Mapping for Better Care

RHEUMAPS

Supporting service planning for people with rheumatic and musculoskeletal conditions

Technical Report Series 2025/001

February 2025

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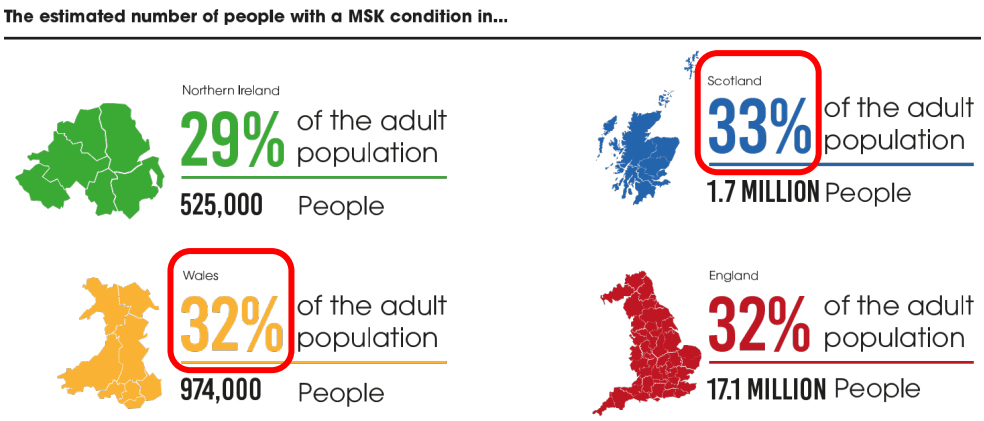
Executive summary

Rationale for study

Around one third of the UK population live with a rheumatic and musculoskeletal disorder (RMD). Diagnostic and treatment delays are associated with poorer outcomes; however, national audits have highlighted significant unwanted variations in access to care and outcomes for people with RMDs across the UK. This is shaped by many factors including individual characteristics (e.g., socio-demographic), and place-based attributes.



From Versus Arthritis 'The State of Musculoskeletal Health 2023'

For example, around **one-fifth of the UK population lives in rural areas**, where the combination of geography, the centralisation of services in large urban centres and a population that is ageing more rapidly than the national average can create challenges for delivering timely and equitable healthcare services. This is compounded by local variations in workforce and the accessibility of health and care-related resources.

MSK services are delivered differently in different places...

Recognising the unwanted variation in care and health inequalities in RMDs, there is a **drive to better support local services to meet the needs of their local population**. To do so we first need to understand individual priorities for care, the existence and extent of any geographical differences in prevalence and health outcomes. For example, in each area, **how many people are there with RMDs**, **what is the current service provision and to what extent do these services enable people living with RMDs to meet their care priorities**?

However, **this is challenging on several levels**:

Firstly, most of the evidence on patient priorities for care is focused on **specific conditions and symptoms** as opposed to components of services needed to meet these priorities.

Secondly, existing planning tools commonly **estimate geographical prevalence** by extrapolating data from other populations. To date, the prevalence and health outcomes for those living with RMDs in different geographical areas is largely unquantified.

Routinely collected healthcare data offers an opportunity to measure actual burden of disease within a given population. However, **much of the data we have is patchy** and **collected by different systems** that **do not talk to each other**. Some RMDs (e.g., osteoarthritis) are looked after mainly in primary and community care, whereas others such as inflammatory arthritis and rarer rheumatic conditions are looked after in specialist services. Together, this makes it hard to plan and target local, regional and national healthcare services to improve patient outcomes.

Aims

The RHEUMAPS study aimed to address these key evidence gaps by:

Exploring the priorities for care across different groups of patients with a broad range of RMDs living in different places across the UK, and the resources and components of service that are important to meet these needs.

Measuring the prevalence of RMDs and health outcomes across different geographical areas in Scotland and Wales using national administrative healthcare data, specifically:

- whether there are **differences in health outcomes** between those living in **rural** and **urban** areas, and
- the extent to which they can be explained by **socio-economic factors**

Developing interactive maps to provide timely and accessible data to inform local, regional, and national service planning and evaluation of RMD services, sensitive to the needs of local populations.

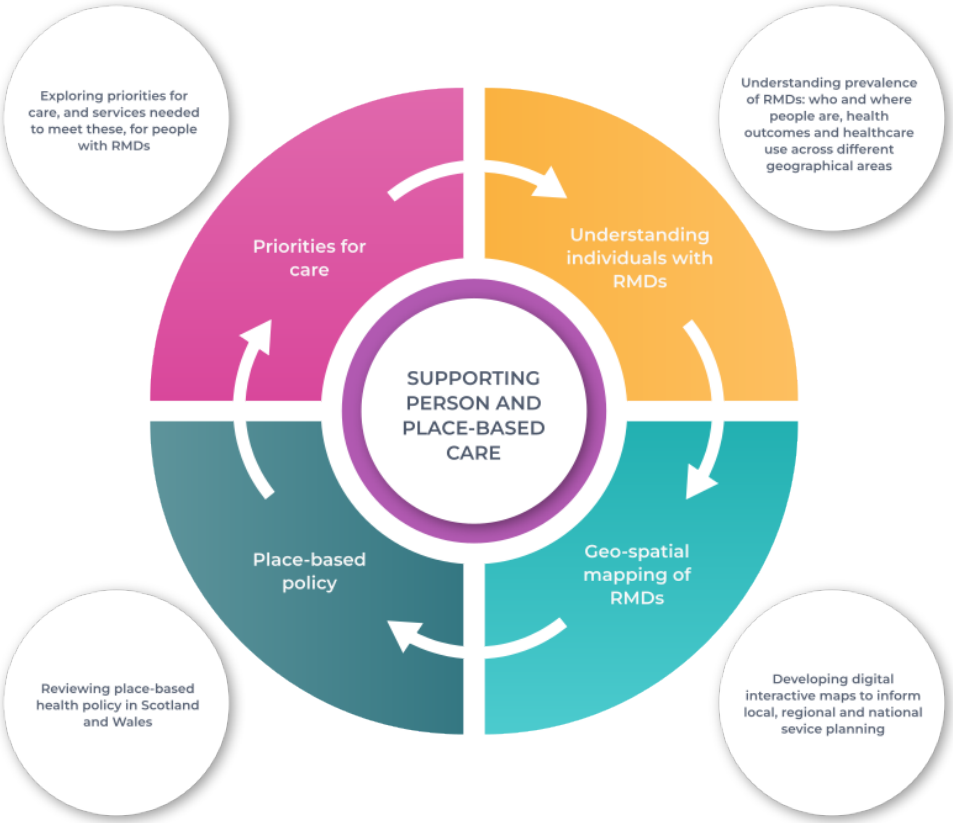
Reviewing the approach to rural healthcare policy in Scotland and Wales over the past 20 years, identify gaps, and consider ongoing and future policy directions.

Together, the study aims to provide evidence and strategic context to create a sustainable, data informed approach to support the development of person and place-based policies and services to better meet the needs of local populations with RMDs.

Methods

To achieve this, we conducted **four interlinked work streams**: priorities for care, understanding individuals with RMDs, geo-spatial mapping of RMDs and place-based policy.

Overview of RHEUMAPS study work streams



Priorities for care

Firstly, we gathered **insights into the care priorities** of people living with a broad range of rheumatic conditions, what services were needed to meet these needs and identified any gaps and challenges in accessing services those living with RMDs experienced through a UK wide survey, co-designed with our patient partners. Alongside this we conducted in-depth interviews with people with RMDs living in rural communities across the UK to further explore issues identified in the survey.

Our priorities for care survey was co-designed with our RHEUMAPS patient partners

Understanding individuals with RMDs

Secondly, we used **routinely collected healthcare data** in Scotland and Wales to **understand individual with RMDs**. We identified people with relevant codes (using validated code lists) for **inflammatory arthritis** (including rheumatoid arthritis, psoriatic arthritis and axial spondyloarthritis), **rare autoimmune rheumatic conditions** (including systemic vasculitis, SLE, myositis, scleroderma and Sjogren's syndrome) and **osteoarthritis** from primary care datasets (and linked these to secondary care health datasets).

We chose to identify people from primary care records because only identifying individuals from secondary care records would miss a significant proportion of people with osteoarthritis, for example. This approach also provided a more holistic assessment of health and healthcare use as it captured co-existing conditions such as diabetes and high blood pressure that are mainly looked after in primary care.

The date the code first appears in the primary care electronic health record (index date) was taken as a surrogate for date of diagnosis.

In **Wales**, we accessed the SAIL databank (85% population coverage). This included primary care records, from the Welsh Longitudinal General Practice (WLGP), linked to secondary care datasets.

In **Scotland**, primary care data was accessed through a trusted third-party provider (TTP), Albasoft, with individual practice consent required. Data was collected across five health boards in Scotland (two mainland and the three island-only boards included a mix of urban, accessible and remote rural mainland communities and island communities) and linked to national healthcare datasets covering secondary care, community prescribing, cancer and deaths.

Across rural and urban areas in Wales we explored **how many people in each region had a given condition**(s), their **socio-demographic characteristics** (e.g., age, sex, deprivation (income-based domain of the Welsh Index of Multiple Deprivation), the presence of **other health conditions**, and their **healthcare use**.

We also explored how **time to access specialist rheumatology and orthopaedic services** by car and bus (at individual household level and aggregated to small geographical areas) **varied by region in Wales**, and its **relationship to healthcare use**.

Due to issues with access to and the quality of the primary care dataset in Scotland, particularly the data extracted from the island-only health boards, a **more limited analysis was undertaken in Scotland** to characterise the prevalence and sociodemographic features of RMDs across two mainland health boards.

Geo-spatial mapping of RMDs

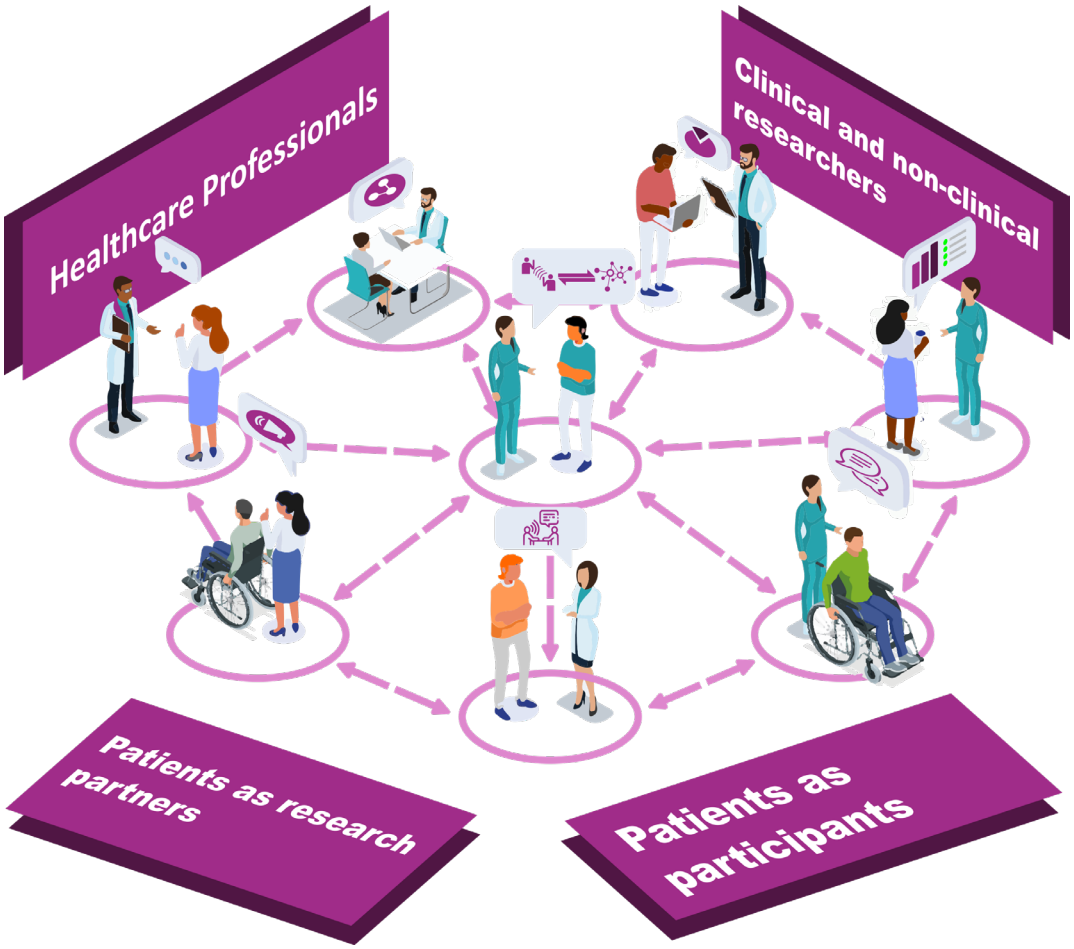
We then used these data to create a series of **interactive geospatial maps** using ARC GIS software (StoreyMaps). These maps illustrate the **prevalence of RMDs** in relation to **key socio-demographic features** at both **health board and regional level** (primary care cluster in Wales/integrated joint board level in Scotland).

In Wales prevalence of RMDs was also mapped in relation to **access to specialist services** (rheumatology and elective orthopaedic services) and key outcomes (e.g., joint replacement).

Place-based policy

Finally, we conducted a **rapid review of place-based policy in Scotland and Wales**. This included **academic publications**, publicly available **policy documents** and other grey literature that either included or was exclusively concerned with urban-rural health inequalities in Scotland and Wales and published within the last 20 years. The search strategy included: databases such as Google Scholar and PubMed; government websites; news websites and search engines. Identified documents were also searched for additional relevant publications. **A total of 126 documents** were identified and reviewed, comprising 62 policy documents, 40 academic publications and 24 items of grey literature. This was narratively synthesised and key themes identified.

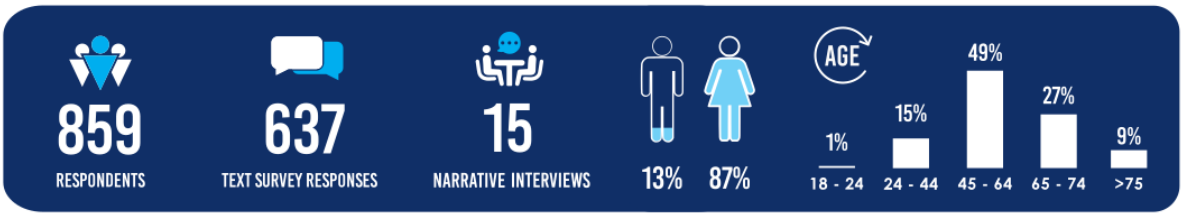
Embedded across the study were **engagement activities with a broad range of stakeholders** to understand, co-create, synthesise, generate and use research knowledge and support translation of this into action in policy and practice. We engaged with **people living with RMDs**, **healthcare professionals**, **health care decision makers**, and **third sector organisations**.



