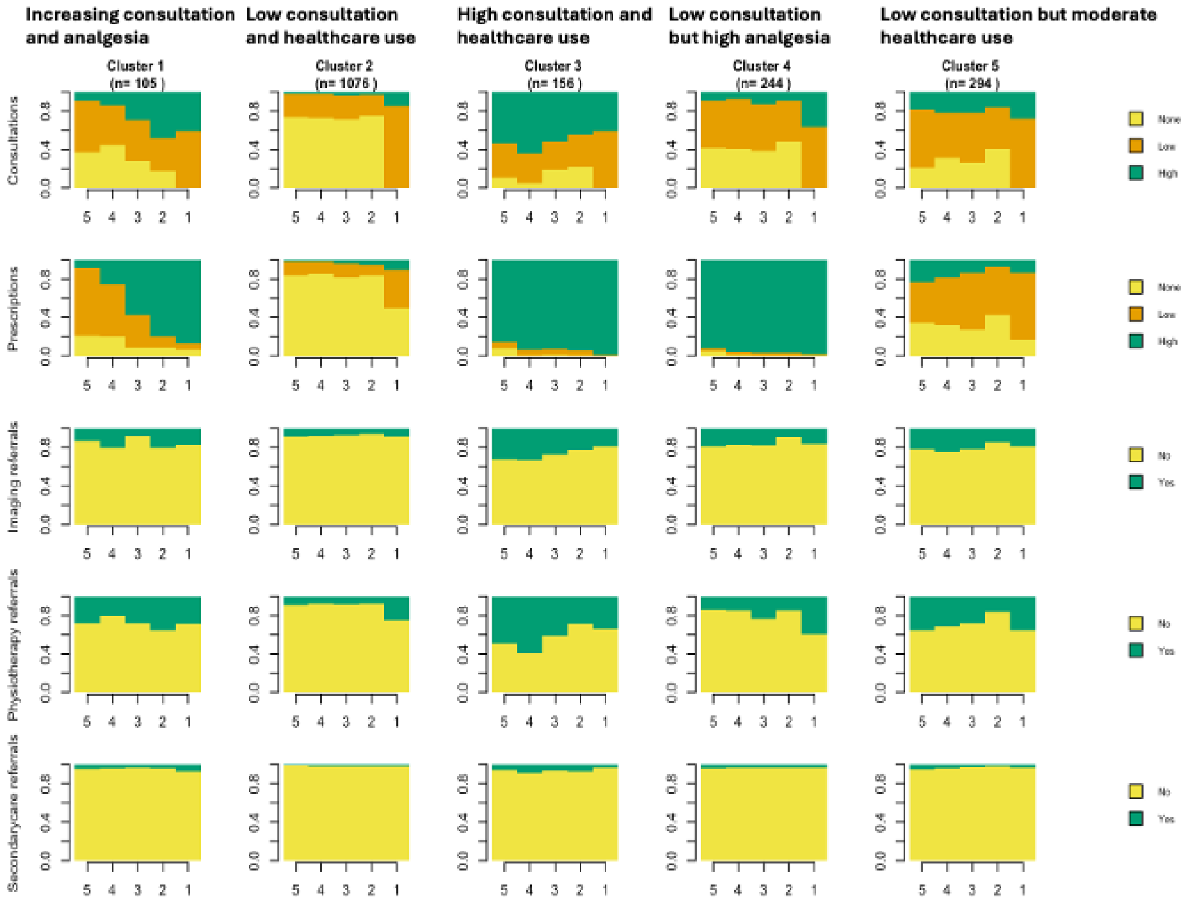


Figure 7. Sequence analysis of healthcare utilisation patterns in adults presenting to primary care with a MSK pain condition

Estimating costs and carbon output of primary care management

What is the problem? By 2050 the NHS has pledged to achieve Net Zero. To achieve this, all areas of healthcare must strive to establish greener more sustainable practices. The methods to assess variation in the carbon and cost output of care associated with MSK conditions is unclear.

What did we do? Based on published evidence from targeted literature reviews we created a way of calculating both the environmental (carbon footprint) and economic (cost) impact of MSK care in NHS general practice. We analysed data from health records and patient surveys in the MIDAS GP project under the following categories: 1) GP or healthcare practitioner appointments, 2) Medication prescriptions, 3) Imaging/Scans, 4) Self-management, 5) Urgent referrals, 6) Routine referrals, 7) Patient travel, and 8) Additional outcomes.

What did we find? On average, we estimated that caring for one MSK patient over six months resulted in 47 kilograms of carbon emissions and costs around £182 (primary care appointments £57, routine referrals £55, diagnostic imaging £33, urgent referrals £21, medication prescriptions £12, other £4). However, there were noticeable differences between practices. For all the patients who presented with MSK pain, medication prescription was found to be the highest contributor to carbon emissions (**Figure 8**). Due to high levels of medication prescription, the care associated with patients who presented with multiple pain sites or widespread pain had the highest carbon output. Likewise, because of high imaging rates, care associated with back pain patients had the highest cost.

What does it mean? This is the first study to combine both carbon and cost measurements for MSK care in primary care settings. The methods established within this study provide a framework for future research in this area. Additionally, future research should focus on creating benchmarks for sustainable and cost-effective MSK care and implementing policies to reduce healthcare's environmental impact without compromising patient outcomes.

How could this be used? The data could highlight areas for further work and transformation e.g. medication use. Often the data is the starting point for a collaborative conversation between GPs and PCNs. The data could be shared with voluntary and community sector organisations and patient groups to increase awareness of the financial and environmental cost of interventions for MSK pain conditions, which may ultimately lead to environmental impact becoming a greater consideration in shared-decision-making.

Research article: Braybrooke A, et al. *Int J Health Plann Manage*. 2025;40:907-922. https://doi.org/10.1002/hpm.3919

Figure 8. Mean carbon output (% of total) per person within the overall cohort by resource category

Inequality gaps in outcomes, experiences and care

What is the problem? People living in more deprived neighbourhoods often have more complicated health needs. It is unclear if the care they receive for their MSK pain condition is effective in helping them recover as much as people living in more affluent neighbourhoods.

What did we do? Using MIDAS-GP data (patient self-report linked to primary care electronic health record), we compared patients living in the most deprived neighbourhoods with those living in less deprived neighbourhoods, in terms of:

- how severe their pain and disability were at the time of consulting the GP
- how much their pain and disability improved 6 months after their initial consultation
- whether they were prescribed an opioid painkiller
- how satisfied they were with their care

What did we find? Compared to patients from the most affluent neighbourhoods, patients living in the most deprived neighbourhoods:

- began with much worse pain and disability
- had less improvement in their pain and disability 6 month later (**Figure 9**)
- were more likely to be prescribed an opioid painkiller (30% versus 19%)

Few patients felt dissatisfied with their consultation - only 6% overall - too few to analyse further.

What does it mean? Treatment currently given in primary care does not close the inequality gap in pain and disability between patients living in the most and least deprived areas.

How could this be used? By ICS/ICB and PCN leads in service transformation / quality improvement discussions.

Research article: Peat *et al*. *BMJ Open*. 2025 Jul 15;15(7):e095132. https://bmjopen.bmj.com/content/15/7/e095132.long

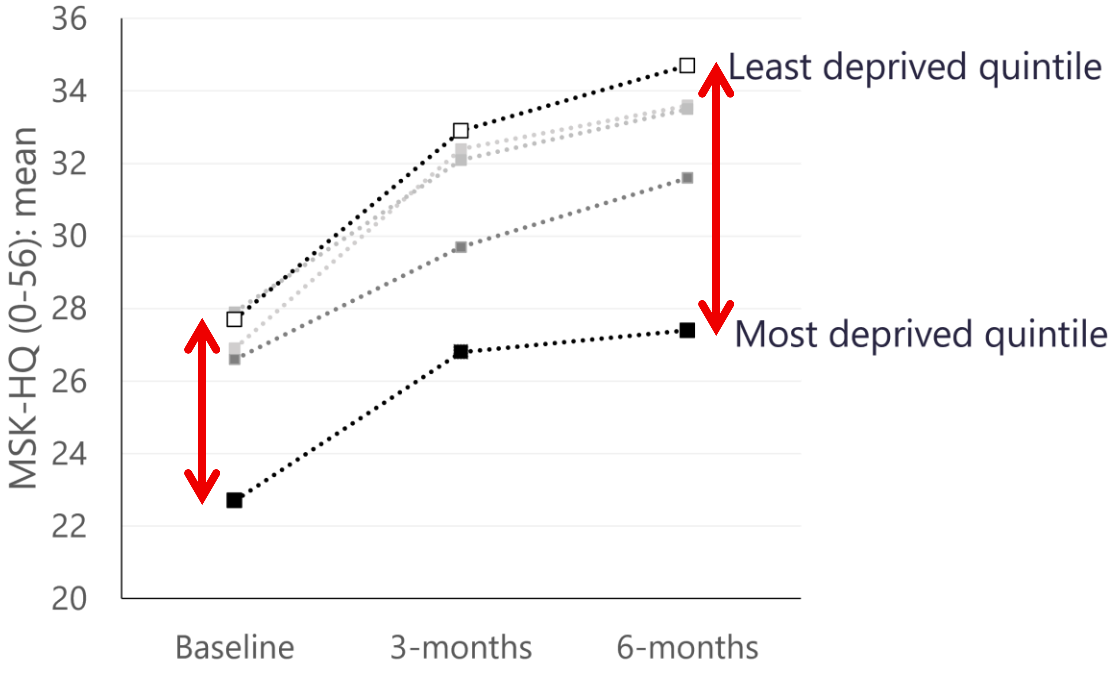


Figure 9. Inequality gap in patient-reported outcomes (MSK-HQ score) does not reduce after consultation; higher scores indicating better MSK health

Variation in MSK pain consultation rates between GP practices

Why did we do this study? The percentage of patients who consult their GP practice about a musculoskeletal pain condition varies from one practice to another. This could indicate that there are important differences between the surgeries in how easy it is to access appointments, whether patients feel that an appointment about their condition will be helpful, or whether patients can access other sources of support/treatment for these conditions. However, it might also simply be because the percentage of people who need help with these conditions is different at each practice.

What did we do? In a study of 30 general practices in North Staffordshire we calculated the percentage of each practice's adult patients who consulted about a musculoskeletal pain condition. We compared this to estimates of the number of people at the practice that were likely to have a musculoskeletal pain condition (estimates were based on responses to questionnaires on pain that were sent to random samples of adults at each practice), the characteristics of their practice and the type of patients who are registered at that practice.

What did we find? Between September 2021 and July 2022, 18,388 adults had a consultation about a musculoskeletal pain condition. We had to adjust our data to take account of the difference in how each practice recruited patients to the study e.g. how long it took them, time of year, differences in the number of people from each age range and sex. Our final results showed that the proportion having a consultation varied up to double the amount between practices (**Figure 10**). It also showed that this was not explained by the number of people registered at the practice who self-reported (in PRELIM and GP Patient Surveys) that they had a long-term musculoskeletal problem, chronic pain, or high impact chronic pain.

What does it mean? Monitoring within- and between-practice variation in consultation rates against the underlying prevalence of MSK pain is feasible with existing data. This could direct further investigation into problems of accessibility, perceived usefulness, and availability/use of alternative sources of care and support.

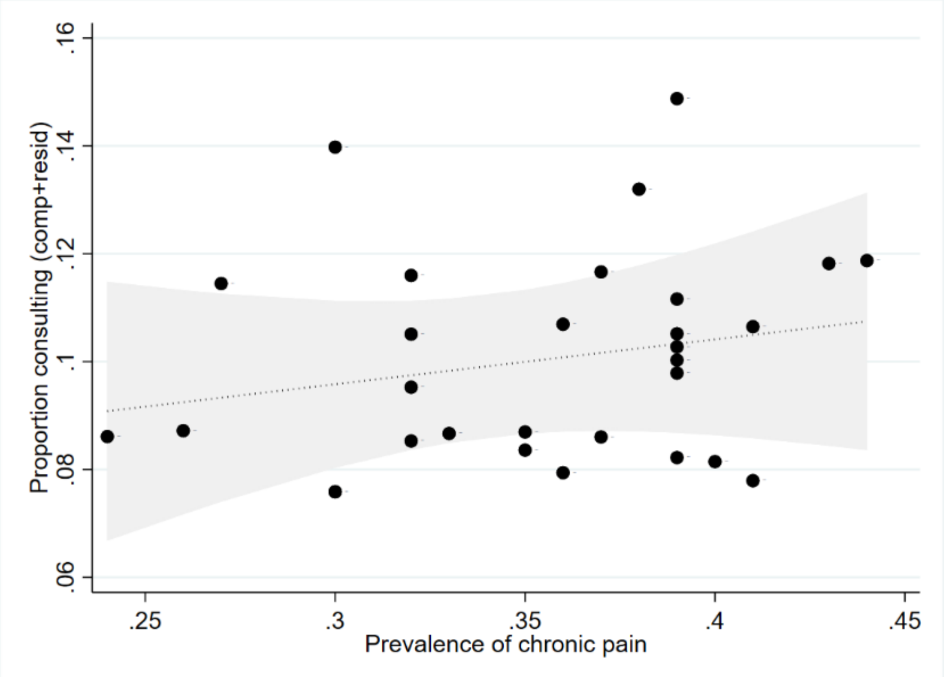


Figure 10. Lack of clear correlation between prevalence of chronic pain in the registered practice population and the proportion consulting for a MSK pain condition (each point represents a GP practice)

Research article: Peat *et al*. *Prim Health Care Res Develop* 2025;26:e52. doi:10.1017/S1463423625100133

Co-developing and evaluating the MIDAS GP MSK dashboard: a mixed-method study

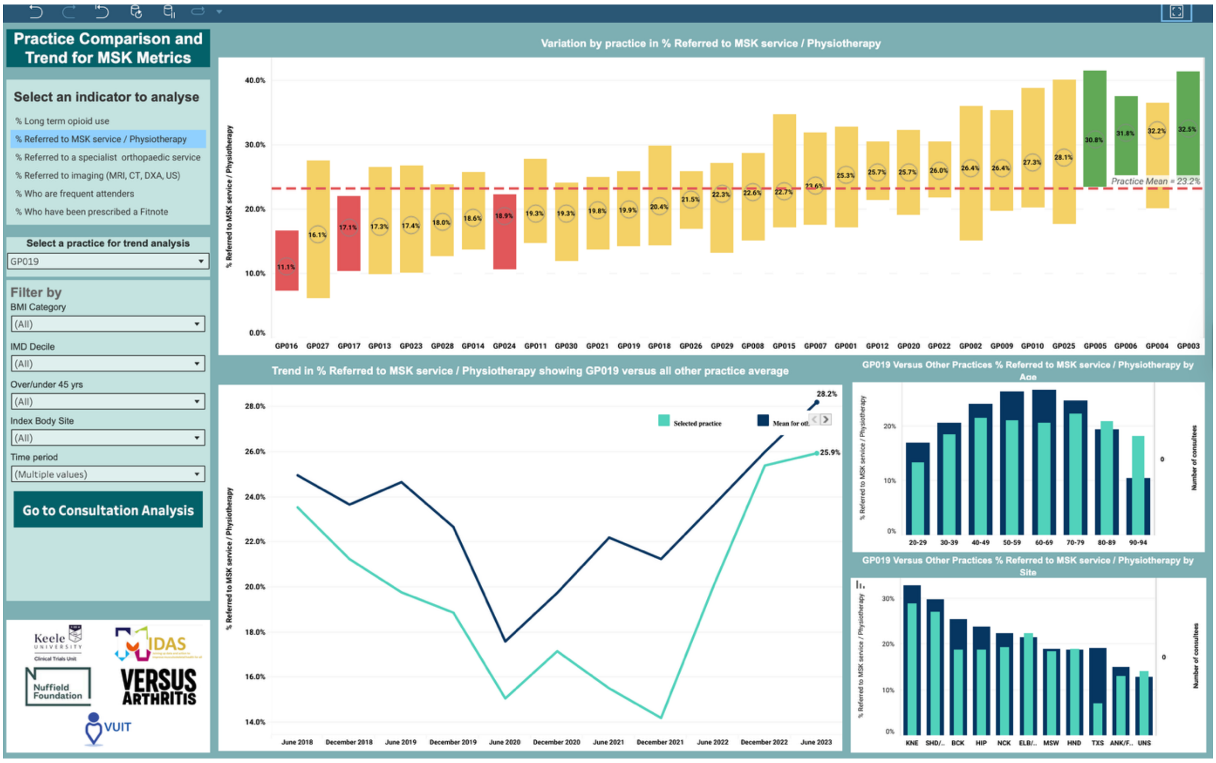
Why did we do this study? GP practices have currently not got access to data intelligence on the numbers of their MSK patients, their characteristics, the treatments provided, and how this compares with other local GP practices. This lack of accessible information limits how clinicians, managers, and patients can understand and optimise MSK primary care. Interactive dashboards are a useful method to present this type of information and to show the variation across practices and over time. They mean that large amounts of data can be easily examined and presented visually.

What did we do? We used our health record data toolkit to co-develop a dashboard with input from multi-stakeholder Community of Practice, involving clinicians, patients, and commissioners. Drawing on seven years of extracted health record data from all MSK consulters across the 30 GP practices who participated in MIDAS GP study, the dashboard (**Figure 11**) includes pages on standardised consultation rates, consulters' demographics, between-practice variation in care, practice delivery over time, and the cost and carbon model described earlier in this report. We are in the process of evaluating the dashboards usability and value through a mixed-methods study combining workshop discussions, task-based challenges, and standard usability questionnaires.

What did we find? The dashboard is still being developed but early engagement shows strong interest and engagement from both patients and GPs. We are now undertaking a thematic analysis of workshop recordings to generate a framework for the future development of health record data visualisation. A final usability testing workshop will then be completed to assess how the dashboard can best support clinicians, commissioners, and patients.

What does it mean? This work already demonstrates the powerful potential of co-designed dashboards to make primary care data more transparent, usable, and relevant for different stakeholders. By involving patients, clinicians, and commissioners throughout development, the dashboard reflects real-world priorities and ensures that outputs are meaningful to those delivering and receiving care. The forthcoming framework and usability testing will provide practical guidance for how electronic health record data can be visualised in ways that support decision-making, improve service delivery, and ultimately enhance patient outcomes.

Figure 11. Screenshot of the MIDAS GP Electronic Health Record prototype dashboard



Practice Comparison and Trend for MSK Metrics

Select an indicator to analyse

- % Long term opioid use
- % Referred to MSK service / Physiotherapy
- % Referred to a specialist orthopaedic service
- % Referred to imaging (MRI, CT, DXA, US)
- % Who are frequent attenders
- % Who have been prescribed a Fitnote

Select a practice for trend analysis: GP019

Filter by

BMI Category: (All)

IMD Decile: (All)

Over/under 45 yrs: (All)

Index Body Site: (All)

Time period: (Multiple values)

Evaluating innovations and 'natural experiments'

What is the problem? Strengthening data access and information governance are among the key recommendations of the Innovation Ecosystem Programme, which recognises their importance for prioritising and monitoring real-world testing and development, adoption and scaling of new clinical interventions(18).

What did we do? In MIDAS, we used local observational data from the MIDAS-GP study to construct an external comparison group to help evaluate a novel digital self-management intervention (SelfSTarT) being introduced by first contact practitioners (FCP) in the same Integrated Care System to patients presenting to primary care with low back pain. SelfSTarT combined two evidence-based primary care innovations that are known to assist in the management of patients with low back pain: the Keele STarT Back risk stratification tool, and the SelfBacK app that supports back pain self-management. Both had been previously evaluated in RCTs(19,20).

What did we find? Digital self-management provision/uptake appeared to favour younger, working patients with more recent, less severe back pain and higher levels of health literacy (**Table 2**). In a simple comparison of the two groups, patient experience appeared similar or better in the SelfSTarT group.

What does it mean? The availability of local, harmonised data may provide a useful source of comparative data for efficient description. Evaluating the intended and unintended effects of interventions may be possible but requires more rigorous design and analysis in a way that gets closer to the ideal of a RCT.

How could this be used? By service providers and planners to perform more efficient evaluation of new services when introduced/piloted.

Table 2. Comparison of patient characteristics and experiences: SelfSTarT vs MIDAS-GP

	SelfSTarT N=52	MIDAS-GP N=397
Female	54%	72%
Age (years): mean (SD)	52 (15)	55 (16)
Self-reported ethnicity: White	93%	95%
Body mass index (kg/m^2): mean (SD)	29 (6)	29 (7)
Poor health literacy	2%	7%
Employed	69%	47%
Unable to work due to sickness/disability	0%	14%
Duration of current pain episode > 3 months	40%	58%
Pain intensity (0-10): mean (SD)	5.8 (1.6)	7.2 (2.1)
Patient experience of primary care consultation†:		
Needs met	93%	83%
Overall experience	93%	81%

† Data available for n=28 in SelfSTarT
SD Standard deviation

Research article: Stevenson *et al*. *Musculoskeletal Care*. 2024;22:e1876. https://doi.org/10.1002/msc.1876.

Section 4. Wider Outputs and Impact

MSK Health Intelligence Toolkit

Part of the MIDAS contribution to scalable and sustainable MSK health intelligence systems was to develop, test, and share components of a MSK health intelligence toolkit for analysts and researchers.