Findings

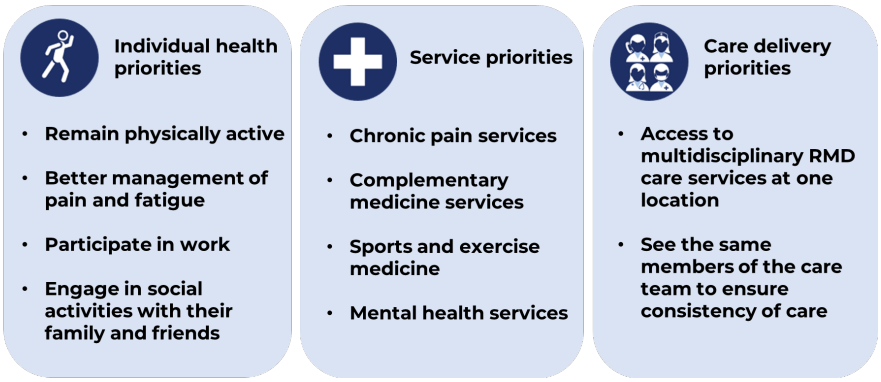
Priorities for care

Responses from **859 survey participants**, including **637 free-text responses**, and the transcripts of **15 semi-structured interviews** with individuals with RMDs from across the UK were analysed. Compared to urban dwellers, rural dwellers (256 (29.8%)) were **older** (% 65 years or older 39.5% v. 34.8%) and **less likely to be from the two highest multiple deprivation quintiles** (15.7% v. 26.9%).



People with different RMDs shared a **common set of care priorities**, **key service needs** (other than from their rheumatology team) and **valued aspects of care**, irrespective of where they lived (see Box 1). **Complementary medicine services** were perceived by many to offer more time, continuity and a holistic approach to care than was available from existing clinical healthcare services.

Box 1. Common health, service needs and care delivery priorities of people with RMDs



Overall, 373 (43%) of survey respondents said that the services they currently accessed **did not enable them to meet their care priorities**. Approximately 1 in 3 respondents reported that they had **difficulty accessing information about their condition**, including work-related support for those who wished to work. More than half of respondents reported that they had **difficulty attending services**, specifically they mentioned **travel difficulties**, while 44% reported that **caring responsibilities** meant that it was difficult to attend health services.

Rural dwellers were **not more likely to express dissatisfaction with services** than their urban counterparts. However, there were some **aspects of services** which impacted a greater proportion of rural patients, namely two interlinked factors (i) **travel issues** creating difficulties in attending services and (ii) services **not being available locally**.

Factors significantly associated with service dissatisfaction included:

Socio-demographic factors (being female, younger age, living in areas with higher levels of deprivation, and not being in paid employment due to illness)

Musculoskeletal health-related factors (having a non-inflammatory musculoskeletal condition, and a longer time between symptom onset and seeking care)

Factors linked to accessing care (not knowing how to access locally available services; relevant services not being available in their local health board or trust; problems accessing information; and caring responsibilities)

People told us that it was important to know **where to go for help** – a '*map and compass*' to signpost relevant self-management resources – and to have **timely access** to community-based and specialist services. A complex interaction between factors affected people's ability to access services.

These findings highlighted the importance of better understanding the characteristics of both the **local population** and the **places where they live** when designing or delivering services.

> **Lack of certain services means that I feel unsupported at times and feel that there are moments when I feel that I'm floundering. Not knowing which way to turn for the help I need.**

Understanding individuals with RMDs in Wales

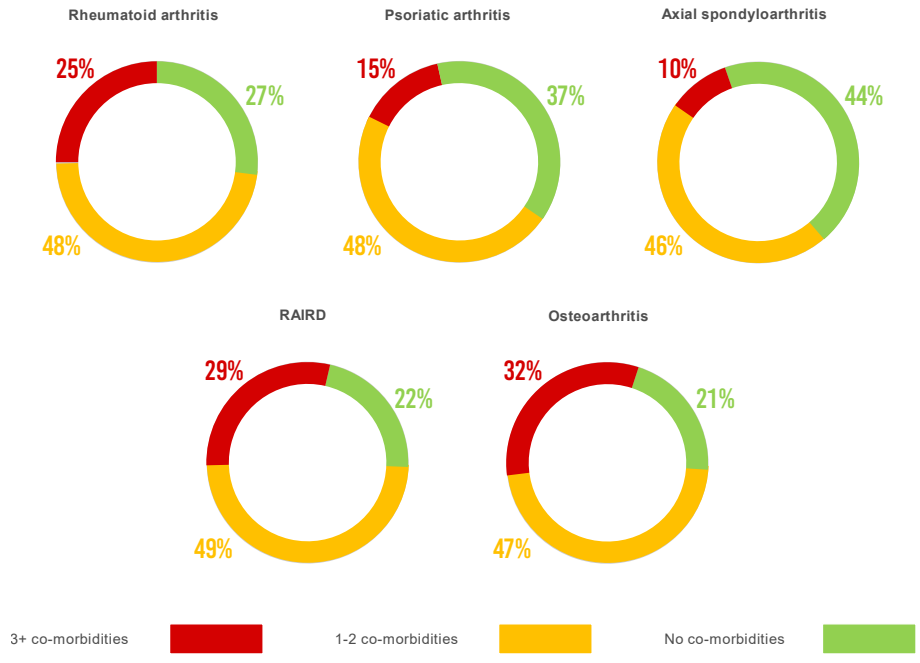
Prevalence of RMDs

Our analysis identified that around **10%** of the Welsh population had **osteoarthritis**, **0.9%** had **inflammatory arthritis**, and **0.7%** had a **rare autoimmune rheumatic disorder (RAIRD)**, based on the presence of at least one relevant code in primary care records. In those with inflammatory arthritis and RAIRDs who also had two prescriptions or more for at least one relevant disease modifying drug, the prevalence was 0.7% and 0.1%, respectively. Overall, the prevalence of RMDs was in keeping with the published literature.

Compared to living in an urban area, the **risk amongst those living in a rural area of having osteoarthritis** (RR 1.10, 95% CI 1.09 – 1.11), **inflammatory arthritis** (RR 1.1, 95% CI 1.07, 1.14) and **RAIRD** (RR 1.16, 95% CI: 1.07 to 1.26) **was higher**. However, this excess risk is most likely a result of the **rural population being older**.

Clinical characteristics

In people with osteoarthritis, inflammatory arthritis and RAIRDs, around a half had at least one comorbidity and **over a quarter had three or more comorbidities**. **Rural dwellers with osteoarthritis and inflammatory arthritis** were **more likely than urban dwellers** to have had a **hip replacement in the 5 years following diagnosis**.



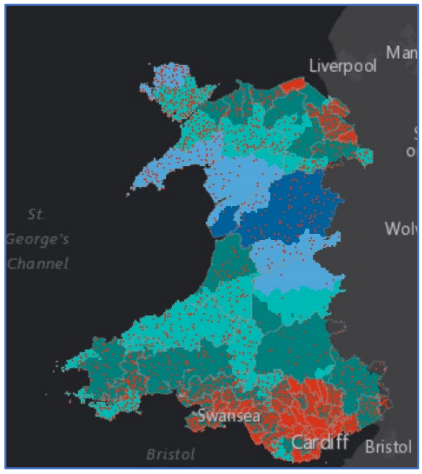
Healthcare use

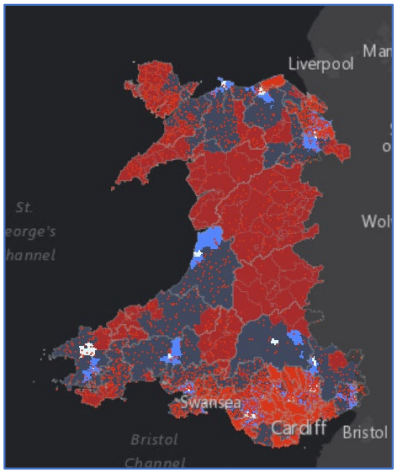
Individuals with inflammatory arthritis and RAIRDs require long term care from rheumatology services. Whilst most people had at least one outpatient appointment at 0-1 and 4-5 years post index date, **12% of those with inflammatory arthritis and 28% of those with RAIRDs had no recorded rheumatology outpatient appointments in the year after the index date,** rising to 22% of those with inflammatory arthritis and 33% of those with RAIRDs at 4-5 years.

Proportionally fewer people with RAIRD appear to have rheumatology outpatient appointments compared to those with inflammatory arthritis, with a greater proportion having outpatient appointments in other specialties. This may reflect the multi-system nature of their condition and care provided across multiple specialities. **Individuals with RAIRDs (in comparison to those with inflammatory arthritis) had proportionally more emergency and elective hospital admissions**, as well as days with a GP "event".

Travel time to access specialist services

Across Wales, **car-based travel times to rheumatology services** were generally **within 30 minutes** (although it should be noted that around 22% of the population in Wales do not have access to a car). For those **without access to a car**, **bus journeys to specialist care facilities could be long** which presents significant challenges for people with limited mobility and multiple health issues. Approximately **1 in 10** people with inflammatory arthritis and RAIRDs in Wales **do not have access to rheumatology services within a 2-hour bus journey time**.



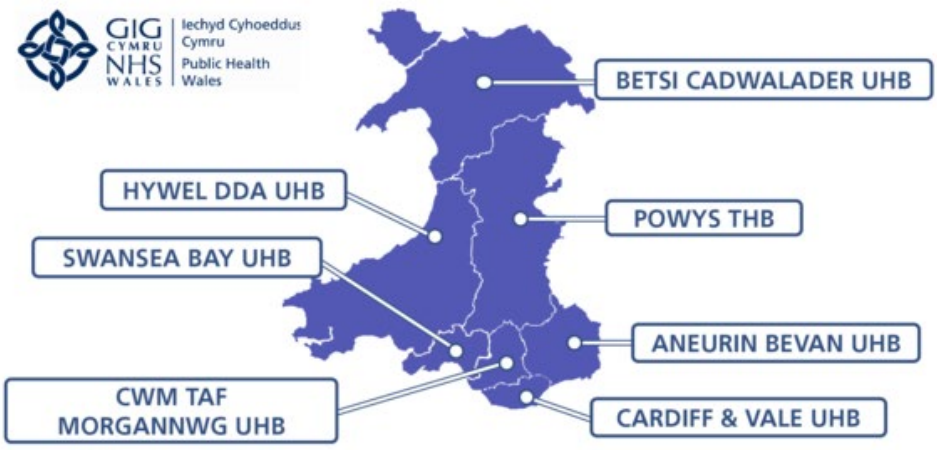


Relationship between travel time to access specialist services and healthcare use

Individuals with inflammatory arthritis in Wales who lived **more than 60 minutes' drive away from a rheumatology service** were **half as likely as those who lived closer to have at least one rheumatology outpatient appointment within the first-year post index date** (OR 0.48, CI 0.43 – 0.54). They **remained less likely to have had a rheumatology outpatient appointment at 4-5 years** post index date (OR 0.63, CI 0.55 – 0.73). They also had a **greater likelihood of having any hospital admission within the first year** (OR 1.28, CI 1.03 – 1.58) **and at 4-5 years** (OR 1.67, CI 1.35 – 2.04) post index date, driven by an increased likelihood of elective hospital admissions.

Similarly, **individuals with RAIRDs in Wales who lived more than 60 minutes' drive away from a rheumatology service** were **half as likely to have at least one rheumatology outpatient appointment within the first-year post index date** (OR 0.46, CI 0.34 – 0.64). There was a greater likelihood of having at least one hospital admission but there was uncertainty around this estimate (OR 1.27, CI 0.92 – 1.72).

Most people with RMDs who lived more than 60 minutes' drive away from a rheumatology service lived in either Hywel Dda University Health Board (81%) or Powys Teaching Health Board



Understanding individuals with RMDs in Scotland

Challenges encountered

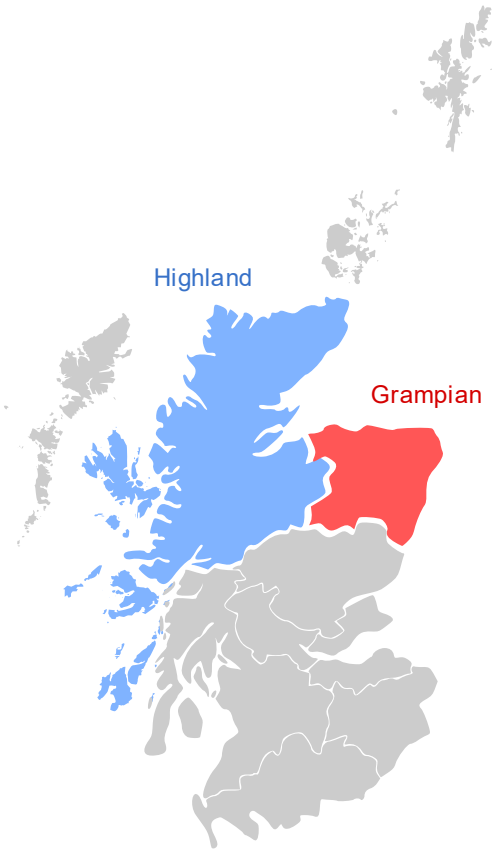
In Scotland we encountered **significant challenges in accessing and analysing primary care data** due to the **absence of a national dataset**, **reliance on third-party providers**, and **data quality issues**, particularly in relation to data covering the three island-only health boards. This meant that we conducted a **more limited analysis** than that undertaken with Welsh data.

The Scottish analysis therefore focused on two health boards: **Grampian** (comprising **Aberdeen City**, **Aberdeenshire** and **Moray** integrated joint boards responsible for health and social care delivery) and **Highland** (which serves mainland and island communities within the jurisdiction of **Highland and Argyll and Bute Councils**) where we had primary care coverage of around 50% of the population.

Despite the limitations of the Scottish data our research represents **the first effort in Scotland** to establish geospatial prevalence data for RMDs using routinely collected primary care data to inform service planning.

Prevalence of RMDs

Prevalence of RMDs was based on the **presence of at least one relevant code in the primary care record**. Issues with the community prescribing dataset precluded further analysis that also included the presence of a relevant disease modifying drug. There was a **higher prevalence of osteoarthritis amongst those living in predominantly rural areas**, those which also have demographically older populations, such as Aberdeenshire, Moray, and Highland, compared to those living in large urban areas, such as Aberdeen City. For example, within NHS Grampian, the prevalence of osteoarthritis was 10% in Aberdeenshire and Moray compared to 7% in Aberdeen City. In NHS Highland, the prevalence of osteoarthritis was 11%.

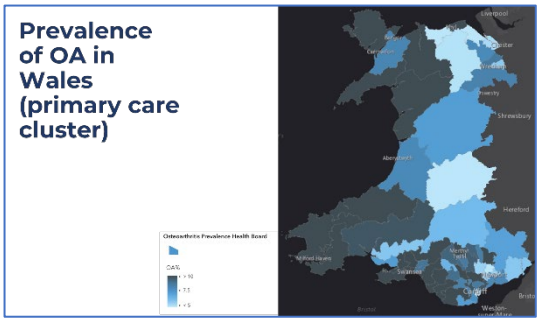


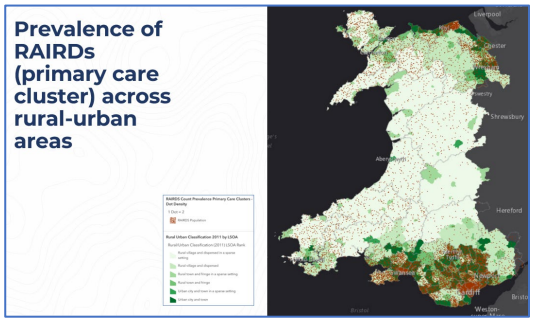
Inflammatory arthritis and **RAIRDs** were also **more prevalent in rural regions** and **among older females**. The prevalence of inflammatory arthritis was almost double in Aberdeenshire and Moray (2.5%) compared to Aberdeen City (1.3%). A similar pattern was seen with RAIRDs with a prevalence of 2.4% in Aberdeenshire and 2.9% in Moray, compared to 1.4% in Aberdeen City.

In NHS Highland, the prevalence of inflammatory arthritis and RAIRDs was 2.2% and 2.4%, respectively. In females over the age of 65 years, the prevalence of inflammatory arthritis and RAIRDs was considerably higher at 5-7% and 6-8%, respectively. In females aged 24-64 years it was around 1-3%.

Geospatial mapping of RMDs

Unlike existing planning tools that estimate disease prevalence by extrapolating data from other populations or assessing the prevalence of risk factors, the **interactive maps** created in this study **provide a detailed view of the actual burden of disease within a given population**, derived from routinely collected healthcare data.





Using the data gathered for individuals with RMDs, **we created interactive tools to support service planning**. In **Wales**, these incorporated **geo-spatial mapping** to show **where individuals with RMDs reside**, the **number of cases** at primary care cluster and health board levels, and **travel times by car and bus** to access specialist services. Additionally, the maps highlight the prevalence of RMDs in relation to **key socio-demographic factors**, such as **area-based deprivation** and **rural versus urban residency**. They also examine **prevalence among working-age individuals** (18–65 years) and **those over 65**, aiding **targeted support for those who wish to remain in work**—an important priority for people living with RMDs. Key outcomes, such as **joint replacement rates** were also mapped at health board and primary care cluster levels.

A **more limited set of maps** were created using the available data in **Scotland**, which **serve as a prototype for what could be achieved** with improved access to data, and the findings have **already been used to inform discussions about regional service planning**.

What the data can and cannot tell us

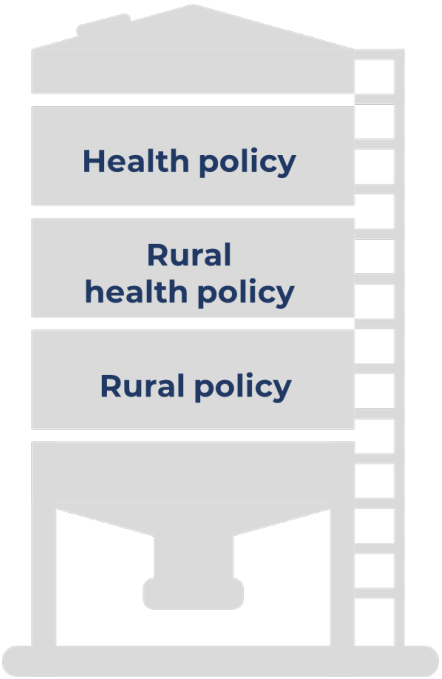
We faced **considerable challenges in conducting the geo-spatial analysis**, specifically in terms of **access to, and quality of, primary care data in Scotland**, and in the **extraction of geo-spatial healthcare data in Wales** to create the interactive maps, due to **concerns about use in performance management of health boards** and the **potential for identification of individuals with RMDs**. However, the insights gained in the process have been **invaluable in informing future work** to **create sustainable data platforms that can usefully inform service planning**.

Discussions with stakeholders at national workshops emphasised the **importance of interpreting and using the maps alongside both local insights into service structure and delivery** and an **understanding of the lived experiences of people with RMDs**. This includes understanding **which groups of people are potentially under-represented** in the data and an **awareness of how local parts of the health care system work**. It is also important to acknowledge that **reliance on area-based measure of health determinants** such as deprivation to measure geographical inequalities in health outcomes **can underestimate levels of deprivation in rural communities**. As such, these maps serve as a **starting point for informed discussions** to understand local needs and engage stakeholders in planning RMD services at local, regional, and national levels

Place-based policy

The review of rural healthcare policy in Scotland and Wales over the past 20 years **highlighted persistent challenges** such as **workforce shortages**, **health inequalities**, and **accessibility to services challenges**, particularly for the **most geographically remote rural populations**. Efforts to address these challenges have often been **siloed**, with **limited coordination** across health, transport, housing, and digital infrastructure policies.

A significant issue identified is that if policy decisions are informed by the assumption that health inequalities are positively correlated with high levels of socio-economic deprivation, the **extent of health inequalities between rural and urban populations can be underestimated**. Spatial clusters of **deprivation** are **less likely to be identified in villages and small towns** than they are in larger towns and in cities, but **similar proportions of the urban and rural population are known to live in poverty**. Addressing these challenges requires a **more integrated and sophisticated person- and place-based approach to policymaking**.



One approach to address this and reflected within recent Scottish policy initiatives is **'rural proofing'**, a process by which policymakers evaluate how proposed policies might have unintended outcomes that negatively affect rural communities and identify potential mitigations. For example, 'rural proofing' can ensure that the unintended consequences of centralised healthcare services, inadequate public transport, or poor digital infrastructure are considered and addressed.

Furthermore, the development of **National Clinical Frameworks in Wales and Scotland** marks a **significant shift in the policy landscape**. These frameworks emphasise **person-centred care**, **data-driven decision-making**, and **cross-sector collaboration** to address geographical health disparities.

Key recommendations for policy and practice

Our findings were **shared at national workshops in Wales and Scotland**, offering opportunities for validation, collaboration, and sense-making with stakeholders. These discussions underscored the **importance of contextualising data within lived experiences and local healthcare delivery**. Our findings demonstrate that **a complex interplay of factors** influence whether services effectively support individuals living with RMDs in meeting their care priorities, including their access to and use of healthcare.

A deep **understanding of the local context** from patients, carers and professionals, alongside the **information gathered from routine health care data**, provides **important insights grounded in patient experience to better support local service planning**. Stakeholders also highlighted the need to understand both the **potential benefits and limitations of routine healthcare data** for service planning, including incomplete or missing data and underrepresentation of certain populations and health outcomes, and the importance of ensuring adequate resources and **robust information governance** to enable detailed geospatial analysis.

Building on these insights, **we developed recommendations to improve care delivery** and **support policymakers and service providers** in creating **effective, person- and place-based healthcare strategies** tailored to the **unique needs of populations and their locations**. We anticipate that the insights from the RHEUMAPS study will help **shape development of the National Clinical Frameworks** in Scotland and Wales.

As well as **clinical recommendations**, these include **broader data and policy considerations**, such as the **information governance and technical infrastructure**, which are essential to **support development and implementation of sustainable services for people with RMDs** within a learning healthcare system.

The key recommendations are summarised on the following page.


Identifying common set of priorities across broad range of RMDs
Combining administrative healthcare data with lived experience
Careful translation of administrative data into insight for planning
Effective person and place based policies
Improve quality of administrative healthcare data
Sustainable data platform to inform service planning
Ask questions
Analyse data and synthesise with external knowledge
Identify and agree potential improvements
Make service changes
Service delivery
Generate data
Supporting person and place based care

✓ **Support to better meet the care priorities of people living with rheumatic and musculoskeletal conditions**

It is important to **ensure that the solutions developed are relevant to the care needs of local populations**, particularly those **we identified whose care priorities are not currently being met**, including **younger adults**, people who are **not working due to their RMD**, those who have **longer to travel to access specialist care**, and **those with non-inflammatory RMDs**.

- *Improved access to information and services*
  - Timely, relevant and accessible information and services, particularly to **manage pain and fatigue**.

  - **Development of a framework for understanding** and **sharing pathways and resources** across community, health and social care services to **improve signposting and access to support** for people living with RMDs.

- *Support to meet key care priorities*
  - **Development of strategies to improve awareness and access** to **work-related support** for people with RMDs.

  - **Development of effective pathways to community-based resources** to support people living with RMDs who struggle to achieve their desired levels participate in social and community-based activities.

- *Support for self-management*
  - **Development of an overarching policy framework for sustainable self-management support** for long-term conditions to enable early access to visible support as part of their overall treatment plan and to ensure equitable and sustainable resourcing.

✓ **Support to enable better and sustainable use of national healthcare data to inform service planning and evaluation across a broad range of RMDs**

Moving data from research to real time to inform service planning presents several **challenges that need to be overcome**. The following recommendations consider the **infrastructure**, **resources**, **methods** and **information governance issues** that need to be addressed to support this.

- **Strategies to improve the quality of routinely collected healthcare data** – transparent and consistent coding, understanding the purpose of data collection, and support for creation of a data catalogue and metadata for new datasets.
- **Agreed information governance protocols to enable timely extraction of granular (e.g. data zone level) geo-spatial prevalence and outcome data** from national health databases to inform service planning.
- Future work should include **methods that combine administrative health data with lived experience** and an **understanding of the context** in which health data is **collected** and **used**.
- Opportunities to **ensure research technical code is curated**, **shared** and **acknowledged** for future use, supporting **open and reproducible science**.

Conclusion

In summary, the RHEUMAPS study has provided important insights into the care priorities, geo-spatial prevalence and health outcomes, and access to services for individuals living with rheumatic and musculoskeletal disorders in Wales and Scotland.

The study identified **shared care priorities** across diverse populations, including managing pain and fatigue, staying physically active, maintaining social connections, and participating in work and hobbies. Access to multidisciplinary care in one location and consistent, holistic care were particularly valued, with many participants expressing dissatisfaction with current services due to travel challenges, limited local availability, and insufficient information. We have also identified structural barriers, such as limited local services and travel challenges, that disproportionately affect rural communities.

Our findings underscore the need for **place-sensitive policies** and **sustainable, data-informed strategies** to **improve healthcare delivery and support for people with RMDs**. The creation of **interactive geospatial maps** serves as an important starting point for informed discussions on how to **tailor healthcare planning and delivery to meet local needs**, cognisant of what the data can and cannot tell us. By visualising the prevalence of RMDs, socio-demographic characteristics, and travel times to services, these maps **provide actionable, data-driven insights** to **inform person- and place-based strategies**. There has been a **historically siloed approach to rural health policy,** where healthcare, transport, housing, and workforce challenges were often addressed in isolation. Encouragingly, **there is now momentum toward a more integrated framework**.

The findings from the RHEUMAPS study offer **important evidence and tools to support this shift**, helping policymakers and healthcare providers **develop sustainable, equitable, and person-centred solutions** to meet the diverse and evolving needs of people with RMDs as part of a **learning healthcare system**.

Chapter 1 - Introduction

Why did we do this research?

Around one third of the UK population live with a rheumatic and musculoskeletal disorder (RMD) (Versus Arthritis, 2023). This includes inflammatory conditions such as rheumatoid arthritis, psoriatic arthritis and axial spondyloarthritis, and rarer rheumatic conditions such as systemic vasculitis and lupus, where care is led by hospital-based specialists such as rheumatology. Other conditions such as gout, osteoarthritis (OA) and fibromyalgia are mainly looked after in primary care, with severe osteoarthritis requiring joint replacement by orthopaedic specialists. Some people have more than one condition, for example, rheumatoid arthritis and osteoarthritis.

Unwanted variation in care

Health inequalities are "unfair and avoidable differences in health across the population, and between different groups within society" (NHS England, 2022). Diagnostic and treatment delays are associated with poorer outcomes for those with RMDs (Stack et al., 2019). however, national audits have highlighted significant unwanted variations in access to care and outcomes for people with RMDs across the UK (British Society for Rheumatology, 2024; Kay et al., 2021; Versus Arthritis, 2023).

There is increasing evidence that socio-economic status drives differences in outcomes for people with RMDs (Bergstra, 2023; Dey et al., 2022; Hollick, Rosemary J. & Macfarlane, 2021; Lee et al., 2022; The Lancet Rheumatology, 2021). Geography also plays an important role in shaping access to care (Shergold & Parkhurst, 2012), with approximately one fifth of the UK population living in rural areas. This includes communities near to urban centres, in sparsely populated areas, and in islands which presents a significant challenge to the delivery of timely and equitable healthcare services. Inequitable access to healthcare services in rural areas can compound and amplify negative health effects of other inequalities such as physical and social isolation, poor housing and low income

(Asthana & Halliday, 2004). Furthermore, significant geographical variations in the Rheumatology and Orthopaedic workforce can contribute to long waiting times and delays in the care pathway (British Society for Rheumatology, 2021; Judge et al., 2010).

Delivering equitable care in practice

Recognising the unwanted variation in care and health inequalities in RMDs, there is a drive to better support local services to meet the needs of their local population. However, this is challenging on several levels.

Firstly, we need to better understand the care priorities of different groups of patients with a broad range of RMDs living in different geographical areas across the UK, and the elements of health services necessary to meet these priorities. This includes the availability, ease of access to and timeliness of pertinent information, specialist, and community-based services, as well as support for self-management.

However, most of the available evidence on patient priorities for care is focused on symptoms such as pain and fatigue, and the attainment of specific treatment targets and healthcare outcomes such as improved disease activity, usually within specific RMDs. It is not clear what resources and service components are important, absent, could be improved or currently working well to meet these priorities, and whether these priorities differ depending on where you live. e.g., rural versus urban areas. Furthermore, it is unclear whether specific groups of people are more likely to report dissatisfaction with the ability of services to meet these needs. Understanding these aspects will help us to improve care experiences for people who live with RMDs.

Secondly, we need to understand how many people in each region have a given condition(s), where they live, who they are (e.g., their age, sex, ethnicity), what services are currently available (and where these services are in relation to the people who need them).

However, the problem is that much of the data we have is patchy and collected by different systems that don't talk to each other. Existing planning tools commonly estimate geographical prevalence, not based on actual numbers in a population, but by extrapolating from surveys and samples of information for other populations. For example, the MSK Calculator (MSK Calculator | MSK Calculator FAQ | Versus Arthritis) provides estimates of the number of cases of musculoskeletal conditions in an area based on statistical modelling. It uses information on disease prevalence (usually from national sources) together with demographic information, and where available, information on risk factors to estimate the number of cases in an area. It assumes that the national disease rates apply to the small area population where the number of cases is being estimated. For some conditions (osteoarthritis) it uses patient-reports of doctor diagnosis, for others (back pain) it uses patient reports of symptoms (rheumatoid arthritis), or information from primary care health records.