The MIDAS programme contributed the following:

1. **SNOMED CT Concept ID codelists**
   SNOMED CT is the standard clinical terminology for the NHS to support recording of clinical information. It provides a comprehensive set of clinical phrases or terms covering over 350,000 concepts which can be used across all care settings and all clinical domains. Our programme contributed:
   - A list of SNOMED CT Concept IDs suitable for practical application in UK primary care data for identifying consultations and clinical events for non-inflammatory musculoskeletal pain conditions and injuries in adults. The codelist was derived with relation to existing codelists, consensus development involving clinical and methodological experts familiar with health care records, and analysis of national primary care data. This provides a consistent basis for identifying healthcare contacts for MSK pain conditions in primary care electronic health record data.
   - SNOMED CT Concept IDs for MSK-relevant primary care referrals and processes of care
   - SNOMED CT Concept IDs for selected comorbidities: alcohol misuse/abuse; anorexia or bulimia; anxiety and depression; cancer, cardiovascular events; dementia; diabetes; digestive conditions; hearing loss/impairment; learning difficulties; neurological conditions; psychoactive substance misuse/dependence; renal disorders; respiratory disorders; severe mental illness; visual loss/impairment. These codelists help take comorbidities into account when describing and comparing patterns of care and outcomes for people with MSK pain conditions.

2. Recommended **core patient-reported outcome and experience sets** and **data collection instruments**. Work undertaken towards a national MSK audit, together with public/patient involvement, informed the choice of self-report questionnaires used in the MIDAS studies. These included the use of the MSK-HQ and covariates for case-mix adjustment.

3. **Prototype data dashboards** designed for local health commissioners, service managers, and healthcare professionals. See page 26. Free access to the MSK dashboard will be considered on request.

MIDAS toolkit resources are available open access at Open Science Framework. Codelists are provided in machine-readable format, with supporting documentation. Our Musculoskeletal Pain/Injury codelist has also been deposited in the open access Health Data Research UK (HDRUK) Phenotype Library (PH941/1961) to aid discoverability.

Dissemination

The MIDAS project and its initial findings featured in a **national inquiry into Musculoskeletal Health Inequalities and Deprivation** that was led by Arthritis & Musculoskeletal Alliance (ARMA)(21). Our findings have also been presented on multiple occasions to the **National Musculoskeletal Health Data Group** hosted by Arthritis UK.

Impacts

Stakeholder meetings including local and regional system and provider finance leads, physiotherapists, orthopaedic surgeons, GPs, public health consultants and patient partners produced a forum for discussion and knowledge exchange between providers, commissioners, and researchers that did not previously exist.

Stakeholder engagement has already directly contributed to:

- The development of a business case to address chronic pain service inequities in Stoke-on-Trent, underpinned by MIDAS data.
- New collaborations, such as a partnership between researchers and Staffordshire & Stoke-on-Trent Integrated Care System to investigate opioid use for MSK pain management.
- The use of the MIDAS data to support value-based healthcare discussions with stakeholders within Staffordshire & Stoke-on-Trent Integrated Care System for people over the age of 45 with knee pain.
- Development of a business case to support the ongoing use of the SelfBack App to help people consulting with a musculoskeletal pain condition.

Further stakeholder meetings and community of practice events are planned.

Section 5. Lessons learnt

The following sections summarise critical reflections of the MIDAS team, our Patient Advisory Group, and from stakeholders at meetings convened with representatives from local Staffordshire and Stoke-on-Trent Integrated Care System, Primary Care Networks, patient and public contributors, and healthcare professionals, academic researchers, service managers, and policymakers attending Musculoskeletal Community of Practice events hosted by Keele University Impact Accelerator Unit.

Relative cost and efficiency of data collection methods

1. Patient self-report data can be efficiently collected for periods of between 3-6 months from GP consulters using general practice SMS text message services signposting to online questionnaires.

2. Multiple methods were required to obtain self-report data from samples of the general population. This included pen-and-paper questionnaire, online questionnaire, and doorstep interviews in targeted areas of socioeconomic deprivation and greater ethnic diversity. The doorstep interviews did successfully enrich our mailed/online survey respondents with younger (54% aged under 55 years) and more ethnically diverse (27% Black, Asian, Mixed, or Multiple ethnic background) adults living in deprived neighbourhoods. Combining these data was complex and the overall cost of population surveys was comparatively high and response rates were lower in 2021/2022 than for a similar survey conducted in 2016/2017.

3. Collection of patient self-reported data relied on **support from NIHR West Midlands Clinical Research Network** (now NIHR Research Delivery Network) and **time and resource from general practice staff** as a portfolio-adopted research project. CRN support was particularly helpful for enabling the participation of general practices serving more deprived and ethnically diverse communities and who may not have previously been involved in many research projects.

4. Linked datasets held on University secure servers requires 'data travel' that other emerging approaches using Trusted Research Environments (TRE) or Secure Data Environments (SDE) would not. Datasets held on University secure servers may also be **difficult to discover and access for researchers and analysts based in other organisations**. During MIDAS we explored several alternative avenues for data linkage and analysis, including access to TRE via a primary care IT supplier, access to shared care record data via local Integrated Care Board, hosting projects on the regional Secure Data Environment (SDE), discussions with IT suppliers involved in Shared Care Record provision for Integrated Care Systems, and Commissioning Support Units. **Cost** and **data sharing agreements/contractual requirements** to enable researchers employed in Higher Education Institutions to access NHS data were the main barriers. The MIDAS programme informed the development of a proposed MSK PROMs Visualisation and Research Platform with West Midlands Secure Data Environment (**Figure 11**).

Inclusion and bias

5. The collection of patient-report data involved a **trade-off** between gaining **valuable data** that is absent from routine electronic health records and the **costs** of data collection and likelihood of **selective non-response**. Collecting data directly from patients, carers, service users and members of the public loses the advantage of 'N=all' routine data (although NHS National Data opt-outs and those not registered with a GP may still be missed in routine data).

6. Response rates of 10-25% across all MIDAS studies were seen despite sampling at different

points in the care pathway and adopting strategies designed to minimise selective non-response. **Analytic strategies** that evaluate and attempt to correct for selection bias are an essential part of health intelligence systems. Access to information on the characteristics of the target population is typically a requirement. Challenges of generalisability, response bias, and missing data are not new - similar issues have arisen in arthroplasty registries collecting PROMs(22). Follow-on work using MIDAS data will explore the use of matching and weighting using de-identified EHR data from the total target population to evaluate and correct for bias.

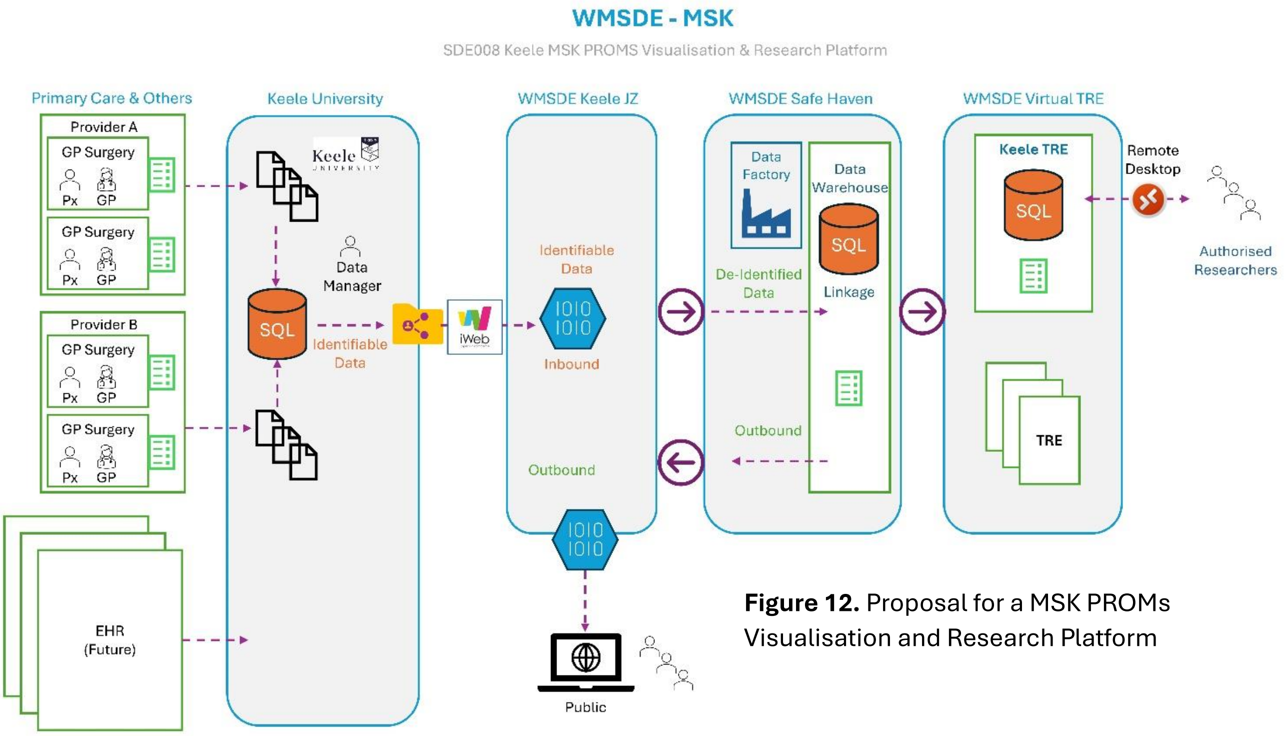


Figure 12. Proposal for a MSK PROMs Visualisation and Research Platform

Information needs and preferences of stakeholders

7. The full impact case study report is presented in Appendix G. The following are some of the headline findings.

8. Exemplar analyses acted as a necessary starting point for discussions between stakeholders, rather than a conclusion, helping to elicit priority issues and data preferences.

9. Health system decision-makers need **timely, up-to-date data**. Our approach to collecting self-report data from patients/public provided **static data** within the confines of a time-limited research grant. The cost, frequency, and usefulness of periodic collection of patient self-report data for ongoing monitoring of musculoskeletal health and care should be explored.

10. **Different stakeholders have very different information needs**. The importance of financial planning to Integrated Care Systems means that information on costs for Business Leads should be included. Patients and public emphasised the value of understanding what 'good' care looks like and what to expect from a healthcare consultation. Healthcare professionals and service managers may be most interested in information that helps them evaluate and improve the quality of care.