This can be sufficient to help a service planner estimate the potential number of people who may need care, however, these sorts of extrapolated estimates:

- may under/overestimate need if they don't take patient characteristics into account,
- do not allow planners to monitor for changes in their population,
- do not allow evaluation of service redesign or changes to care pathways.

In planning care needs for a population, it is important to understand the population characteristics and, even better, to be able to plan services accurately based on actual/recent numbers of people with the conditions in the area.

Together, a lack of this essential data makes it hard to plan and target healthcare services to meet patient's needs.

What did we set out to do?

The RHEUMAPS study aimed to address these key evidence gaps by:

- **Exploring the priorities for care** across different groups of patients with a broad range of RMDs living in different places across the UK, and the resources and components of service that are important to meet these needs.
- **Measuring the prevalence of RMDs** and health outcomes across different geographical areas in Scotland and Wales using national administrative healthcare data, specifically:
    - **whether there are differences in the health outcomes between those living in rural and urban areas, and**
    - **the extent to which they can be explained by socio-economic factors**
- **Developing interactive maps** to provide timely and accessible data to inform local, regional, and national service planning and evaluation of RMD services, sensitive to the needs of local populations.
- **Reviewing the approach to rural healthcare policy** in Scotland and Wales over the past 20 years, identify gaps, and consider ongoing and future policy directions.

Scotland and Wales, with large rural populations and unique national healthcare record linkage capabilities, provided potentially ideal settings to do this. In Scotland, researchers can access administrative health data through the electronic Data Research and Innovation Service (eDRIS). This secure safe haven environment allows researchers to access bespoke datasets of anonymised individual health records created for individual projects. Available national datasets include emergency care (GP out of hours, A&E), hospital admissions (including surgery), cancer, and community prescribing data. Primary care data is accessed through a trusted third-party provider. In Wales, administrative health and social data is available through the SAIL databank. This contains anonymised primary care health data on around 85% of the Welsh population. Other available datasets include emergency care, hospital admissions, outpatient attendances and surgery.

Chapter 2 - Overview of methods

How did we do this?

The RHEUMAPS team conducted four areas of work. An overview of the methods are summarised below. Further details of the methods used, and the challenges encountered can be found in the relevant results chapters.

Identifying care priorities

We co-designed a web-based survey with patient partners to identify priorities for care for people living with a broad range of RMDs living in rural and urban areas across Scotland, England and Wales. The survey was disseminated to charities and social media channels between 30th August and 26th November 2021. We also conducted 15 qualitative interviews with people living with RMDs in rural areas across the UK between May and August 2021.

Building a platform

Across the whole of Wales, and five health boards in Scotland we integrated population level digital health care data from community, emergency and hospitalised care for people with osteoarthritis (OA), inflammatory arthritis, and rare autoimmune rheumatic conditions. (RAIRDs).

Identifying individuals with RMDs

Our choice of rheumatic and musculoskeletal conditions to focus on (see Table 1) and our approach to identifying individuals using administrative healthcare data was informed by our overall aim to support local, regional and national service planning to effectively meet the needs of people with a broad range of RMDs. Firstly, we considered the different ways in which conditions were looked after as this is important when considering service planning. For example, conditions such as osteoarthritis are managed mainly in primary care, with infrequent access to secondary care. In contrast, care for those with inflammatory arthritis and RAIRDS is led by secondary care-based specialists, with RAIRDs requiring input from multiple medical specialties.

Table 1. Rheumatic and musculoskeletal disorders included in the RHEUMAPS study.

RMD Group	**Conditions included**
Degenerative	Osteoarthritis (OA)
Inflammatory arthritis	Rheumatoid arthritis, Psoriatic arthritis, Axial Spondyloarthritis
Rare autoimmune rheumatic conditions (RAIRDs)	Systemic vasculitis and connective tissue diseases (including systemic lupus erythematosus, scleroderma, myositis, Sjogren's syndrome)

We therefore chose to identify people from primary care records, with linkage to secondary care records. Only identifying individuals from secondary care records would miss a significant proportion of people with osteoarthritis, for example. This approach also provided a more holistic assessment of health and healthcare use as it captured co-existing conditions such as diabetes and high blood pressure that are mainly looked after in primary care.

We looked at existing research to identify validated diagnostic and monitoring codes for the RMDs listed above (see Appendix 2). We then identified people from primary care records with these codes, taking the first date that a relevant RMD code appeared in an individual's GP record (the index date) as a surrogate for the date of diagnosis.

For people with inflammatory arthritis and RAIRDs, we also looked at those individuals with relevant READ codes for the condition of interest, and two or more prescriptions for at least one relevant disease modifying medications e.g., methotrexate, sulfasalazine, hydroxychloroquine, azathioprine and mycophenolate.

Access to administrative health data

The process of **accessing the administrative health data** in Wales and Scotland was very different, each with their benefits and downsides. The study started in June 2019 and creating the datasets was significantly impacted by COVID-19 pandemic, both in terms of delays to the research governance and ethics processes, the demand for access to national datasets, and the ability to recruit study participants (GP practices and survey participants).

Wales

Primary care data for 85% of the Welsh population is available within SAIL. All people alive in Wales registered with a general practice who contribute data to SAIL were identified as of 23rd March 2020. Individuals with diagnostic codes for relevant RMDs from 1st January 2005 to 22nd March 2020 were identified from this general population group using primary care records in the Welsh Longitudinal General Practice (WLGP) database. This information was linked to other national databases in SAIL: outpatient appointments, emergency care, hospital admissions to hospital and surgical procedures such as joint replacements.

Scotland

In contrast, there is no national, anonymised primary care dataset in Scotland and primary care data can only be accessed through a trusted third-party provider. This process currently requires written permission from individual GP practices and reimbursement for time to complete the agreements. Due to time and financial constraints, this practically limited the scope of data collection in Scotland. We therefore sought primary care data from five out of the 14 health boards in Scotland: Grampian, Highland, Orkney, Shetland and the Western Isles across five health boards in Scotland. These were selected to provide a mix of urban, accessible and remote rural mainland communities and island communities and different healthcare settings. However, we recognise that there are rural areas in south of Scotland with different characteristics which were not captured in this study. The primary care data were then linked to the national community and emergency care, hospital admissions, hospital outpatient attendances and prescribing datasets via eDRIS.

Understanding individuals with RMDs in Wales and Scotland

Once we had created the datasets in Wales and Scotland, we measured the prevalence of RMDs, the socio-demographic and clinical characteristics of people with RMDs across different geographical areas, health care outcomes, and identified factors associated with patterns of healthcare use.

We compared the number of people with relevant RMD codes to the number of people within the general population to calculate the prevalence. We gathered demographic information on people with osteoarthritis, inflammatory arthritis and RAIRDs, such as age, sex, and area of residence.

In Wales were able to conduct a more detailed analysis of individuals with RMDs: their clinical characteristics e.g., co-morbidities, number of joint replacements, prescriptions and healthcare use in primary and secondary care. We explored difference between those living in rural and urban areas. We also measured time and distance to access elective orthopaedic services and specialist

rheumatology services. Furthermore, in people with inflammatory arthritis and RAIRDs who required long-term ongoing specialist care, we examined their healthcare use and whether longer travel times to access care was associated with reduced healthcare use, and for whom.

The information available was also grouped at the health board and primary care cluster (PCC) level in Wales, and health board and integrated joint board (IJB) in Scotland to create interactive maps (see below). This enabled us to determine the prevalence of RMDs, better understand individuals with RMDs and how they are distributed across the country and health care providers.

Creating interactive maps

We used the information from the priorities of care survey, socio-demographic and clinical data for people with RMDs, in conjunction with geospatial mapping methods, to create a series of freely available web-based interactive digital geographical maps (Storeymaps). Detailed interactive maps were produced for Wales that characterised the prevalence, individual socio-demographic and clinical features, health outcomes (such as joint replacement where relevant) and access to specialist services for people with osteoarthritis, inflammatory arthritis, and RAIRDs.

Reviewing delivery of healthcare services in Scotland and Wales

Finally, we undertook a rapid review of academic publications, publicly available policy documents and other grey literature in the past 20 years that referred to urban-rural health inequalities in Scotland and Wales. The review sought examples of health policy and service delivery being tailored to the needs of rural communities and identified gaps in knowledge.

Stakeholder involvement

Embedded across the study were activities to work with a broad range of stakeholders to understand, co-create, synthesise, generate and use research knowledge and support translation of this into action in policy and practice. We engaged with people living with RMDs, healthcare professionals, health care decision makers, and third sector organisations.

Table 2. Summary of stakeholder involvement activities

Dissemination *Broadcasting*	**Exchange** *Sharing*	**Brokering** *Connecting*	**Co-creation** *Doing together*
Reports - Meeting the care priorities of people with rheumatic and musculoskeletal conditions: priorities for action - Improving support to work resources for people living with rheumatic and MSK conditions Interactive maps - Geospatial prevalence data for Wales and Scotland Evidence synthesis - Policy review	Workshops - 21st Feb 2024 - 6th March 2024 Webinar Planned for 2025	Welsh Government Public Health Wales NHS Wales MSK Clinical Network National Centre for Population Health and Wellbeing Scottish Government Research Delivery Scotland Public Health Scotland NHS Scotland Medical Directors Network National Centre for Remote and Rural Health Scotland Scottish General Practice Committee Clinical Leads in acute and community healthcare settings Versus Arthritis RAIRDA Vasculitis UK	Patient priority survey and co-production of recommendations to improve patient care Working with Versus Arthritis to shape development of work resources Working with the MSK Strategic Network in Wales to develop interactive RMD maps

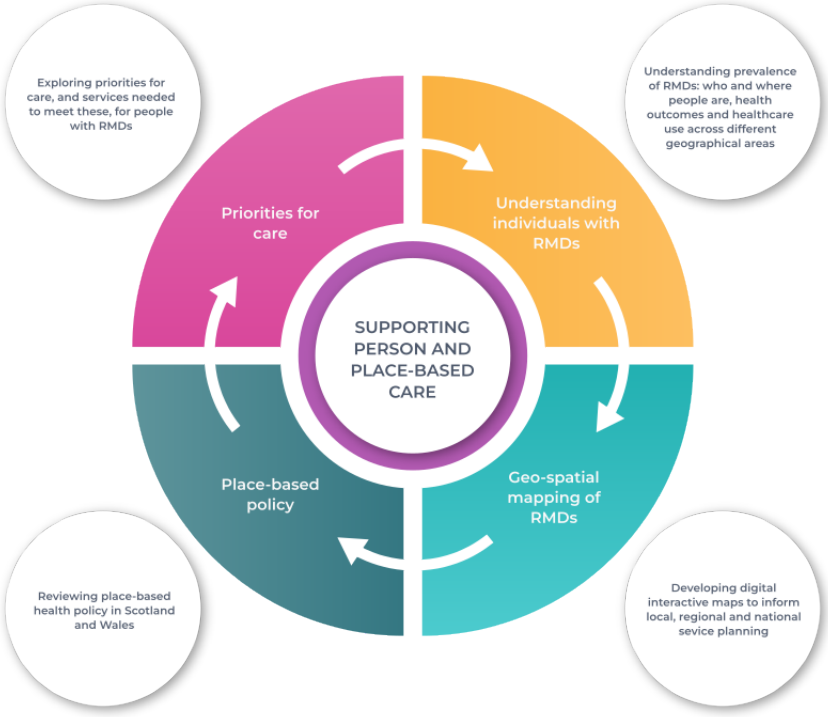
Chapter 3 - Key findings

In this chapter we bring together and summarise the findings from our four areas of work:

- **Priorities for care**
- **Understanding individuals with RMDs**
- **Geo-spatial mapping of RMDs**
- **Place based policy**

Figure 1 illustrates how they link together to inform how best to support a people and place-based approach to healthcare planning for those with rheumatic and musculoskeletal conditions.

Figure 1. Overview of RHEUMAPS study work streams



Exploring priorities for care

Key messages

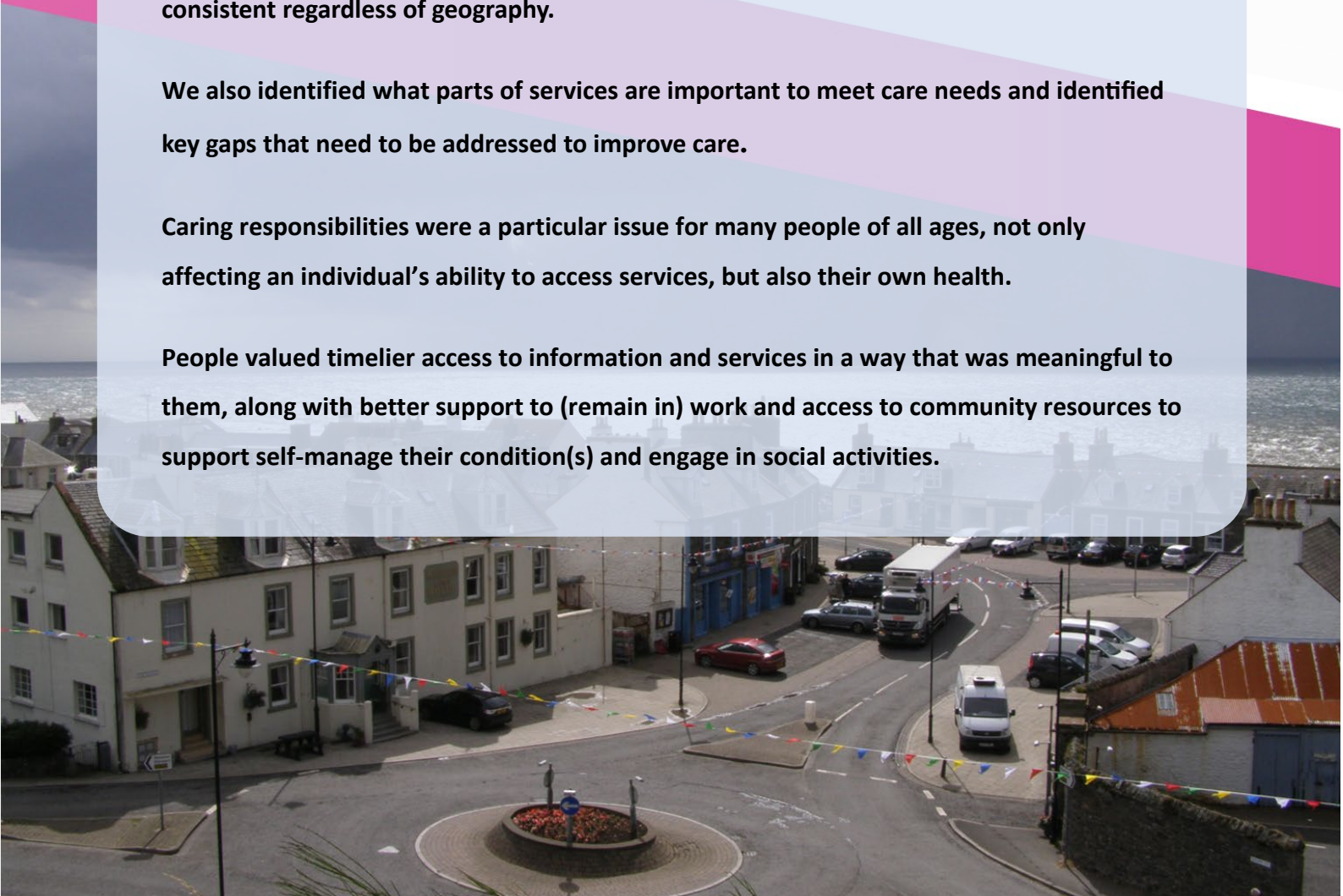
Key factors contributing to patients reporting that services for their RMD were not meeting their needs include individual characteristics (such as being unable to work due to illness or having a non-inflammatory RMD), difficulties with the availability and convenience of services, challenges accessing available services and information about their condition, and practical barriers to attending health services.

While certain aspects of care, such as access, posed greater challenges for those living in rural areas, the underlying factors influencing whether services met patients' needs were consistent regardless of geography.

We also identified what parts of services are important to meet care needs and identified key gaps that need to be addressed to improve care.

Caring responsibilities were a particular issue for many people of all ages, not only affecting an individual's ability to access services, but also their own health.

People valued timelier access to information and services in a way that was meaningful to them, along with better support to (remain in) work and access to community resources to support self-manage their condition(s) and engage in social activities.



We aimed to better understand the care priorities for people living with a broad range of RMDs, and whether these differed depending on whether you lived in a rural or urban area across the UK. We explored the extent to which people were satisfied with the ability of current services to meet these priorities and factors predicting dissatisfaction with services. This included the availability, ease of access to and timeliness of pertinent information, specialist, and community-based services, as well as support for self-management. We also examined the resources and components of service that are important to meet people's needs.

How we did it

UK wide survey

We conducted a cross-sectional survey of people, living in the United Kingdom and who reported having been diagnosed with a rheumatic and musculoskeletal condition by a health professional, to identify their priorities for care.

The web-based survey was co-designed with our patient partners. An initial meeting identified key areas to aid the development of survey questions, and a subsequent meeting provided in-depth comments on the questions and the structure of the survey. The survey was piloted with the patient partner group and other members of the study team.

During the final phase of survey development, several interviews were carried out (see below) to explore the priorities for care of patients with rheumatic and musculoskeletal conditions living in rural areas across the UK. This led to further refinement to the focus of the survey questions.

The platform used for survey completion was Microsoft Forms. Information about the survey was disseminated to broad range of condition specific charities (e.g., National Rheumatoid Arthritis Association, National Axial Spondyloarthritis Society, Fibromyalgia Action UK, the Royal Osteoporosis Society) and patient charities (e.g., Versus Arthritis, AgeUK), and advertised through social media channels between 30th August and 26th November 2021. A copy of the survey is provided in Appendix 1.

The survey included items on demographic and socio-economic factors (including employment status) and requested information on place of residence (postcode). Participants were required to confirm diagnosis of one or more rheumatic and MSK condition including year of their first diagnosis. Using the information provided we categorised participants as having an inflammatory condition or not.

Questions asked about whether the health services they could access enabled them to meet their priorities. We also gathered information on experiences of different aspects of accessing current health services (such as availability and experience of services and convenience of access in terms of timing and ease of travel). Place of residence information was used to derive a measure of local area deprivation in quintiles (based on the distribution of the relevant country within the UK) from 1 (most deprived) to 5 (least deprived) (Northern Ireland Statistics and Research Agency, 2017; Scottish Government, 2020; UK Government, 2019; Welsh Government, 2019). Participants were categorised according to whether they lived in rural and urban areas (Northern Ireland Statistics and Research Agency, 2015; Office for National Statistics, 2011; Scottish Government, 2018b). Rural areas were categorised as settlements of less than 10,000 population for England and Wales (Office for National

Statistics, 2011), 3,000 for Scotland (Scottish Government, 2018b) and 5,000 for Northern Ireland (Northern Ireland Statistics and Research Agency, 2015).

Data analysis

Data was exported as an Excel spreadsheet into R (version 4.0.0) and R Studio (version 2022.2.3.492), for analysis.

The response to the question "Do the services you currently access for your rheumatic and musculoskeletal condition enable you to meet your own priorities "was used as the outcome variable in a logistic regression model. The aim was to identify factors independently associated with answering "no" to this question i.e., dissatisfaction with care. We considered predictors across the following domains: demographic; socio-economic; geographic (country of residence, urban/rural residential location); aspects of their rheumatic and musculoskeletal condition; issues with the availability of, and accessing, services and information. For multi-level factors, the most common category selected, was generally chosen as the reference category.

In the first stage, a univariable logistic regression was conducted to examine the association between each of the candidate predictor variables and the outcome. Those variables which reached a significance threshold of $p \leq 0.2$ were considered as candidate variables for the second stage of analysis: a forward stepwise logistic regression model. In the stepwise model, variables were added using the entry criteria of $p \leq 0.1$ and were removed using the criteria of $p > 0.15$. Where it made clinical sense, we considered interactions between variables entered and retained in the final (Stage 2) model. The performance of the final model was assessed through positive predictive value (PPV) and negative predictive value (NPV). The area under the receiver operator characteristic (ROC) curve was also calculated to measure how well the model discriminates between participants who answered positively and negatively to the question on if services allowed them to meet their own priorities.

Qualitative methods

We conducted telephone semi-structured interviews with adults living with RMD living in rural areas across the UK. Interview participants were recruited via patient charities such as Versus Arthritis and advertised through social media channels between May and August 2021. We aimed for a maximum variation sample across a range of characteristics, including age, gender, type of RMD and time since diagnosis. The interviews topic guide was developed in conjunction with our PPI group. Interview participants received a one-off payment (£25 gift voucher) to compensate for their time and effort required to participate in the study.

In the survey, participants were asked 'Do the services you currently access for your rheumatic and musculoskeletal condition enable you to meet your own priorities' and given the option of an additional free-text response to this question. These were analysed thematically (see below).

Qualitative analysis

Interview data and open-ended responses from the survey were analysed using NVivo (qualitative data analysis (QDA) computer software) and using a thematic analysis (Braun & Clarke, 2021).

Integration of quantitative and qualitative data

Integration of quantitative and qualitative data occurred at various points. For example, in the survey design phase, initial interview analysis contributed to refining the survey focus and questions. Survey finding also informed analysis of interviews and opened ended questions to illustrate and explain findings from the quantitative data (Doyle et al., 2009).

Ethics

The survey received ethical approval from the University of Aberdeen Ethics Review Board (School of Medicine, Medical Sciences and Nutrition, Reference CERB/2021/7/2143). The interviews received ethical approval from the University of Aberdeen Ethics Review Board (School of Medicine, Medical Sciences and Nutrition, Reference CERB/2021/4/2060).

What we found

A lay summary of the care priorities report can be found here.

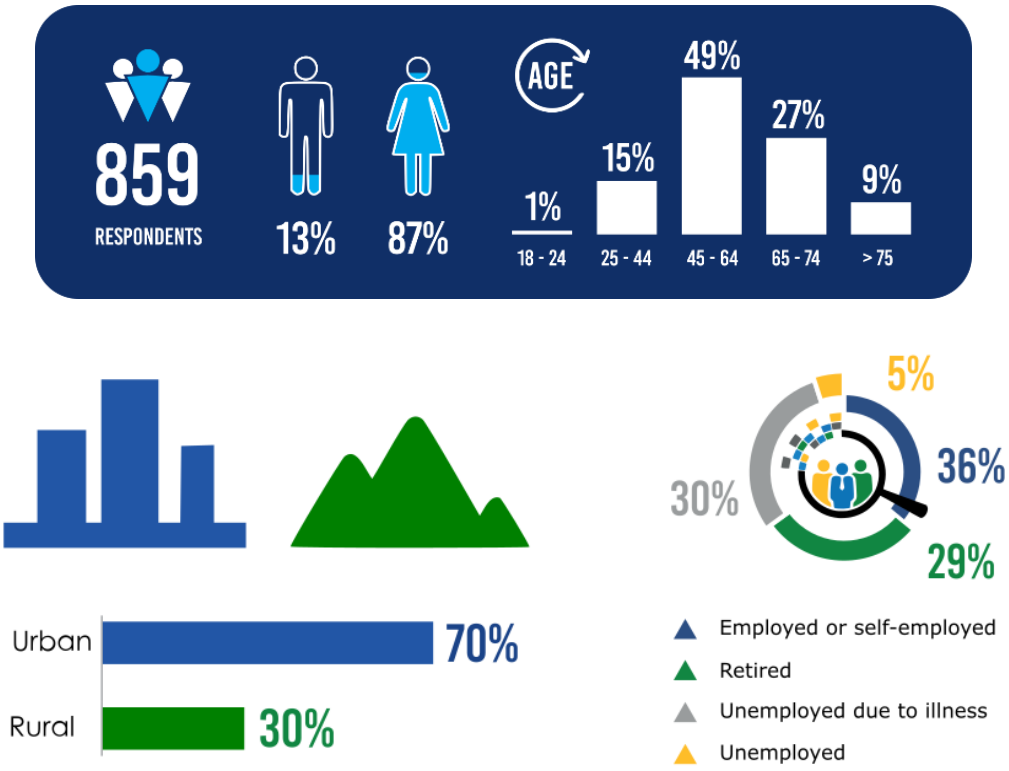
Who participated in the study?

A total of 916 questionnaires were submitted. Of these, 34 participants were excluded based on missing postcode information and/or not resident in the UK, 5 participants were excluded due to not reporting having been diagnosed with a rheumatic and musculoskeletal condition and a further 18 because of missing data in one or more responses, giving a total of 859 participants eligible for analysis.

In addition, we conducted narrative interviews with 15 people (5 men, 10 women) across the UK (Scotland [n=6], England [n=5] and Wales [n=4]) with different types of RMDs (inflammatory arthritis [n=6], RAIRD [n=3] and non-inflammatory [n=6]). Time since diagnosis ranged from 5 to 10 years (n=4) to 11 or more years (n=11). There were also 637 free-text responses from the 859 survey participants that were analysed alongside the interview data.

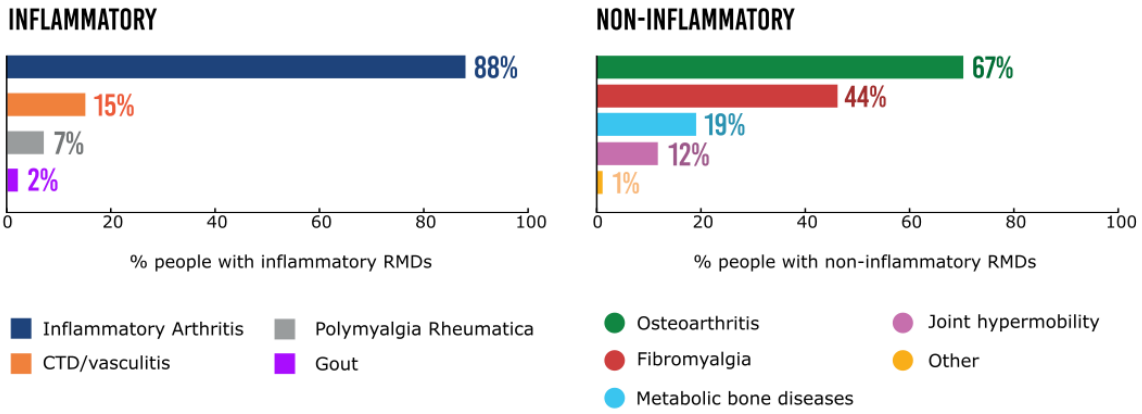
Figure 2 summarises the survey respondents. Most (87.1%) were female; approximately half of participants were in the age group 45-64 years, a quarter were in the two most deprived quintiles, while those living in rural areas (29.8%) and the employed or self-employed were well represented (36.3%). 30% were not in employment due to illness.

Figure 2. Demographic characteristics of survey respondents



In terms of the type of rheumatic and musculoskeletal conditions, 84.9% of participants reported having at least one inflammatory condition, see Figure 3.

Figure 3. Inflammatory and non-inflammatory RMDs of survey respondents



Most participants sought care for their symptoms within a year of onset (71.3%) and received their diagnosis from a specialist service, such as rheumatology or orthopaedics (80.2%).

There were some differences noted in relation to characteristics of people with RMDs resident in rural and urban areas. Those living in rural areas were less likely to be of young age (18-44 years age group: 7.8% v 18.4%) and were less likely to be resident in areas of deprivation (resident in areas within the two highest quintiles of deprivation (15.7% v. 26.9%). There was no significant difference in gender or in employment status. In relation to musculoskeletal health there were no significant differences in type of musculoskeletal conditions or where their diagnosis was made, but those resident in rural areas were less likely to have long delays in seeking care for symptoms (waiting ≥ 3 years 5.4% v. 15.4%).

Do people with RMDs share a common set of care priorities?

Care priorities were similar irrespective of RMD type and where people lived. For example, priorities relating to individual health outcomes that were evaluated as “very important” were the same in rural and urban dwellers (remaining physically active 73.8% v 75.0% respectively, better managed fatigue 66.8% v. 71.0% and better managed pain 67.2 v 70.5%).

89% of all respondents said it was important that their care enabled them to engage in hobbies and interests and socialise with friends and family. 60% said they wanted to enjoy physical relationships; and 48% wanted to be able to look after children/grandchildren.

Priorities for aspects of services/care (other than from their rheumatology team) were also very similar between people living in rural and urban areas (chronic pain services 56.2 v. 57.9%; complementary services 15.2 v. 16.6%; sports and exercise medicine 16.4 v 13.6%; mental health services 11.7% v. 11.3% and sexual health services 0.4% v. 0.7%).

The qualitative data highlighted the collective importance (and lack of) chronic pain services, fatigue management, and mental health support to enable people to meet their personal goals - often

everyday tasks such as work, shopping, and caring responsibilities and engaging in social activities with family and friends:

> **Pain is difficult to manage. Caring for my husband (younger than me) is beginning to prove difficult as his dementia worsens and no social care involvement regarding my health.**
>
> **Female, 65-74 years, inflammatory RMD, rural resident**

> **I am not able to meet my priorities such as taking the children out... being able to play with them... go on holiday without having to plan everything carefully to ensure I have toilets nearby, no steps to walk up and short journeys. I used to love going on long walks in the countryside with my dog and children and can no longer do that**
>
> **Female, 25-44 years, inflammatory RMD, urban resident**

Some felt healthcare professionals were not interested in addressing remaining symptoms beyond control of active inflammation and did not understand the wider impact of RMDs on their lives. Participants often described being 'left to my own devices' and relying on support from friends and family. They valued care that involve[d] specialists in all aspects of the condition, and treating a patient with a holistic approach. The ability to access multi-disciplinary care in one location and to see the same members of the care team to ensure consistency of care was particularly valued.