11. **Dynamic, interactive data visualisation** was preferred by several stakeholders so that they could choose which aspects of the data to focus on. Our team has been developing prototype dashboards in response to this expressed need (Appendix H). It is evident that

different audiences are wanting different visual information which we are currently identifying and seeking to accommodate. The team have also been encouraged by the engagement from different audiences including patients, clinicians and commissioners with the dashboards. Our approach is improvement-oriented and explicitly avoids "name-and-shame". Results are risk-adjusted and peer cluster displays (e.g. funnel/caterpillar plots) provided with uncertainty bands and small-number safeguards; accompanied by local contextual notes and clear "what to do next" prompts. In our discussions with GPs, they have told us they are used to seeing practice-level comparisons from resources such as QOF, https://openprescribing.net/ and https://www.prescqipp.info/our-resources/data-and-analysis/ which are widely used across primary care and not perceived as threatening.

12. All stakeholders welcomed information that was presented in **understandable, clear, non-judgemental ways that gave confidence in the data and analysis**. Being clear about sources of bias and uncertainty may be part of this. Particular care is needed when communicating information on inequalities and unwarranted variation in care to avoid stigmatising identifiable neighbourhoods or services.

Public involvement in data integration research

13. A **Public Advisory Group** with 7 standing members, continuity of membership, regular (monthly) meetings with research team members, and involvement across the lifecycle of the programme of work was a particularly strong feature of MIDAS. This model of working was welcomed by public contributors who recommended that this be adopted for other future studies (see **Appendix I** for a reflection on this).

14. Patient Advisory Group members were particularly concerned about unfair exclusion of potential participants. They advocated for conventional pen-and-paper self-complete questionnaire with telephone support; encouraging sufficient time and support for GP practices in the most deprived areas to participate and recruit; actively being involved in the design and procurement of a booster doorstep survey; and identifying questions for analysis focussed on hidden need.

Frequently changing organisational labels, structures, strategies and policies

15. The challenge for health data research of frequent organisational change was highlighted in the Sudlow Review. This was also clearly seen over the course of the MIDAS programme. Several organisations with strategic roles in health data at the start of MIDAS – Public Health England, BestMSKHealth initiative, and latterly Integrated Care Boards and NHS England (see p8), have undergone significant change (or are about to). It is undoubtedly difficult in such a changing context to build sustainable relationships and procedures that support efficient cumulative progress and knowledge. Navigating access to integrated care record data and to community services data were particularly time-consuming.

16. Our experience with NHS England Data Access Requests was generally positive, taking 11 months from initial request to data transfer, much of this due to iterative clarification of the specific details in the data request.

17. We welcome the Sudlow Review's recommendations to:

- reduce ecosystem complexity
- coordinate long-term planning and investment in publicly funded health data infrastructure;
- support a national health data service

- ensure ongoing nationally coordinated engagement with patients, public, health professionals and politicians

- a UK-wide strategy for data access and trustworthy governance

- a UK-wide system for SDE standards and accreditation.

18. Critical additional considerations for musculoskeletal health and care arising from MIDAS include:

- that the interests of musculoskeletal health, care, and prevention must be represented within the above developments.

- that planning for national and local health data infrastructure must ensure the ability to incorporate patient-reported information.

- that in addition to reducing complexity, attention must also be given to reducing cost and contractual barriers to accessing secure data environments if these are to form the central basis for a future national health data service

Additional information

Disclosure of interest

This project has been funded by the Nuffield Foundation's Oliver Bird Fund and Arthritis UK (OBF/43990), but the views expressed are those of the authors and not necessarily the funders. Visit www.nuffieldfoundation.org and www.arthritis-uk.org.

MIDAS project was conducted in partnership with Keele Clinical Trials Unit (UKCRC ID 36).

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Members of Staffordshire Integrated Care Board and the Community of Practice

Data sharing statement

Keele University is a member of the UK Reproducibility Network and committed to the principles of the UK Concordat on Open Research Data (https://www.ukri.org/wp-content/uploads/2020/10/UKRI-020920-ConcordatonOpenResearchData.pdf). The School of Medicine and Keele CTU have a longstanding commitment to sharing data from our studies to improve research reproducibility and to maximise benefits for patients, the wider public, and the health and care system.

Metadata, including study protocol, statistical analysis plan, data dictionaries and key study documents (Participant Information Leaflet, consent form) will be deposited on a publicly accessible repository.

Anonymised individual participant data (IPD) that underlie the results from this trial will be securely stored on servers approved by a government-backed cyber security scheme and made available to bona-fide researchers upon reasonable request via our controlled access procedures. Unless there are exceptional circumstances, data will be available upon publication of main study findings or within 18 months of study completion (whichever is earlier) and with no end date. Data requests and enquiries should be directed to medicine.datasharing@keele.ac.uk. We encourage collaboration with those who collected the data, to recognise and credit their contributions.

Any requests for access to the data from anyone outside of the research team (e.g. collaboration, joint publication, data sharing requests from publishers) will follow the Keele CTU Standard Operating Procedure (SOP) Data Request Process.

The data generated from this study will remain the responsibility of the Sponsor. Release of data will be subject to a data use agreement between the Sponsor and the third party requesting the data. Anonymised individual participant data will be encrypted on transfer.

The full Privacy Notice for Research Participants can be found at https://www.keele.ac.uk/legalgovernancecompliance/legalandinformationcompliance/informationgovernance/checkyourinformationisbeinghandledcorrectly/researchparticipants/#data-sharing.

As a condition of access to, and use of data and meta-data arising from the MIDAS programme of research, all outputs must acknowledge the original funding sources.

Ethics statement

The MIDAS-GP study received IRAS/NHS REC approval from Yorkshire & The Humber – Leeds West Research Ethics Committee (21/YH/0178; 10 Aug 2021). Written informed consent was obtained from individual participants.

The MIDAS-Population study received IRAS/NHS REC approval from Wales Research Ethics Committee 4 – Wexham (22/WA/0256;1 Sep 2022). Written informed consent was obtained from individual participants.

The National Musculoskeletal Community and Primary Care Audit and Research Database received IRAS/NHS REC approval from South West - Central Bristol Research Ethics Committee (23/SW/0059; 8 Jun 2023). The MIDAS-COMM study received approval from Keele University Research Ethics Committee 1018.

Full list of publications and other outputs arising from this programme

Original research articles

Lynch M, Peat G, Jordan K, Yu D, Wilkie R. Where does it hurt? Small area estimates and inequality in the prevalence of chronic pain. *Eur J Pain*. 2023 Nov;27(10):1177-1186. doi: 10.1002/ejp.2148.

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Quinn L, Yu D, Lynch M, Jordan KP, Wilkie R, Peat G. An application of matching algorithms to generalize small-area estimates of chronic pain prevalence to neighbourhoods across England. *J Public Health (Oxf)*. 2025;47(2):355-363. doi: 10.1093/pubmed/fdaf002.

Mathew S, Peat G, Parry E, Wilkie R, Jordan KP, Hill JC, Yu D. Sequence Analysis to Phenotype Healthcare Patterns in Adults with Musculoskeletal Conditions Using Primary Care Electronic Health Records. *Arthritis Care Res (Hoboken)*. 2025 Mar 2. doi: 10.1002/acr.25514.

Braybrooke A, Pegg M, Naylor R, Bailey J, Scott J, Burgess R, Yu D, Wathall S, Jordan KP, Malcolm R, Holmes H, Peat G, Banerjee A, Hill JC. Estimating the Cost and Carbon Output of Musculoskeletal Primary Care Management Decisions: A Retrospective Analysis of Electronic Health Records. *Int J Health Plann Manage.* 2025 Mar 22. doi: 10.1002/hpm.3919.

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Yu *et al.* Comparison of musculoskeletal health in the general population between 2016/17 and 2022/3: a tapered matching study. *Submitted manuscript*

Hill J, Yu D, Jordan KP, Bailey J, Wathall S, Thompson C, Parry E, Wilkie R, Burgess R, Peat G. Case-Mix Adjusted Analysis of Musculoskeletal Outcomes and Opioid Prescribing in England. *Submitted manuscript*

Conference abstracts, posters, presentations

Quinn L, Yu D, Lynch M, Jordan KP, Wilkie R, Peat G. An application of matching algorithms to generalize small-area estimates of chronic pain prevalence to neighbourhoods across England. Association of Directors of Public Health. Sector-Led Improvement Conference. 8 Nov 2024, Sheffield.

Quinn L. An application of matching algorithms to generalize small-area estimates of chronic pain prevalence to neighbourhoods across England. Royal Statistical Society. 1-4 Sep 2025, Edinburgh.

Meta-data

The MIDAS project's Open Science Framework site (https://osf.io/e542w/) contains SNOMED CT codelists (GitHub), study protocols, presentations, manuscripts, data dictionaries, statistical code and other meta-data.

List of abbreviations

CCG	Clinical Commissioning Group
CPRD	Clinical Practice Research Datalink
CRN	Clinical Research Network
CSP	Chartered Society of Physiotherapy
CTU	Clinical Trials Unit
DARS	Data Access Request Service
DHSC	Department of Health and Social Care
EHR	Electronic Health Record
FCP	First Contact Practitioner
GIRFT	Getting it right first time
GP	General practice
HDRUK	Health Data Research UK
HES	Hospital Episode Statistics
ICB	Integrated Care Board
ICS	Integrated Care System
LSOA	Lower Super Output Area
MIDAS	Multi-level Integrated Data for musculoskeletal health intelligence and ActionS
MPFT	Midlands Partnership NHS Foundation Trust
MSK	Musculoskeletal
MSK-HQ	Musculoskeletal Health Questionnaire
NHSE	NHS England
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health and Care Research
OHID	Office for Health Inequalities and Disparities
ONS	Office for National Statistics
PAG	Patient Advisory Group
PCN	Primary Care Network
PHE	Public Health England
PPI	Patient and public involvement
RDN	NIHR Research Delivery Network
SDE	Secure Data Environment
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms
TRE	Trusted Research Environment

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Appendix

Appendix A: MIDAS Logic Model

Appendix B: MIDAS-GP Design and Cohort Description

Appendix C: MIDAS-POP Design and Cohort Description

Appendix D: MIDAS-COMM Design and Cohort Description

Appendix E: Patient-reported descriptive characteristics, outcome measures and experience measures collected in the MIDAS studies

Appendix F: General structure for ‘realistically complex’ multi-level models in MIDAS

Appendix G: The Impact of the MIDAS Study on the Local Healthcare System: A Case Study