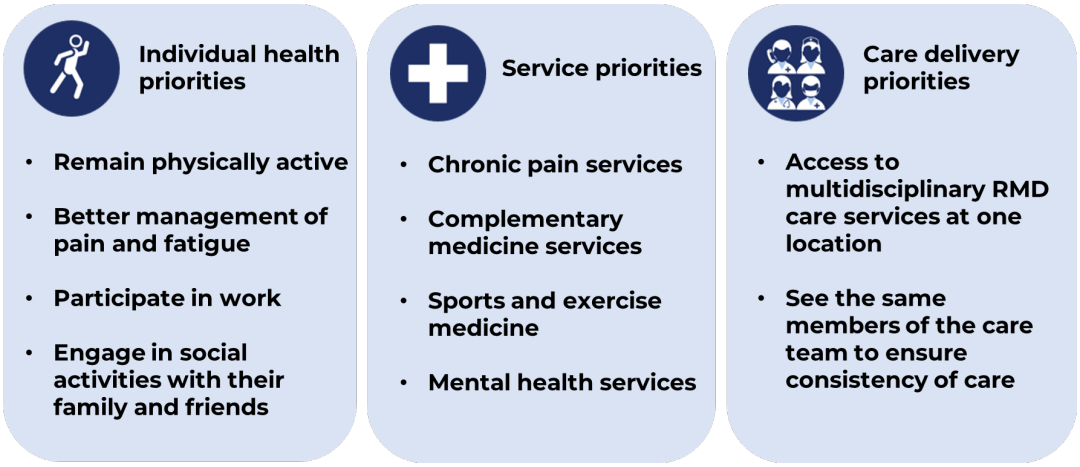
Complementary medicine services were perceived by many to offer more time, continuity and a holistic approach to care that was missing from healthcare services.

> I don't feel I've ever (in 30+ years) had any advice in managing pain and fatigue - but I've done a reasonable job of working out my own strategies!
>
> Female, 65-74 years, inflammatory RMD, rural resident

> There's basically no support to deal with pain or fatigue, which are the two biggest symptoms of my illness. It is clear I do not have active inflammation due to the medication I'm on, but there seems to be little willingness or interest in dealing with the remaining symptoms, despite their impact on quality of life.
>
> Male, 25-44 years, inflammatory RMD, urban resident

We grouped care priorities into individual, service and care delivery priorities, see Figure 4.

Figure 4. Individual, service and care delivery priorities



What factors predict dissatisfaction with current services?

Whilst priorities for care relating to individual health outcomes and aspects of services to meet those needs were similar across a broad range of people with different RMDs, 373 (43% of participants) responded "No" to the question "Do the services you currently access for your rheumatic and

musculoskeletal condition enable you to meet your own priorities?" Logistic regression aimed to identify factors associated with a negative response.

Demographic and socio-economic factors

Being female, younger age, living in areas with higher levels of deprivation, and not being in paid employment due to illness were associated with a greater likelihood of dissatisfaction with services, see Table 3. Given the focus of the survey, it is notable that there was no difference between rural and urban dwellers in terms of dissatisfaction with current services (rural v urban 0.91 95% CI (0.68, 1.22)). However, there were some aspects of services which impacted a greater proportion of rural patients: travel issues creating difficulty attending services (68.4% v. 60.7%) and services not being available locally (37.5% v. 29.0%). In contrast rural patients were less likely to report that services were not available at convenient times (27.7% v. 35.2%).

Table 3. Socio-demographic characteristics of participants and the relationship with services not enabling them to meet their priorities (univariable logistic regression analysis)

Characteristics		N	%	Odds Ratio	95% CI
Gender	Female	748	(87.1)	1.79	(1.18, 2.77)
	Male	111	(12.9)	Reference	
Age group	18 to 44	125	(14.6)	1.51	(1.01, 2.26)
	45 to 64	423	(49.2)	Reference	
	65 to 74	233	(27.1)	0.46	(0.33, 0.64)
	75 years or older	78	(9.1)	0.54	(0.32, 0.88)
Deprivation	1 (most deprived)	59	(6.9)	1.46	(0.82, 2.58)
	2	143	(16.6)	1.99	(1.32, 3.03)
	3	192	(22.4)	1.42	(0.97, 2.09)
	4	214	(24.9)	0.96	(0.66, 1.40)
	5 (least deprived)	251	(29.2)	Reference	
Area	Urban	603	(70.2)	Reference	
	Rural	256	(29.8)	0.91	(0.68, 1.22)
Employment	Employed or self-employed	312	(36.3)	Reference	
	Not in paid employment	43	(5)	0.88	(0.46, 1.68)
	Not in paid employment, due to illness	254	(29.6)	1.61	(1.15, 2.25)
	Retired	250	(29.1)	0.49	(0.34, 0.69)

The qualitative data provides further insights into the factors identified as predicting dissatisfaction with services. Several participants commented on a lack of support to continue working when they would have liked to, and of its importance as part of a more holistic approach to care.

> **I feel like I would like to know more about what service I can access for pain management and how to stay in work as I need advice for these things.**
>
> **Female, 25-44 years, inflammatory RMD, urban resident**

> **There are no solutions given other than continue to take the drugs. Accessibility to complimentary therapy is not available. There is no holistic approach to care and acknowledgement that people want to continue to work and maximise their contributions to the wider world.**
>
> **Female, 25-44 years, inflammatory RMD, rural resident**

Musculoskeletal health-related factors

Having a non-inflammatory musculoskeletal condition, and a longer time between symptom onset and seeking care was associated with services not enabling participants to meet their priorities, see Table 4.

Table 4. Musculoskeletal health-related factors of participants and the relationships with services not enabling them to meet their priorities for care (univariable logistic regression analysis).

Musculoskeletal health-related factors		**N**	**%**	**Odds Ratio**	**95% CI**
Type of rheumatic and MSK condition	Inflammatory	729	(84.9)	Reference	
	Non-inflammatory	130	(15.1)	4.40	(2.93, 6.75)
Where diagnosis was made	Specialist service e.g., rheumatology, orthopaedics	689	(80.2)	Reference	
	Primary care e.g., GP	146	(17)	0.95	(0.66, 1.36)
	Complementary or other services	24	(2.8)	0.92	(0.39, 2.09)
Years since diagnosis	Less than a year ago to 4 years ago	228	(26.5)	Reference	
	5-10 years ago	218	(25.4)	0.90	(0.62, 1.30)
	11-20 years ago	225	(26.2)	0.68	(0.47, 0.98)
	More than 20 years ago	188	(21.9)	0.53	(0.35, 0.78)
Time from symptoms to seeking care	Up to three months	386	(44.9)	Reference	
	4-11 months	227	(26.4)	1.55	(1.11, 2.16)
	1-2 years	145	(16.9)	1.82	(1.24, 2.68)
	3-4 years	38	(4.4)	2.47	(1.26, 4.94)
	5 or more years	63	(7.3)	2.25	(1.31, 3.87)

Those with a non-inflammatory RMD, often younger women, described a sense of abandonment, isolation and being left to 'get on with it.'

> There is nothing really available to help. GP tells you it's all about pacing. Impossible when you have children. Pain clinics are a waste of time. Once diagnosed, you are left to manage your condition yourself. Very difficult to do when you don't have any clue how to manage it properly.
>
> Female, 25-44 years, non-inflammatory RMD, urban resident

> I would question, what services? I feel very let down by the services offered, or more to the point, the lack of services available.
>
> Female, 45-64 years, non-inflammatory RMD, urban resident

Whilst a point of contact was important for everyone, younger participants with non-inflammatory conditions often reported little or no ongoing care and were therefore less likely to have a designated point of contact.

> I had a 6 week online virtual 'How to manage Fibromyalgia' course, left with a booklet and that was about it.
>
> Female, 45-64 years, non-inflammatory RMD, urban resident

> One appointment at GPs to identify illness, two years later one appointment with hospital consultant to confirm diagnosis. Two telephone calls from physiotherapist to inform me of online Pilates exercises. All pain relief tablets not tolerated. Follow up care and support from services would have helped me from feeling isolated… [but I'm] simply left to get on with it, with no hope of improvement and an even bleaker future going forwards.
>
> Female, 45-64 years, non-inflammatory RMD, rural resident

However, even for those with inflammatory conditions cared for in specialist services, it was not always clear where to go to seek help when required.

> **I need to know where to get help from and who. I am so lost re my illness.**
>
> **Female, 45-64 years, inflammatory RMD, urban resident**

Factors associated with accessing information and services

Several factors related to accessing information and services were associated with participants reporting that health services did not enabling them to meet their care priorities, see Table 5.

Table 5. Participant reported difficulties in accessing health services and their associations with participants reporting that health services did not enable them to meet their care priorities (univariable logistic regression analysis)

Participant report difficulties in accessing health services		**N**	**%**	**Odds Ratio**	**95% CI**
Have you experienced problems accessing any information?	No	547	(63.7)	Reference	
	Yes	312	(36.3)	3.61	(2.70, 4.85)
Does the information you access help you to manage your condition?	No	697	(81.1)	Reference	
	Yes	162	(18.9)	2.85	(2.01, 4.09)
Do you have any difficulty attending services (eg. GP, specialist services)?	No	350	(40.7)	Reference	
	Yes	509	(59.3)	2.65	(1.99, 3.54)
Do travel issues create difficulties in attending health services?	No	318	(37)	Reference	
	Yes	541	(63)	2.60	(1.94, 3.50)
Does services not being available at convenient times create difficulties?	No	576	(67.1)	Reference	
	Yes	283	(32.9)	2.76	(2.07, 3.71)
Does services not being available locally create difficulties ?	No	588	(68.5)	Reference	
	Yes	271	(31.5)	3.68	(2.72, 4.99)
Does services not being available in your health board/trust create difficulties?	No	690	(80.3)	Reference	
	Yes	169	(19.7)	5.06	(3.50, 7.45)
Does not knowing how to access available local services create difficulties?	No	690	(80.3)	Reference	
	Yes	169	(19.7)	6.93	(4.69, 10.46)
Does inconvenient appointment times create difficulties in attending health services?	No	607	(70.7)	Reference	
	Yes	252	(29.3)	2.53	(1.88, 3.43)
Do caring responsibilities issues create difficulties attending health services?	No	481	(56)	Reference	
	Yes	378	(44)	3.31	(2.50, 4.40)
Do you have any issues with getting your medicines (e.g. delivery)?	No	730	(85)	Reference	
	Yes	129	(15)	1.39	(0.96, 2.03)

Accessing information

Approximately 1 in 3 of respondents reported that they had difficulty accessing information about their condition. Participants reporting difficulties in accessing information were more likely to express dissatisfaction with services ability to meet their care priorities (OR 3.61 95% CI (2.70, 4.85). Most people accessed information through general web searches, charity websites, NHS services and websites.

From the interviews, gaps included information on non- inflammatory conditions and work-related support services in a way that was meaningful and accessible to patients. Some people found self-organised social media groups e.g., Facebook helpful as a source of support when needed, particularly considering difficulties access healthcare post COVID-19 pandemic. In contrast, others found them 'tedious' and introspective and looked for 'something much more positive rather than an inward looking negative, listening to everybody else's negative experiences.'

Support to work resources

We know from previous research that work support is an issue for people with RMDs and PPI identified this as an important area to explore in the survey. We have previously shown greater work impairment in rural dwellers with axial spondyloarthritis. In our survey, slightly more people living in urban compared to rural areas reported that it was very important/important that the care they received enabled them to stay in work (40% vs. 36%) or go back to work (18% vs. 15%). This likely reflects the fact that rural participants tended to be older and more likely to be retired. However, people told us that they struggled to access work support irrespective of where they lived.

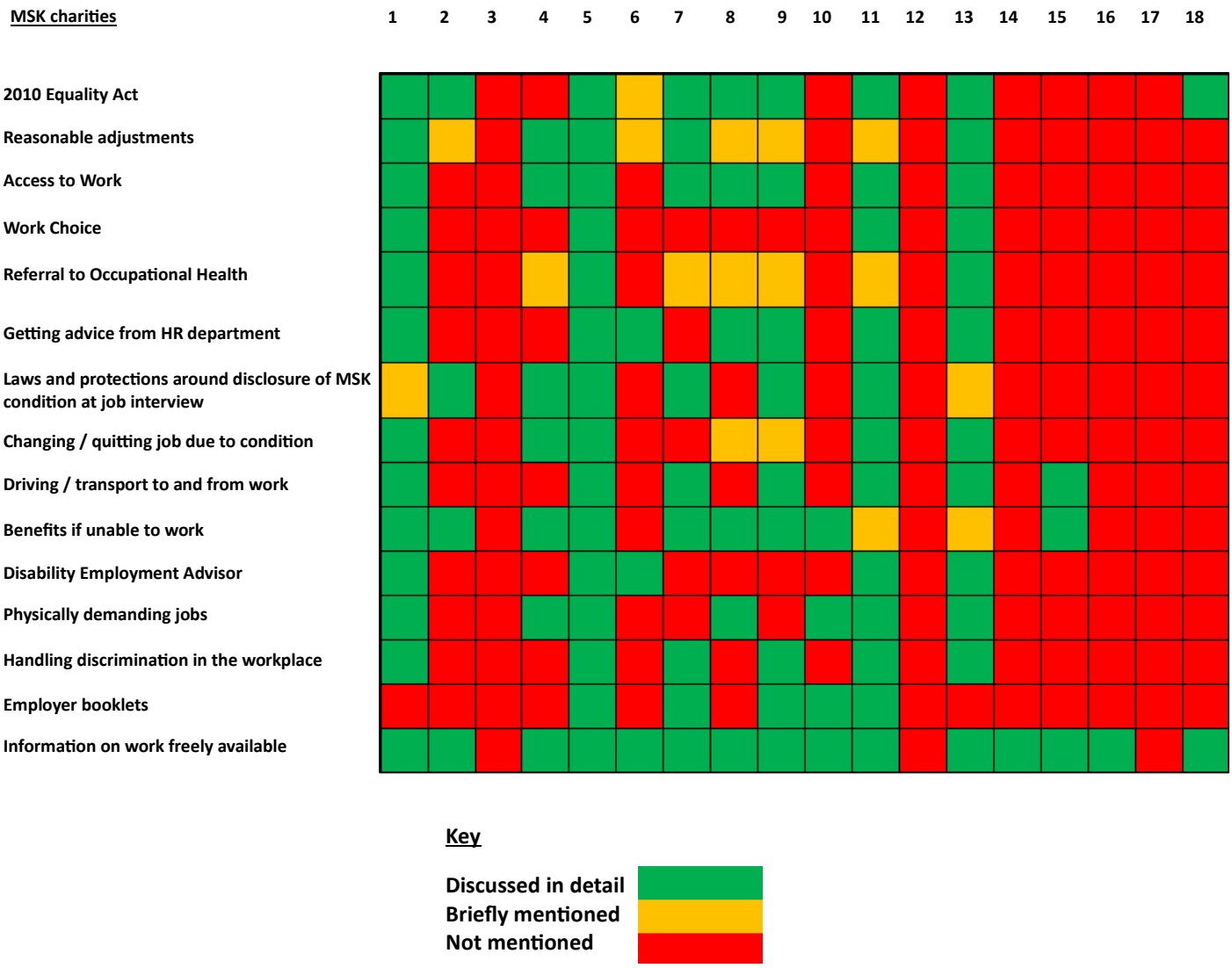
> **"Neither have there been, since the time I was forced to give up the job I loved, any interest in what I can do and what I'd like to be able to do. I hope that these days, with greater mental health awareness, there would be support in place for anyone coming to terms with the implications of a chronic illness diagnosis."**
>
> **Female, 65-74 years, inflammatory RMD, rural resident**

Of the 859 people who completed the survey, 36% were currently employed. Most people who were employed, irrespective of where they lived, were not aware of work-related support services such as 'Access to Work' (56.7%), or availability of support from a disability employment advisor/Job Centre (73.1%). Few had received work advice/rehabilitation from an NHS therapist (7.3%) or occupational health practitioner (12.7%), and over 70% were not aware that such support was available.