Appendix H: Prototype interactive dashboard

Appendix I: Public Involvement in MIDAS

Appendix A: MIDAS Logic Model

Problem	Resources/inputs	Activities	Outputs	Outcomes/impact
Absence of valid, patient-relevant information on outcomes/health states/risk factors linked to routinely available healthcare data for MSK, thereby limiting efforts to understand groups at greatest need, outcomes of care, and unwarranted variation in these	Measures/indicators: validated key PROMS and other recommended key MSK indicators, incl. MSK-HQ; Read MSK codelists; quality of care indicators; PHE Fingertips; indicators evaluated through PRELIM; case-mix adjustment Local research infrastructure: Keele CTU; West Midlands North CRN; high-quality coding local general practices; community MSK services; Keele Repository Knowledge/skills/experience of data collection platforms and processes, e.g. MSK-Tracker, FCP Pilot, population/practice-based surveys	Collect data: • Review and update relevant codelistsSNOMED • Design and execute cross-sectional survey of general population and primary care consulters for MSK problems • Design and execute point-of-care episode of care cohort studies of patients with MSK problems presenting to primary care and community MSK services	Updated codelists freely available to individuals and organisations nationally and internationally through institutional website Validated survey instruments Online data collection platform Integrated datasets with rich musculoskeletal data within a defined local population for future stakeholder-led/student analysis Anonymised datasets available through Keele Repository for sharing with researchers via 'controlled access' procedures New evidence on valid musculoskeletal health indicators that 'make sense' and that 'matter' Population 'normative' data on MSK-HQ for benchmarking Static and interactive presentations of local musculoskeletal health and care valued by end-users Ways of implementing key recommended interventions to prevent and manage musculoskeletal conditions	Standardised methods of identifying common musculoskeletal problems in primary care EHR data, capable of being applied at practice, PCN, CCG, regional, and national level Efficient methods for evaluating (variations in) outcomes of care in primary care and community MSK settings Raise profile of musculoskeletal health among clinicians and patients/members of the public, including improved awareness of inequalities and inequities in musculoskeletal health and care Proposals for additional MSK indicators in national PHE Fingertips tool Local service transformation informed by evidence; influence on national roll-out Priority supplementary PROM, quality indications and analyses for Integrated Care Records
Lack of integrated datasets suitable for 'population musculoskeletal health management' in defined local populations	Data: NHS Digital datasets and products, including HES (Keele University Data Agreement); public health datasets available from ONS/PHE and others Local research infrastructure: Keele CTU; Keele RIE Partnerships: CCG; Consortium; Stoke-on-Trent Local Authority department of public health	Link data: • Make DARS application to NHS Digital for linkage of our local consenting respondents survey and primary care data • Extract and link aggregate data on primary care workforce, area-level deprivation and assets and other wider determinants of health		
Lack of sufficiently detailed information on musculoskeletal health and care with a clear equity focus and repeated across time	Datasets: PRELIM; multi-level dataset created in this project Knowledge/skills/experience of statistical data analysis and handling of linked datasets Training: interactive presentation, e.g. R Shiny	Analyse data: • Quantify (change in) inequality gaps and gradients in MSK health • Describe variation in care and episode outcomes across healthcare services and organisations • Evaluate the impact of MSK service transformation Produce presentations of estimates: • Tables, figures, maps • Digital vs offline		
Historical low priority of musculoskeletal health; under-use of (cost-)effective nonpharmacological interventions; problematic overuse of some pharmacological treatments (e.g. opioids); variability in the above Concern over potential for iatrogenic effects of action (e.g. misuse of metrics, unintended consequences of intervention, including widening inequalities)	Local MSK service improvement initiatives: Transforming MSK services; First Contact Practitioner service Partnerships: Keele Impact Accelerator Unit; MPFT; UHNM; RUG; CSP; GIRFT; Together We're Better Health and Care Partnership; WMAHSN; WMARC; EBP@Keele	Disseminate, engage: • Clinical review meetings with participating general practices and MSK services • Communities of Practice • Presentation/discussion at Alliance Board/other local commissioner meetings • PHE Musculoskeletal; Productive Healthy Ageing • Versus Arthritis Data Group • Keele Medical School		
Uncertainty over ability of locally designed systems to scale-up and adapt activities/outputs to other settings and to be sustainable over time	Data: CPRD (GOLD and AURUM licenses) Partnerships/links: PHE; CSP; Versus Arthritis; MRC-VA Centre for Musculoskeletal Health & Work; Together We're Better Integrated Care Record	Transport algorithms to national data Offer online options in new data collection Seek additional funding for advanced modelling of small-area estimates and/or qualitative exploration of inequalities in MSK health and care		

Appendix B: MIDAS-GP Design and Cohort Description

Design: multicentre, prospective observational cohort with repeated measures at 3 waves (baseline, 3 months, and 6 months after index consultation).

Setting: 30 general practices in North Staffordshire & Stoke-on-Trent, England

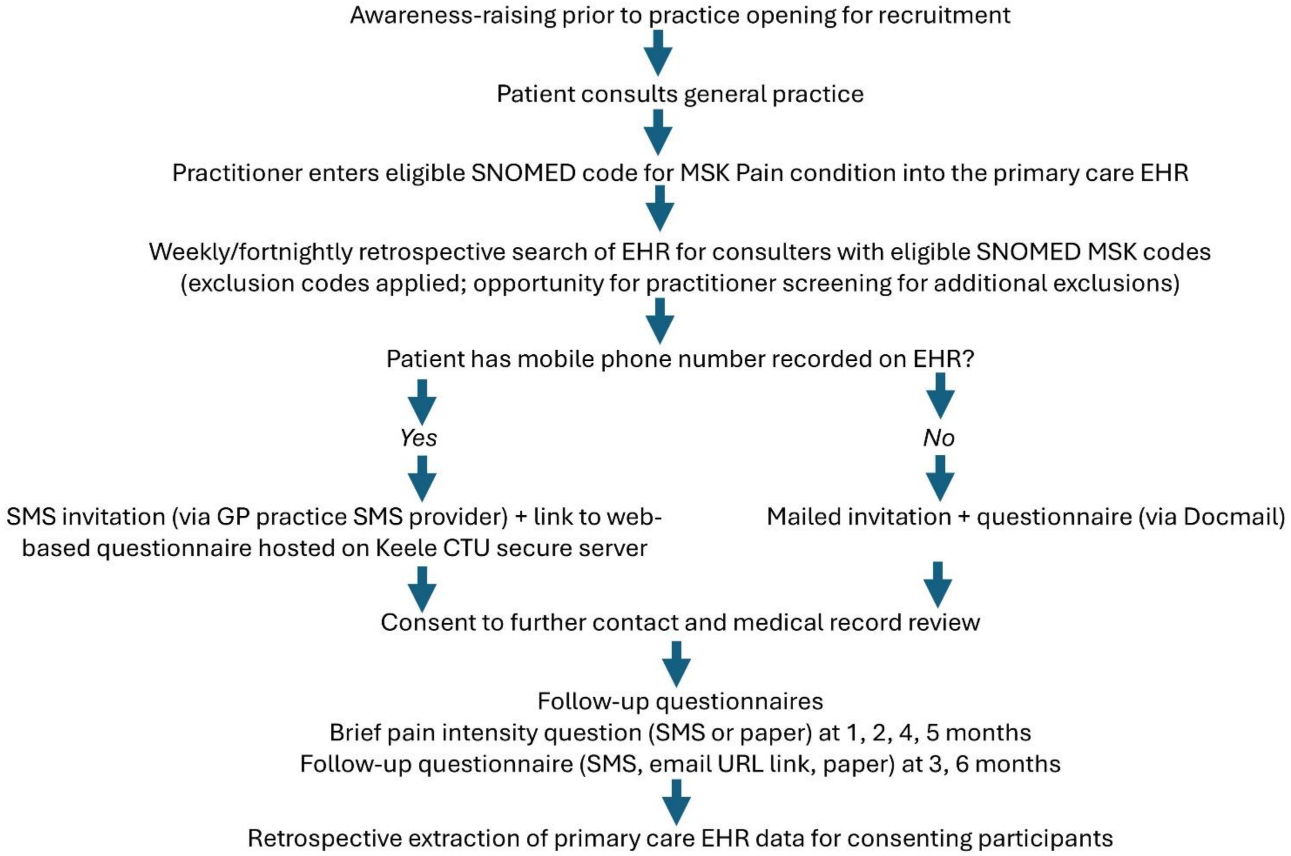
Participants: Consecutive, eligible, consenting patients aged 18 years and over presenting with a relevant SNOMED CT-coded non-inflammatory musculoskeletal pain condition between September 2021 and July 2022.

MIDAS-GP cohort characteristics (n=1875)		
Age (years): mean (SD)		58 (16)
Female		66%
Ethnicity:	Asian	2%
	Black	2%
	Mixed/Multiple	1%
	Other	1%
	White	95%
Lives in most deprived quintile of neighbourhoods nationally		28%
MSK-HQ (0-54): Mean (SD)		26 (11)
Reported BMI (kg/m^2): mean (SD)		29 (7)

Data collection: Patient-reported measures of musculoskeletal symptoms, disability, and health, patient experience of care, healthcare utilisation, general health, demographic and socioeconomic characteristics, and employment were collected using mixed-mode (online and pen-and-paper) questionnaires. The flowchart for data collection is shown below.

Data linkage: Participants were invited to consent to medical record review and linkage (primary care electronic health records extracted from GP practices and hospital episode and other data via NHS Digital). NHS number was used for individual-level linkage. GP practice code and Lower Super Output Area were used to construct multilevel datasets linking publicly available data on practices and neighbourhoods.

Cohort characteristics: 2008 patients completed baseline questionnaires of whom 1875 consented and were successfully linked to their EHR. Their basic characteristics are shown in the table.



Further details on the design of MIDAS-GP can be found in the study protocol which is published on open access at the Open Science Framework: OSF | Multi-level Integrated Data for musculoskeletal health intelligence and ActionS (MIDAS)

Appendix C: MIDAS-POP Design and Cohort Description

Design: cross-sectional population prevalence survey using hybrid online/pen-and-paper collection, plus booster doorstep survey in more socioeconomically deprived and ethnically diverse neighbourhoods in Stoke-on-Trent

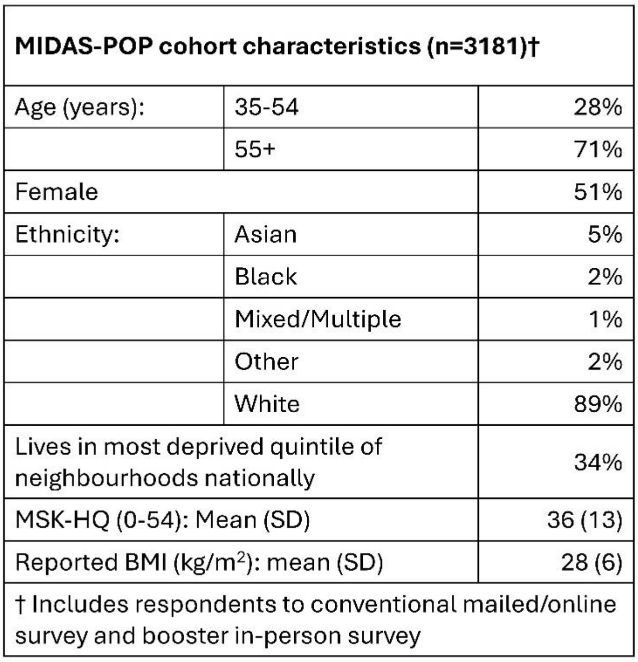
Setting: North Staffordshire & Stoke-on-Trent, England

Participants: Adults aged 35+ years

Data collection: Invitation and URL link to online survey were sent by SMS text to a random sample of 450 adults registered with each of 30 general practices in North Staffordshire & Stoke-on-Trent and who had a mobile phone number registered with the GP practice. Non-respondents and those without a registered mobile number were mailed the invitation, Participant Information Sheet, questionnaire, and consent form with pre-paid envelope. The booster survey was conducted by a third-party survey provider commissioned by the MIDAS team. Interviewers conducted doorstep surveys in target neighbourhoods within the catchment areas of 6 of the 30 general practices who demonstrated a low response rate to the conventional survey. A quota of 600 respondents was set.

Data linkage: Participants were invited to consent to medical record review and linkage (primary care electronic health records extracted from GP practices and hospital episode and other data via NHS Digital). NHS number was used for individual-level linkage. GP practice code and Lower Super Output Area were used to construct multilevel datasets linking publicly available data on practices and neighbourhoods.

Cohort characteristics: 3181 patients completed and returned a survey questionnaire, of whom 1962 consented and were successfully linked to their EHR. Their basic characteristics are shown in the table.



MIDAS-POP cohort characteristics (n=3181)†		
Age (years):	35-54	28%
	55+	71%
Female		51%
Ethnicity:	Asian	5%
	Black	2%
	Mixed/Multiple	1%
	Other	2%
	White	89%
Lives in most deprived quintile of neighbourhoods nationally		34%
MSK-HQ (0-54): Mean (SD)		36 (13)
Reported BMI (kg/m^2): mean (SD)		28 (6)
† Includes respondents to conventional mailed/online survey and booster in-person survey		

Further details on the design of MIDAS-POP can be found in the study protocol which is published on open access at the Open Science Framework: OSF | Multi-level Integrated Data for musculoskeletal health intelligence and ActionS (MIDAS)

Appendix D: MIDAS-COMM Design and Cohort Description

Design: Secondary analysis of routine anonymised retrospective observational cohort data, with repeated measures at 2 waves (baseline, 3 months)

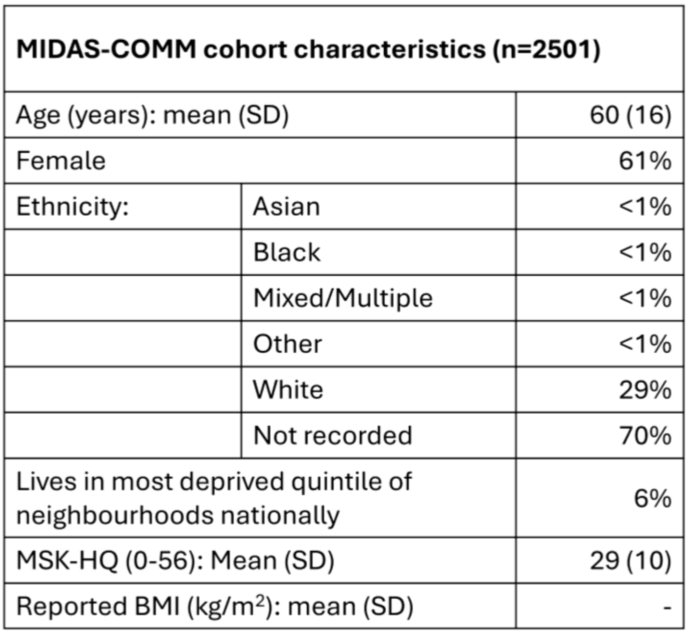
Setting: Community musculoskeletal service in North Staffordshire, England

Participants: Consecutive, eligible, consenting patients aged 18 years and over presenting with a relevant SNOMED CT-coded non-inflammatory musculoskeletal pain condition between January 2024 and December 2024.

Data collection: Data had already been routinely collected by the clinical service. This included MSK-HQ at baseline and 3 months, and selected demographic characteristics (e.g. age, sex, IMD, ethnicity), clinical characteristics and treatment received, wherever possible harmonised with those collected in MIDAS-GP and MIDAS-POP studies.

Data linkage: At the time of reporting no data linkages had been established.

Cohort characteristics: Preliminary data were extracted for 2501 patients with completed baseline. Their basic characteristics are shown in the table.



MIDAS-COMM cohort characteristics (n=2501)		
Age (years): mean (SD)		60 (16)
Female		61%
Ethnicity:	Asian	<1%
	Black	<1%
	Mixed/Multiple	<1%
	Other	<1%
	White	29%
	Not recorded	70%
Lives in most deprived quintile of neighbourhoods nationally		6%
MSK-HQ (0-56): Mean (SD)		29 (10)
Reported BMI (kg/m^2): mean (SD)		-

Further details on the design of MIDAS-COMM can be found in the study protocol which is published on open access at the Open Science Framework: [OSF | Multi-level Integrated Data for musculoskeletal health intelligence and ActionS (MIDAS)]

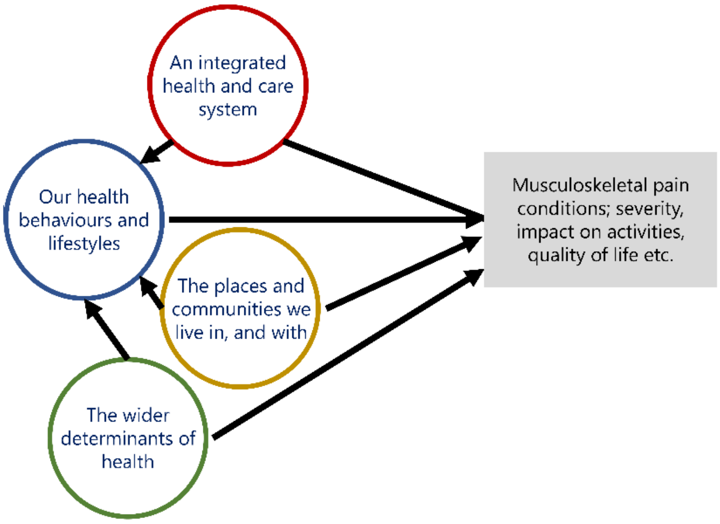
Appendix E: Patient-reported descriptive characteristics, outcome measures and experience measures collected in the MIDAS studies

		MIDAS-GP			MIDAS-POP	MIDAS-COMM	
		BL	**3m**	**6m**		**BL**	**3m**
Demographic / socioeconomic							
Age	1	●	●	●	●[a]	●	
Sex at birth	1	●	●	●	●[a]	●	
Ethnicity	1	●			●	●	
Marital status	1				●		
Educational attainment	1				●		
Perceived financial strain(23)	1	●			●[a]		
Health literacy (single item)(24)	1	●			●		
Health literacy (HLS-EU-6Q)(25)	6				●		
Informal caregiving	1				●		
Housing needs(26)	2				●		
Food poverty	3				●		
Fuel poverty	1				●		
Transport poverty	1				●		
Community participation	1				●		
Trust and community engagement	6				●		
Emotional support	4				●		
Loneliness	1				●		
Patient experience							
Doctor-patient communication(27)	5	●					
Personalised care plan given	1	●					
Sufficient information given	1	●					
Discussion about impact on work	1	●					
Needs met(28)	1	●					
Convenience of appointment (28)	1	●					
Overall experience of care(28)	1	●					
Healthcare utilisation							
Healthcare professionals seen for MSK condition	1	●	●	●	●		
NHS services used for MSK condition	1	●	●	●	●		
Private healthcare services used for MSK condition	1	●	●	●	●		
Self-management for MSK condition	1	●	●	●	●		
Previous surgery for MSK condition	1	●					
Musculoskeletal health							
Pain location (manikin)	1	●					
Pain duration	1	●					
Previous pain episodes in past 3 years	1	●					
Graded Chronic Pain Scale: Revised(29,30)	5/6	●	●	●	●[a]		
MSK-HQ(31)	14	●	●	●	●	●	●
Global improvement	1	●	●	●			
Occupation / work							
Current employment status	1	●	●	●	●[a]		
Job title	1/4	●			●		
WPAI(32)	3/4	●	●	●	●[a]		
Impact of pain on work	1				●		
Job characteristics, workplace support, work demands, job satisfaction, job security (adapted from (33))	8				●		
General health							
EQ-5D-5L(34–36)	5				●[a]		
EQ-VAS(34–36)	1				●[a]		
HADS(37)	14				●		
Jenkins Sleep Questionnaire (38)	4				●		
Weight	1	●			●		
Height	1	●			●		
Physical activity level in past week	1	●	●	●	●[a]		

[a] Included in Minimum Data Collection version of survey questionnaire for non-respondents

EQ-5D-5L EuroQoL 5 dimensions, 5 option Likert scale; **EQ-VAS** EuroQoL Visual Analogue Scale; **HADS** Hospital Anxiety & Depression Scale; **MSK-HQ** Musculoskeletal Health Questionnaire; **NRS** Numerical Rating Scale; **WPAI** Work Productivity and Absence Index

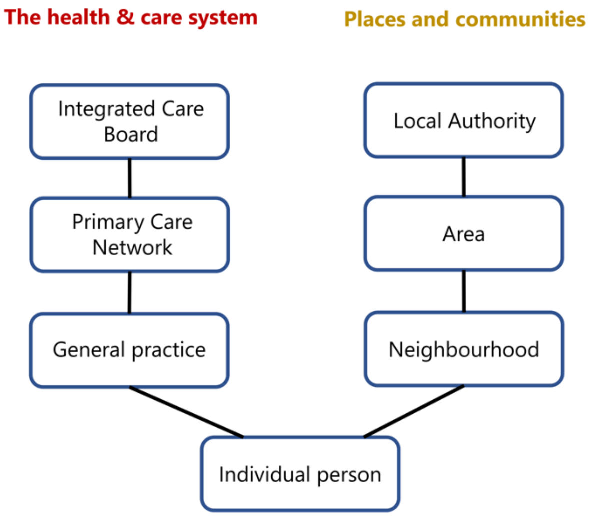
Appendix F: General structure for ‘realistically complex’ multi-level models in MIDAS



To understand patterns of MSK pain outcomes, experiences, and care in a defined population MIDAS sought to produce ‘realistically complex’ multilevel datasets and models of ‘the individual in context’.

This involved collecting and linking data on individual health experiences and health behaviours with information about the health and care system, about the places that people live in, and the communities they live with, as well as wider social determinants of health(11).