Acknowledging that most people looked to individual RMD charity websites for information on their condition and its associated impacts, including information on working with an RMD, we explored this further to help inform recommendations for improved support. We searched RMD charity websites for available information on work, including breadth and frequency of topics covered. Ten patient contributors assessed the usefulness of topics covered and any gaps. We identified 18 UK RMD charities.

We found significant variation in the work information provided, see Figure 5, with limited internal signposting between charities to those with more comprehensive resources. Information for employers was limited.

Figure 5. Summary of the available work information on UK musculoskeletal charity websites. Work topics considered are listed down the left-hand side, with the charities (anonymised) numbered along the top



Our patient contributors found navigating work information on charity websites challenging. External signposting to government resources was variable and often absent (e.g., information on Access to Work, occupational health support, employment benefits) and differences in work policy across devolved nations was often not acknowledged.

Suggested improvements included using simpler language and signposting to 'bone fide' information. Patients wanted positive patient stories, help with 'soft skills' e.g., how to have constructive conversations with their employer, and better employer training as not all employees had access to occupational health services.

The full report on work resources for people living with RMDs can be found here: Improving support to work resources for people living with rheumatic and musculoskeletal conditions.

Accessing services

More than half of respondents reported that they had difficulty attending services and specifically in relation to travel difficulties, while 44% reported that caring responsibilities meant that it was difficult attending health services. All factors related to difficulty accessing services were significantly associated with services not enabling participants to meet their priorities, see Table 3 above. The strongest relationships were with relevant services not being available in their local health board or trust; and not knowing how to access locally available services.

Physical access to services and availability

Whilst there were some aspects of accessing services which impacted a greater proportion of rural patients (e.g., availability of services in a given area), overall physical access to services was problematic irrespective of where someone lived. Commonly encountered issues included availability and access to public transport, appointment times, and broadband speed in relation to conducting virtual appointments. Use of public transport to access health care services, even if it was available, was felt to be unworkable because of the length of journeys and difficulties arising due to the nature of their condition e.g., poor mobility. Most participants accessed health care by car.

> **I currently only have access to my GP and nursing staff there due to being unable to attend scheduled rheumy appointments so my treatment/condition is monitored by me and the staff at my local GP practice. I do not drive and rely on public transport and would require approx 2 hours of travel time (each way) to attend Rheumy clinic. Requests for more appropriate appointment times were denied so I stopped attending.**
>
> **Female, 25-44 years, inflammatory RMD, urban resident**

> **I drive, otherwise I have to wait for an ambulance you know, which means to go for a sort of ten-minute appointment with the haematologist it might take me all day to go there and back in an ambulance.**
>
> **Female, non-inflammatory RMD, rural resident**

> Hospital transport can be really good, but it's a problem accessing it because they say to me "Are you in a wheelchair?" "No". "Have you got oxygen?" "No". "Oh you can no longer have the transport". When I go back to my consultant, he says its nothing to do with him!
>
> Female, inflammatory RMD, urban resident

> I'm very much reliant upon community transport to get me to my appointments because with patient transport I've found sometimes when I booked, I'd get a call at 5pm the day before my appointment and was told they couldn't take me.
>
> Male, inflammatory RMD, rural resident

Individuals with caring responsibilities reported specific difficulties attending health services, particularly when considering travel time, but this was not always understood by others.

> I have elderly parents living 400 miles away who are dependent on me. My husband is supportive but (his) work demands and long hours result in caring for family being on me. Daughter is now a teenager but when she was younger this was much harder. The impact of this on my arthritis is not considered.
>
> Female, 45-64 years, inflammatory RMD, urban resident

> Time taken to travel to hospital and waiting for appointment is very difficult due to care needs for a family member at home.
>
> Male, 45-64 years, inflammatory RMD, urban resident

> I care for my wife - she has mental health issues. Sometimes my inability to access the services seems irrational for outsiders.
>
> Male, 65-74 years, inflammatory RMD, rural resident

Signposting to services and support for self-management

But it wasn't just the presence or absence of local specialist services, or physical access, that mattered. People told us it was important to know where to go for help – **a 'map and compass' to signpost to relevant self-management** – and to have timely access to community-based and specialist services. A complex interaction between factors affected people's ability to access services.

The interviews revealed that problems accessing information about specific conditions and knowing how to access available local services were multi-factorial and included lack of availability of relevant information, services, and support when required, and adequate signposting to support when it was available. People living with RMDs highlighted the importance of the availability of services in a timely way throughout the life course.

> Lack of certain services means that I feel unsupported at times and feel that there are moments when I feel that I'm floundering. Not knowing which way to turn for the help I need.
>
> Female, 65-74 years, inflammatory RMD, urban resident

> When living with a chronic long-term condition, you need access to people who have experience of these conditions whether it's a physio, OT, Specialist Nurse on a regular basis who can then take any queries back to the team and then feedback these queries within a couple of weeks, not wait to see someone for over a year. We are trying to live with these conditions and still need support and access to rehab and advice all through this and beyond.
>
> Female, 45-64 years, inflammatory RMD, urban resident

The unpredictability of flares meant people wanted to be able to access care quickly when needed. Participants particularly valued having a direct point of contact for use when required e.g., email or helpline number and information and support from a person as opposed to simply being given a leaflet.

> I don't really need a huge amount of care currently, I do know if I need it I can call and speak to a rheumatology nurse. I can always speak with my GP as well through ask my GP and know I will get a response and support.
>
> Female, 25-44 years, inflammatory RMD, rural resident

Independent predictors of dissatisfaction with care

In the multivariable model offering all eligible variables, seven factors entered and were retained in the stepwise logistic regression model: employment status; type of rheumatic and musculoskeletal condition; not knowing how to access available health services; experienced problems accessing information about participants' condition; health services not available in participants' health board/trust; travel issues creating difficulties in attending health services; caring responsibilities creating difficulties in attending health services.

We further tested whether any interaction term between the type of condition (inflammatory and non-inflammatory) and any of the other factors in the model was significant and entered in the model. There were none, thus the final model consisted of the above seven factors (see Table 6).

Table 6. Factors associated with participants reporting that health services do not enable them to meet their care priorities (stepwise logistic regression model)

Factors affecting health service priorities	**OR**	**95% CI**
Difficulties knowing how to access available local services	2.92	(1.88, 4.60)
Services not being available in your health board/trust	2.46	(1.61, 3.79)
Difficulties accessing information about condition	2.03	(1.46, 2.84)
Type of RMD: non-inflammatory	2.90	(1.82, 4.70)
Caring responsibilities creating difficulties attending health services	1.59	(1.12, 2.26)
Travel issues creating difficulties attending health services	1.42	(0.99, 2.04)
Employment status		
Not in paid employment due to illness	1.37	(0.93, 2.01)
Retired	0.77	(0.51, 1.14)
Not in paid employment	1.12	(0.54, 2.26)

Overall, the final model demonstrated a good level of fit (ROC curve = 0.78, 95% CI (0.75, 0.81)) and the performance of the model was good with high PPV (73.5%) and NPV (73.5%).

What challenges did we encounter?

There are some methodological issues to consider in interpreting the findings from the survey and interviews. The survey is a convenience sample of people who chose to respond to the survey which was advertised through social media channels and promoted by relevant charities.

The survey was entitled “Understanding the experience and priorities for care for people with rheumatic and musculoskeletal conditions living in urban and rural areas”. It is possible that people with poor care experiences were more likely to take part and we have overestimated this outcome although this would not invalidate the analysis of factors linked to a negative assessment of services.

Except for gender, we have obtained a good spread of respondents across socio-economic, demographic and geographic factors. Only 13% of respondents were male, and so the priorities of men are under-represented in our survey. We had a good spread of interview participants, and whilst we only interviewed people living in rural areas, many had previously lived in urban areas.

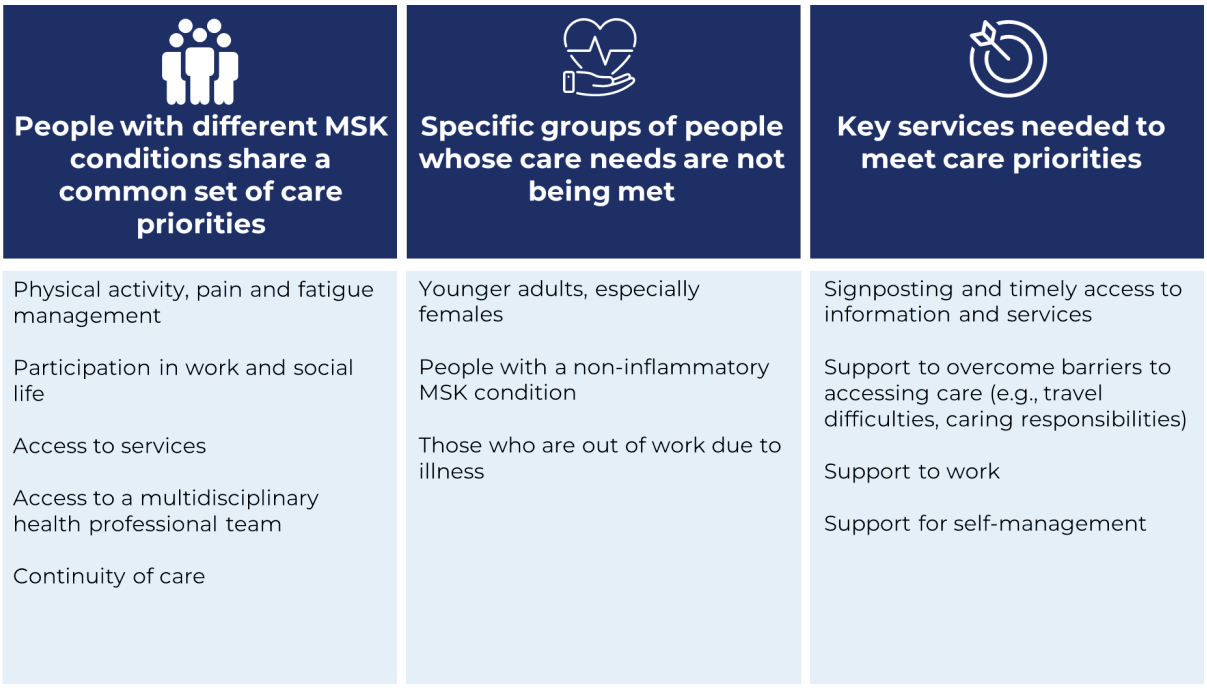
Summary and implications

Summary

The survey and interview findings are summarized in Figure 6 below. Key factors contributing to patients reporting that services for their RMD were not meeting their needs include individual characteristics (such as being unable to work due to illness or having a non-inflammatory RMD), difficulties with the availability and convenience of services, challenges accessing available services and information about their condition, and practical barriers to attending health services. While certain aspects of care, such as access, posed greater challenges for rural dwellers compared to urban residents, the underlying factors influencing whether services met patients' needs were consistent regardless of geography.

We also identified what parts of services are important to meet care needs and identified key gaps that need to be addressed to improve care. Caring responsibilities were a particular issue for many people of all ages, not only affecting their ability to access services, but also their own health. People also valued timelier access to information and services in a way that was meaningful to them, along with better support to (remain in) work and access to community resources to support self-manage their condition(s) and engage in social activities.

Figure 6. Summary of findings: Exploring priorities for care



Implications

We have demonstrated that a complex interplay of factors influences whether services effectively support people living with RMDs in meeting their care priorities, including access to and utilisation of healthcare. These insights, rooted in patient experiences, can complement information from routine healthcare data to better inform service planning. However, further work is needed to gather the perspectives of men with RMDs and other underrepresented groups to ensure their needs are fully considered in service planning.