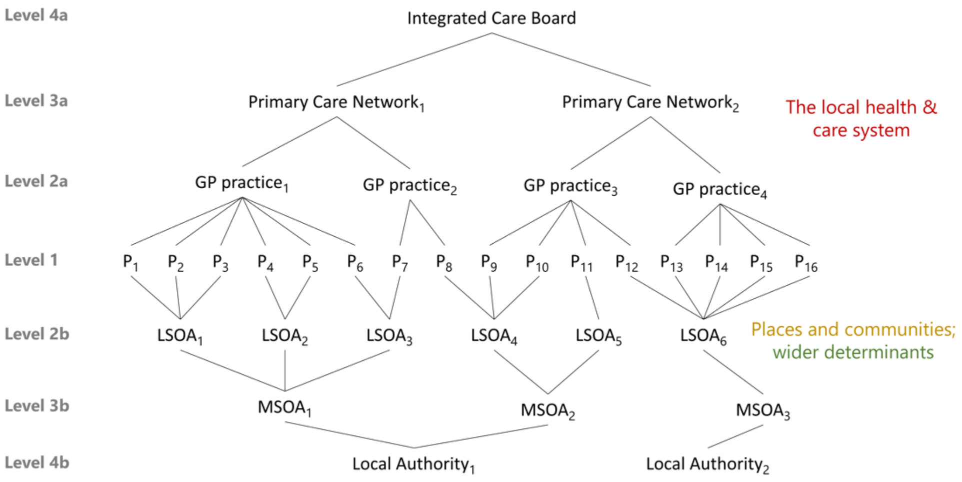
These ‘realistically complex’ models allow for multiple determinants of MSK health and care, and for these determinants to occur and operate at different levels.



In MIDAS we focussed on two main hierarchical, multi-level structures that exist alongside each other and that individuals belong to simultaneously:

The health and care system, starting with belonging to a general practice, which in turn are grouped into Primary Care Networks, which themselves belong to an Integrated Care Board
The places and communities that people live in and with, starting at the level of neighbourhoods (lower super output areas (LSOA)) which are then grouped in larger areas (middle super output areas) belonging to local authorities.

This results in **cross-classified** datasets in which people (P_1, P_2...) are nested in GP practices and LSOAs. Note that there are other levels (e.g. households, workplaces) not represented in the MIDAS data structures and models.



Appendix G: The Impact of the MIDAS Study on the Local Healthcare System: A Case Study

27 March 2025

Prof Kay Stevenson, Consultant Physiotherapist, Senior Knowledge Mobilisation Fellow, Arthritis UK Clinical Champion, Honorary Professor of Musculoskeletal Care and Leadership

Mrs Kirsty Thompson, Advanced physiotherapy Practitioner, Midlands Partnership NHS University Foundation Trust

Dr Hollie Birkinshaw, NIHR School for Primary Care Research Fellow, School of Primary Care, Population Sciences and Medical Education, Primary Care Research Centre | University of Southampton

Executive summary

The MIDAS study aimed to enhance the treatment of musculoskeletal (MSK) conditions in North Staffordshire and Stoke-on-Trent by gathering data through primary care electronic health records and patient surveys. As the study concludes, the team has worked with local stakeholders, including the Integrated Care Service (ICS), Primary Care Network (PCN) leaders, policymakers, and the Patient and Public Involvement and Engagement (PPIE) group, to communicate research findings, discuss their relevance, and explore future actions.

Key Findings

1. Understanding and Complexity of Data: Stakeholders noted that while the MIDAS data is comprehensive, it is complex and difficult to interpret. Suggestions for improving data presentation included creating visual dashboards, interactive maps, and summary formats tailored to specific audiences to ensure better engagement, particularly from policymakers.
2. Relevance to Stakeholders: The data was seen as useful for informing decisions in MSK healthcare, especially in identifying areas for improvement, such as opioid prescriptions, health literacy, and health care variation. However, stakeholders emphasised the need for dynamic, real-time data rather than one-time snapshots to support ongoing decision-making.
3. Implementation for Clinicians and Patients: It was crucial that the data be shared in a way that integrates with how clinicians work. For patients, the focus was on empowerment through providing understandable information to inform their treatment decisions, emphasising the need for clarity and accessibility.

Impact

The stakeholder engagement directly contributed to:

- The development of a business case to address chronic pain service inequities in Stoke-on-Trent, underpinned by MIDAS data.
- New collaborations, such as a partnership between researchers and the ICS to investigate opioid use for MSK pain management.
- The use of the MIDAS data to support value-based healthcare discussions with stakeholders within the ICS for people over the age of 45 with knee pain.

Key Learning Points

Several challenges were identified, including:

- The need to engage a broader range of stakeholders, such as ICS business leads and local public health departments, to ensure comprehensive representation.
- The importance of establishing better communication channels between researchers, clinicians, and policymakers.
- The need for more creative and flexible data presentation to meet stakeholder needs.

Next Steps

To continue collaboration with the ICS, PCNs, PPIE, and policymakers from the MIDAS study, the following actions are being undertaken:

1. Establish a Community of Practice to foster ongoing collaboration among stakeholders.
2. Match researchers with stakeholders for collaborative projects, including a focus on opioid use and frequent MSK pain visits to primary care and value-based healthcare for those over the age of 45 with knee pain.
3. Develop a data dashboard as per the ICS's request for a more dynamic presentation of findings.

Who is this case study for?

This case study will be of interest to any stakeholders interested in, or involved in, improving musculoskeletal health care. This includes:

- Integrated Care Service: leads and business planners
- Primary Care Networks: leads and clinicians
- Policymakers: local and national
- Researchers: any healthcare researchers
- Patients and the public: any members of the public affected by musculoskeletal conditions.

Abbreviations

Abbreviation	Full phrase	Definition
ICS	Integrated Care Service	Integrated Care Services are local organisations that manage and make decisions in relation to health and social care in a local are
MSK	Musculoskeletal	The system of joints, muscles, and bones in the body
PCN	Primary Care Network	A group of GP practices that work together
PPIE	Patient and Public Involvement and Engagement	Groups of members of the public who inform research decisions

Glossary

Term	Definition
Knowledge mobilisation	The process of actively transferring, sharing and applying research findings and evidence to inform clinical practice, guidelines, or policy.
Stakeholder	An individual or organisation who has an interest in, or is affected by, the research.

What was the aim of the MIDAS study?

The MIDAS study aimed to improve the treatment of people with musculoskeletal conditions in North Staffordshire and Stoke-on-Trent. Data were collected through primary care electronic health records and patient surveys. As the MIDAS study is coming to an end, members of the MIDAS teams who have an interest in knowledge mobilisation, wanted to work with local stakeholders, including the Integrated Care Service (ICS), Primary Care Network leaders (PCN) policymakers, and our Patient and Public Involvement Group (PPIE), to communicate the purpose of the research, the findings, the relevance, and to discuss opportunities and next steps.

What did we do?

Multiple discussion groups were held with local stakeholders throughout 2024. These included members of local Primary Care Networks (PCNs), Staffordshire and Stoke-on-Trent ICS, participants from the Keele Deal Health MSK Community of Practice, and PPIE groups. Groups were chaired by Prof Kay Stevenson, Prof Jonathan Hill and Mrs Kirsty Thompson. Questions from the Normalisation Process Theory Framework (NPT)[1] were used to guide discussions.

Stakeholder	**N**
PCN meetings	7
ICS meetings	8
Keele Deal Health MSK CoP	41
PPIE	TBA
Total	56 (+PPIE)

Notes from the meetings and NTP were analysed in workshops with Kay Stevenson, Kirsty Thompson, and Hollie Birkinshaw. The data was analysed descriptively and thematically.

What were the results?

Across all stakeholder groups, several themes were identified. These are summarised below (not presented in any order of priority).

Theme 1: Understanding and complexity of data

People from all stakeholder groups discussed that the data collected in MIDAS is comprehensive and important, but complex. PPIE members feedback highlighted that it's easy to present too much data, that it is hard to read, and that the language used to describe the results needs to be adapted to the audience. Similar feedback was given by the members of the PCNs and ICS, that the data needs to be curated and presented in different formats. Suggested new formats include a 'dashboard'; where data can be presented visually with the ability to filter between relevant options. As the data is region-based, the use of interactive maps was suggested, with potential for showing data specific to certain areas within Stoke-on-Trent and Staffordshire. It was felt that providing these alternative ways to communicating the data and findings will facilitate greater engagement from non-research audiences, particularly policymakers.

Key considerations for future steps identified from these points include:

- Targeting audiences and presenting appropriate and relevant data
- Being able to summarise the data
- Consider who gets what information in what format – not all formats are suitable for everyone.

Theme 2: Relevance of data to the stakeholders

There were multiple conversations regarding the relevance of the MIDAS data to stakeholders, particularly for the ICS. Participants related the findings from the data to their own observations within clinical practice. The benefits of collaboration between research and healthcare services were highlighted, with emphasis on how the research data could stimulate quality improvement. They discussed how the data could help the services in decision-making, particularly how they could use the data to identify drivers for change in community MSK health, including:

- Opioid prescriptions
- Health literacy levels
- Prevention of poor outcomes
- Variation in care – and whether this is warranted or unwarranted
- Implementation of biopsychosocial measures

One key point discussed was the nature of the data capture used in MIDAS. Data from the population survey and electronic health records were only captured at one time point. While this data provides some useful information for the ICS, live and dynamic data capture is essential to ensure decision-making is based on the current context.

Further discussion posited whether the data could inform the wider health and social context in Staffordshire; if it could be used to consider wider health inequalities at a population level such as sickness, return to work, education, and social care.

Finally, it was identified that different audiences within the ICS will require different information. These stakeholder meetings were primarily held with clinical members of the ICS, yet a key motivation for the ICS is achieving financial balance. While the clinical data presented is useful for the current stakeholders, it will need to be framed within an economic context for the business leads of the ICS. Without buy-in from the business leads, this key driver of change will be lost – therefore it is important to consider what cost-analyses can be undertaken on the data.

Theme 3: Implementation of findings for clinicians and patients

All stakeholders discussed the importance in the framing of the data and results. A key message is that the data should be shared widely, but in ways that are understandable, clear, friendly, and builds confidence. There were specific discussions in relation to clinicians and patients/public.

For clinicians, it is important that the findings are framed to focus on understanding, rather than judgement. It is important that this is seen to support GPs and Primary Care teams, rather than downplaying their work. Focusing on understanding variance while avoiding misuse or misunderstanding of the data – it is not the intention for GP practice to compare decision-making against each other, or to decide stop certain treatments because of the findings. GPs in the stakeholder groups emphasized that they are interested in the quality of care being provided, and how to improve this. Furthermore, it was important that the messages and future work with the ICS is shared in a way that is not only focused on finances and reducing costs, but also on quality and consistency.

For patients, all stakeholders felt it was important that patients and the public are not only aware of the results but empowered to understand them and potentially use them to inform consultations and treatment decisions. This was particularly focused on addressing patient expectations, sharing what good practice looks like. Specific suggestions included information around the ‘top five things to expect in an MSK consultation’ and what is recommended in national guidelines. However, it is important consider health literacy and the sensitive sharing of data – it is critical to ensure that this is understandable to everyone, and to communicate that everyone’s treatment is different and individualised.

What was the impact?

There are several examples of direct impact that arose as a result of the stakeholder groups. It is important to recognise that there is a historic divide between providers, commissioners, and researchers – this study helps to bridge this gap.

Firstly, these meetings identified potential collaborations that would have not been established otherwise. A pharmacist working within the ICS had already been working on the high use of opioids for pain management, and by collaborating with researchers, will use the MIDAS data to provide a more robust investigation.

Secondly, a business case has been developed using the MIDAS data to seek funding to address the inequity of chronic pain services in Stoke-on-Trent. The MIDAS data was fundamental to developing this case.

Thirdly, the MIDAS data has been used to support and enhance conversations with stakeholders at a system level to explore value-based healthcare using the STAR tool (Socio technical Allocation of Resources tool) [2]. The first workshop, held on 20th March, was attended by 40 stakeholders who considered how value based is offered to people over the age of 45 with knee pain. Attendees including system and provider Finance Leads, Physiotherapists, Orthopaedic Surgeons, GPs, Public Health Consultants and Patient Partners. The second workshop, planned for May 2025, will focus on how high value interventions are delivered across the system.

What were the learning points?

Four key learning points and challenges were identified.

Who else needs to be involved?

Firstly, some key populations of people were identified as missing from the stakeholder groups. These included:

- Business leads from the ICS
- Local council – particularly the public health departments
- Broader groups of clinicians who see MSK pain – not just GPs but physios, more pharmacists, social prescribers etc

Discussions focused on actively engaging with a broader group of strategic members; identifying specifically who to invite to future meetings to ensure representation and encourage engagement.

Communication and collaboration between researchers and healthcare settings

It was recognised that currently there is no well-established forum for communication between researchers, clinicians, local healthcare governance, and policymakers. As discussed above, linking research with local services can enable quality improvement and innovation. Therefore, the knowledge broker role was highlighted as a key position in order to identify, foster, and facilitate collaborations to ensure longevity.

Presentation of the data

As discussed above, considering different, creative, and appropriate ways of presenting complex data is critical to ensuring understanding and engagement. Future projects should consider this earlier in the study timeline to ensure that these can be developed and implemented within the study timeframe.

Usefulness of data

As discussed above, there was a lot of discussion around the relevance of the MIDAS data to the ICS. For future projects, it is important to involve these parties from the beginning; in the MIDAS study the variables were selected based on a research context, yet there may be additional variables required by the ICS. Furthermore, there is currently an incompatibility between research and ICS as evidenced by the requirement of live data by the ICS. Research studies are funded for a finite period, but the decision-making by the ICS is constant. It is critical that future projects consider what provisions can be implemented to ensure research data is still accessible, useful, and impactful after the end of a study.

What are the next steps?

Several next steps have been identified to continue the impact of the MIDAS project and collaboration with local healthcare services.

1. There is a proposal to set-up a Community of Practice for 6-12 months to continue the conversations started in the stakeholder groups. These will bring all the different stakeholders from previous meetings together (patients, PPIE, ICS, PCNs) in addition to engaging extra stakeholders as discussed above (Public Health at the council, ICS business leads, additional healthcare professionals who see patients with chronic pain).

2. Researchers and stakeholders are being matched up to collaborate on research projects – an ICS pharmacist interested in exploring use of opioids is working with a PhD student exploring the dynamics of ‘frequent fliers’ to primary care for MSK pain.

3. MIDAS researchers are scoping the ability to develop a dashboard as requested by the ICS.

References

Murray, E., Treweek, S., Pope, C. et al. Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. BMC Med 8, 63 (2010). https://doi.org/10.1186/1741-7015-8-63
Star Socio-Technical Allocation of Resources Guidance The Heath Foundation
https://www.health.org.uk/sites/default/files/Star%20guidance%20document.pdf

Appendix H: Screenshot of prototype interactive dashboard

Practice Comparison and Trend for MSK Metrics

Select an indicator to analyse

- % Consultees referred to orthopaedics
- % Consultees who are frequent flyers
- % Consultees with MSK physio
- % Consultees with fitnote
- % Consultees with imaging referral
- % Consultees with long-term opioid use

Select a practice for trend analysis

GP016

Filter by

BMI Category: (All)

IMD Decile: (All)

Over/under 45 yrs: (All)

Index Body Site: (All)

Time period: (Multiple values)

Variation by practice in % of MSK consulters who have been prescribed long term opioids in the 6-months after their index MSK consultation

% of MSK consulters who have been prescribed long term opioids in the 6-months after their index MSK consultation

Practice: GP005
Practice value: 11.4%
Practice’s highest value for selected periods: 16.9%
Practice’s lowest value for selected periods: 7.8%

Trend in % of MSK consulters who have been prescribed long term opioids in the 6-months after their index MSK consultation showing GP016 versus all other practice average

GP016 Versus Other Practices % of MSK consulters who have been prescribed long term opioids in the 6-months after their index MSK consultation by Age

GP016 Versus Other Practices % of MSK consulters who have been prescribed long term opioids in the 6-months after their index MSK consultation by Site

Appendix I: Public Involvement in MIDAS

A dedicated Patient Advisory Group (PAG) was closely involved in multiple aspects of the programme across the 5-year period (see figure below for examples of PAG contributions) shaping the direction, conduct, reporting and impact of the programme as well as the researchers themselves. The PAG was made up of 7 members of the public from a range of backgrounds with a variety of lived experiences of musculoskeletal conditions and healthcare services. The PAG met every month for 90-120 minutes online with the Programme Lead, Trial Manager, and co-investigators. Their contributions were supported by a PPIE co-ordinator, and recognised and remunerated at NIHR recommended rates.

Advocating research inclusion; prioritising research on hidden need, e.g. patients who give up on formal healthcare despite continuing health problems and become invisible in healthcare records; contributions to emerging new ‘spin-off’ studies and grant applications

Critical reflection on PPIE arrangements for MIDAS and implications for other projects

Advocating time and support to enable GP practices serving the most deprived and ethnically diverse communities to take part; offering analogue options for survey data collection; designing and adding a ‘doorstep’ survey to boost inclusion to MIDAS-POP survey; expressing public views on protocol changes to REC; extensive input into invitation and informed consent processes

Identifying communication channels to reach public audiences; advising on clear and sensitive messaging, e.g. avoiding stigmatising deprived areas with high prevalence of pain; contributing to design of data dashboards

Interviewing and scrutiny for procurement of third-party vendors to conduct the ‘doorstep’ survey; scoping and decision-making on local charities for donations linked to study participation

Co-producing plain language summaries of research findings; contributing as co-authors to outputs

Reviewing progress; suggesting and advising on strategies to mitigate bias and risks; contributing to communication and progress reports to funder

Proposing, revising, and testing participant-facing documentation and data collection instruments; interpreting findings from analyses

Critical reflections on PPIE from MIDAS

Strength in numbers

Having a PAG that outnumbered academic researchers in each meeting helped shift the power balance and was popular with PAG members

> *“[MIDAS] started off with one PPI member and it was suggested between us that we form a group which is the group that we have now... We have a different way of working and to be honest this way of working is much better than the other projects I've worked on...we've all got our different ideas and we've been able to put much more input into MIDAS than what a single person can do in another study... I've been promoting this as the way of working in all new studies, so hopefully it will become the norm in future”*
>
> *“Everyone at the meeting was treated equally with regards to contribution, offering advice and ideas. We all had strong voices and were all given the time and opportunity to speak, whilst the rest of the group listened, we politely disagreed.”*

The importance of regular meetings to create time and achieve continuity and depth

> *“what a difference it makes when the meetings are every month. I find it so much easier to remember which project this is, what we have discussed and agreed, where we are at. It reduces the time needed to look it all*

> *up before the meeting and makes it much easier to respond to e-mail requests..., and I hope it has made my contribution more effective. I think it also enhances the feeling of partnership between us all."*

> *"the amount of times I've been involved in setting up new projects where I've said "I'm involved in one project where they meet monthly and Oh my God, that's the way to do it. Don't do long meetings every three months, do short meetings every month"."*

> *"I particularly liked meeting regularly. I noticed that this regular contact gave me a sense of ownership which impacted on both my commitment and enjoyment of the research. Involvement itself became easier because I was familiar with the project. I didn't need to check my notes to the same degree or trawl through e-mails before attending meetings. The regular contact ensured that my memory of what we had done, what we still need to do and where we were up to was easier to access– in the way it would be with any other regular work."*

> *"The only thing I would like you to emphasise in your report back is how much involvement we've had in the study. It seems to be down to the minutest detail that we've been consulted on and that is, in my experience over 12 years, very unusual. I mean some of it's gone over my head, you know, I have to admit it, and I think other people might do the same, but even so, to have the opportunity on a monthly basis more or less to see exactly where we're up to keeps our brains ticking over. We know exactly where the study's at, whereas other studies there might come at you every 12 months or so and you forgot what it's all about. This one is foremost in certainly in my mind, it's, you know, one of the best studies I've ever been involved in and that we've all had, you know, a very unusual amount of involvement."*

But the amount and organisation of PAG member work between meetings was sometimes under-estimated or inefficiently planned by the research team.

> *"What can be improved? If I had to choose something I'd say it would be nice to have a little more time to pre-read documents prior to meetings. Sometimes sent out with minutes and agenda just before meeting"*

Partial progress towards a PAG-led research agenda

As data began to accrue from the MIDAS projects, PAG members proposed topics and questions that they felt were important and which analysis of the data could shed light on. Better advance planning and resourcing from the research team were needed to successfully keep momentum.

> *"I also really enjoyed being able to discuss the questions that we would like to see if the data could answer. This felt empowering – like we might achieve something really important, a chance to steer research in a direction that we felt may be overlooked....Although I really enjoyed us being able to come up with our own questions, the discussions seemed to move away from this and I'm not sure if our questions will be answered or not. In an ideal world, it would also have been good to do this before the research began, so that we could make sure that the design would ensure that it could be answered"*

Openness to complexity, clarification, disagreement, boundaries, and challenge

> *"The friendly, informal approach of meetings. I understand the vast majority of what is said, and if you (or any of the team) occasionally drift into 'science' or 'academic speak' I feel comfortable highlighting it and know that you will take it with good humour. In fact, you openly encourage it."*

> *"I also found that the explanations we were given really helped me to understand the research – I especially remember one point where [a researcher] made a video to explain a challenging concept, which really helped"*

> *"The tasks we are asked to do feel very meaningful and our views are respected and taken on board. Where it is not possible to make changes, these are always explained in a way that doesn't feel dismissive."*

> *"(You) Encourage and allow public/patient participants to be honest and vocal but more importantly take on board what is suggested and don't just give lip service to it."*