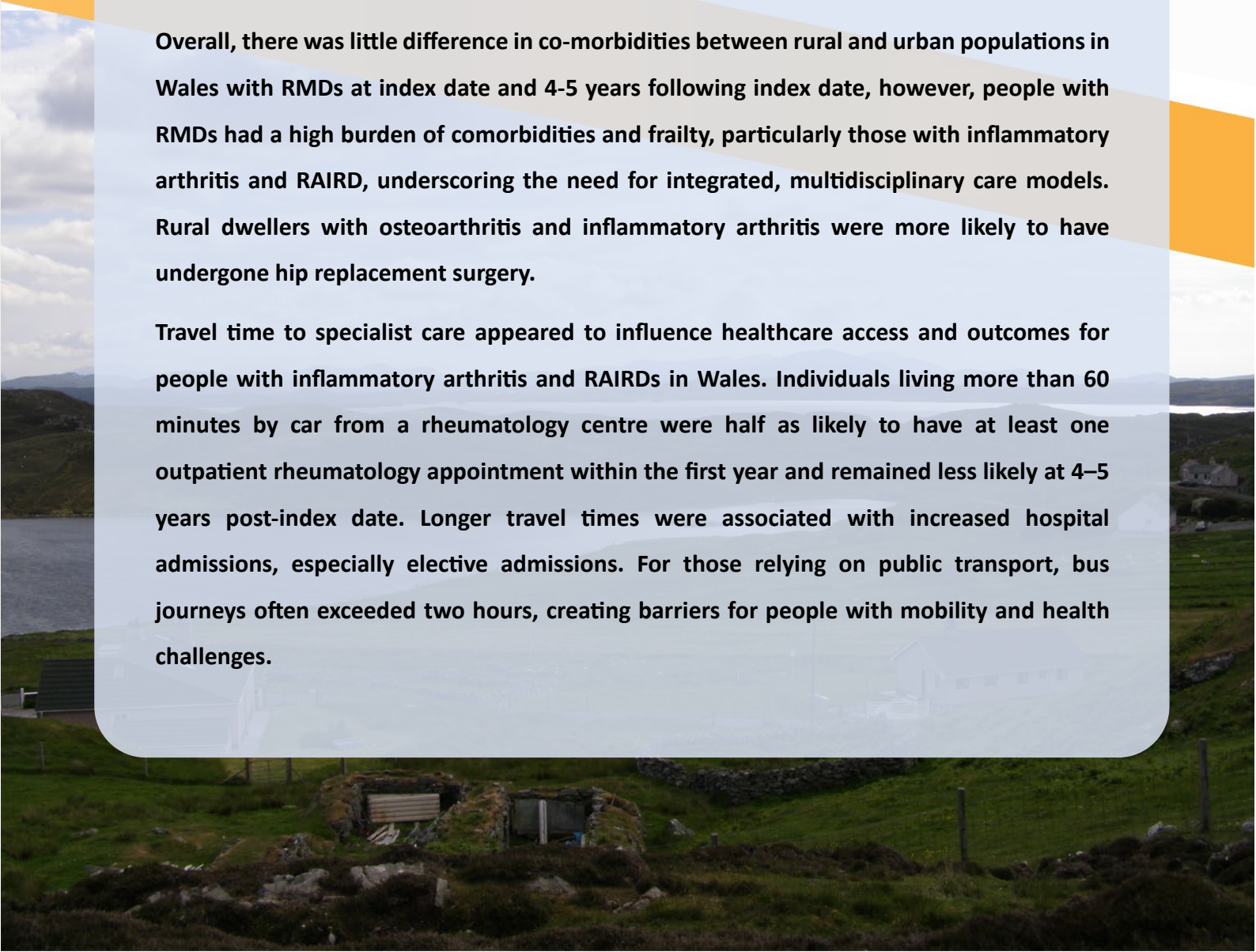
Understanding individuals with RMDs

Key messages

In Wales, osteoarthritis and inflammatory arthritis were more prevalent in rural populations, but this was largely accounted for by differences in population demographics. Similarly, in Scotland, prevalence rates of RMDs were higher in rural areas such as Aberdeenshire and Moray compared to urban areas like Aberdeen City, reflecting demographic patterns.

Overall, there was little difference in co-morbidities between rural and urban populations in Wales with RMDs at index date and 4-5 years following index date, however, people with RMDs had a high burden of comorbidities and frailty, particularly those with inflammatory arthritis and RAIRD, underscoring the need for integrated, multidisciplinary care models. Rural dwellers with osteoarthritis and inflammatory arthritis were more likely to have undergone hip replacement surgery.

Travel time to specialist care appeared to influence healthcare access and outcomes for people with inflammatory arthritis and RAIRDs in Wales. Individuals living more than 60 minutes by car from a rheumatology centre were half as likely to have at least one outpatient rheumatology appointment within the first year and remained less likely at 4–5 years post-index date. Longer travel times were associated with increased hospital admissions, especially elective admissions. For those relying on public transport, bus journeys often exceeded two hours, creating barriers for people with mobility and health challenges.



Understanding individuals with RMDs in Wales

How we did it

This was a population-based descriptive study using electronic health data from the Secure Anonymised Information Linkage (SAIL) databank (Ford et al., 2009; Lyons et al., 2009) in Wales, UK, spanning from 1st January 2000 to 23rd March 2020 (inclusive). The datasets encompassed national longitudinal primary and secondary care information.

Study population

People with relevant Read codes for RMDs (see Appendix 2) were identified from the Wales Longitudinal GP dataset (WLGP), which has 83% population coverage. The SAIL team developed a standardised method of cleaning WLGP registration dates to provide a standardised primary care follow-up measure (Thayer et al., 2020). These cleaned datasets are available to researchers and were used in this study to more accurately identify when individuals are registered with GPs in Wales. The date a relevant Read code first appeared in an individual's electronic healthcare record was taken as the index date for the RMD and a surrogate marker for diagnosis date.

Three RMD cohorts were created: osteoarthritis, inflammatory arthritis and rare autoimmune rheumatic conditions (RAIRDs). These comprised of patients diagnosed at any time between 1st January 2000 to 23rd March 2020 (inclusive). Within this, the point prevalence was calculated using the adult population alive and registered in Wales with the presence of relevant read codes on or before the 1st July 2018. We examined socio-demographics characteristics at index date and clinical characteristics and healthcare use at index date and 5 years post index date.

Socio-demographic and clinical characteristics

Socio-demographic data, specifically age and sex, were extracted from the Welsh Demographic Service Dataset (WDSD). Ages at index dates and point prevalence date were derived from the week of birth (WoB). Any entries with conflicting or missing data regarding WoB or sex were removed. Additionally, the WDSD was also used to retrieve the locality of residence as a small census area known as the Lower layer Super Output Area (LSOA) comprising of around 1500 households. The LSOA was subsequently linked to its respective quintile from the Welsh Index of Multiple Deprivation (WIMD) and the urban/rural settlement classification. To independently assess the level of deprivation and avoid circularity in healthcare analyses, only the income domain was considered, recognising that long-term health conditions already contribute to the overall WIMD ranking. Settlement classification was determined from the Office for National Statistics' (ONS) rural-urban classification (2011) of LSOAs in England and Wales. This classification categorises LSOAs into six settlement groups, which were consolidated to create a binary classification of rural and urban (Appendix 3). LSOAs, WIMD, and rural/urban status were established at both index date and point prevalence date. Individuals without LSOA codes were excluded.

Read codes were used to identify relevant comorbidities (Khan et al., 2010a; Sarica, Shifa, 2019; Sarica, Shifa H. et al., 2021) and prescribed medication, including non-steroidal anti-inflammatories (NSAIDS) (Healthcare Quality Improvement Partnership, 2017) and opiate analgesia (categorised as weak and strong) (Davies et al., 2019; Healthcare Quality Improvement Partnership, 2017).

Prescriptions for analgesia were considered in the six months preceding the index date and the last six months of the fifth year afterwards. The Charlson comorbidity index was evaluated using Read codes from Khan et al. (Khan et al., 2010a). Additional comorbidities were derived from secondary care ICD-10 codelists (Sarica, Shifa, 2019; Sarica, Shifa H. et al., 2021) and translated into Read codes using mapped reference datasets. The presence of comorbidities was determined at baseline if they occurred at any time up to the day before an index date and then between the index date and five years later. Persons who died during this follow-up period were removed from the analyses and accounted for in the prevalence and risk of mortality figures during this period. Read codes were also used to define smoking status and alcohol use at baseline.

The Electronic Frailty Index comprises 36 domains (see Appendix 4) identified by the presence of specific Read codes and, in some instances, values associated with them (Clegg et al., 2016). An example of a value based Read code is '16D2.', the number of falls in the last year, which requires an associated value that is greater than zero. These have been validated for use in the SAIL databank (Hollinghurst et al., 2019). Domains were combined to assign a single frailty score to everyone. These were further categorised into quartiles (fit, mild, moderate, and severe), and a binary split of 'at least moderate frailty' or not.

The Patient Episode Dataset for Wales (PEDW) provided secondary care inpatient clinical data for admissions for joint replacement surgery. These were identified by OPCS-4 surgical procedures.

Mortality data was obtained from WDSD.

Healthcare use

The Patient Episode Dataset for Wales (PEDW) also provided data on the overall number and type of hospital admission (emergency vs scheduled). The outpatient database for Wales (OPDW) provided data on outpatient specialty visits. It is not currently possible to count patient consultations within primary care in SAIL, so a proxy measure was used, namely the number of days on which any event occurred. Admission analyses were conducted for two periods: the year before diagnosis (baseline) and in the year leading up to fifth year after the index date.

Statistical analysis

The point prevalence was calculated on a fixed date (July 1st, 2018) as the number of individuals with relevant Read codes relative to the total number of eligible people in the population. Descriptive statistics were used to examine age, gender, co-variates of interest, and healthcare use of rural and urban participants.

Descriptive statistics were used to describe the characteristics of each condition cohort. Logistic regression models were also used to quantify relationships between living in rural areas and clinical outcomes (including co-morbidities and joint replacement). These were adjusted for age, sex and WIMD quintile. Results are given as risk ratios (RR) with 95% CI. Other outcome measures observed include binary differences in comorbidities (at least one, and none), frailty (moderate/severe and fit/mild), analgesia, clinical outcomes (joint replacement surgery, death), site of OA and hospital admissions. Missing data was treated as missing data throughout the study.

All statistical analyses were conducted using R, version 4.1.3.

Ethical approval

The study was approved by the SAIL Information Governance Review Panel (approval number: 0419). All data used in this study can be accessed by request to SAIL.

What we found

Overview of prevalence of RMDs in Wales

In the population of Wales with **at least one relevant READ code for osteoarthritis, inflammatory arthritis and RAIRDs** we found that:

- **10.8 per 100** people have **osteoarthritis**
- **0.9 per 100** people have **inflammatory arthritis**
- **0.7 per 100** people have a **rare autoimmune rheumatic disorder** (RAIRD)

We also looked at the **prevalence of RMDs in individual health boards in Wales**, see Table 7. The prevalence was similar across health boards, except for Powys where estimates were consistently lower across RMDs. There are several possible reasons for this. Primary care health data covers approximately 85% of the Welsh population, with poorer coverage in some rural areas, particularly Powys. Furthermore, in the workshops with key stakeholders, Powys was given as an example of a health board on the border between Wales and England where a significant proportion of healthcare was delivered by other health boards, or in England which was not recorded in Welsh national datasets.

Table 7. Prevalence of osteoarthritis, inflammatory arthritis and RAIRDs in individual health boards in Wales (individuals with at least one relevant READ code)

Health Board (n=population)	Osteoarthritis		Inflammatory arthritis		RAIRDS	
	N	%	N	%	N	%
Aneurin Bevan University Health Board (n=462888)	35987	7.77%	4240	0.92%	2925	0.63%
Betsi Cadwaladr University Health Board (n=535719)	44572	8.32%	4543	0.85%	4513	0.84%
Cardiff and Vale University Health Board (n=386122)	29300	7.59%	3041	0.79%	2239	0.58%
Cwm Taf Morgannwg University Health Board (n=349956)	34489	9.86%	3849	1.10%	2518	0.72%
Hywel Dda University Health Board (n=295487)	29109	9.85%	3152	1.07%	2098	0.71%
Powys Teaching Health Board (n=100731)	5892	5.85%	563	0.56%	408	0.41%
Swansea Bay University Health Board (n=308027)	33036	10.73%	2928	0.95%	2223	0.72%

Osteoarthritis

Of the 291, 721 people in Wales with at least one relevant diagnosis code for osteoarthritis at any time within the timeframe 1/1/200 – 23/3/2020, we looked at the breakdown per type of osteoarthritis, see Table 8.

Table 8. Breakdown of osteoarthritis types in Wales

Type of osteoarthritis*	**% (n)**
Hip	3.6 (10496)
Knee	16.3 (47644)
Lower limb (foot & ankle)	16.5 (47989)
Upper limb	3.7 (10751)
Hand	6.6 (19386)
Spine	0.2 (644)
Unspecified/Other OA	60.9 (177726)

**An individual could have more than one code for type of osteoarthritis*

Acknowledging that an individual could have more than one type of osteoarthritis code in their primary care record, the most common code was 'unspecified/other osteoarthritis' (60.9%) followed by lower limb (foot and ankle) (16.5%) and knee (16.3%), hand (6.6%), upper limb (3.7%) and hip (3.6%).

Inflammatory arthritis and rare autoimmune rheumatic disorders

Whilst the overall prevalence of inflammatory arthritis and RAIRDs (defined as individuals with at least one relevant READ code) was around 0.9 per 100 and 0.7 per 100, respectively, we went on to specifically look at the number of people alive and registered with a GP in Wales who had relevant READ codes for inflammatory arthritis and RAIRDs, plus two or more prescriptions for at least one relevant conventional DMARD (methotrexate, sulfasalazine, hydroxychloroquine, leflunomide, azathioprine, mycophenolate) at any point between 1/1/2000 and 23/3/2020. Such individuals are most likely to have a diagnosis and be looked after in specialist services.

We identified a total of 18153 individuals with inflammatory arthritis (including RA, PsA and axSpA) and 2985 individuals with RAIRDs on DMARDs, see Table 9. The low number of people with axSpA is because DMARDs are only used where there is peripheral joint involvement in axSpA, therefore individuals with only axial involvement are not included in these figures.

In the population of Wales with **at least one relevant READ code for inflammatory arthritis and RAIRDs plus two or more prescriptions for at least one relevant conventional DMARDs** we found that:

- **0.7 per 100** people have **inflammatory arthritis**
- **0.1 per 100** people have a **rare autoimmune rheumatic disorder (RAIRD)**

Table 9. Number of individuals in Wales with inflammatory arthritis and RAIRDs (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) at any time between 1/1/2000 and 23/3/2020

Condition	**% (n)**
Inflammatory arthritis (n=18153)	
Rheumatoid arthritis	78.9 (14317)
Psoriatic arthritis	18.6 (3368)
Axial spondyloarthritis	2.6 (468)
Rare autoimmune rheumatic disorders (n=2985)	
Systemic vasculitis (including ANCA-associated vasculitis, giant cell arteritis and large vessel vasculitis)	46.0 (1373)
Systemic lupus erythematosus	23.7 (708)
Sjogren's syndrome	11.3 (338)
Systemic sclerosis	10.1 (300)
Polymyositis	4.3 (129)
Dermatomyositis	2.8 (84)
Mixed connective tissue disease	1.8 (53)

We also looked at the prevalence of inflammatory arthritis and RAIRDs on conventional DMARDs in individual health boards in Wales, see Table 10. As before the prevalence was similar across health boards, except for Powys, again where estimates were consistently lower.

Table 10. Prevalence of inflammatory arthritis and RAIRDs on conventional DMARDs in individual health boards in Wales

Health board (n=population)	Inflammatory arthritis (with DMARDs)		RAIRDS (with DMARDs)	
	N	%	N	%
Aneurin Bevan University Health Board (n=462888)	3594	0.78%	527	0.11%
Betsi Cadwaladr University Health Board (n=535719)	3885	0.73%	705	0.13%
Cardiff and Vale University Health Board (n=386122)	2273	0.59%	443	0.11%
Cwm Taf Morgannwg University Health Board (n=349956)	2077	0.59%	405	0.12%
Hywel Dda University Health Board (n=295487)	2797	0.95%	477	0.16%
Powys Teaching Health Board (n=100731)	409	0.41%	66	0.07%
Swansea Bay University Health Board (n=308027)	2710	0.88%	372	0.12%

Comparison with RMD prevalence estimates from the literature

Our findings are in keeping with prevalence estimates from the literature. A recent study analysing UK primary care data from 1997 to 2017, using the UK Clinical Practice Research Datalink, found that the prevalence of general practitioner diagnosed osteoarthritis was approximately one in 10 adults. OA was slightly more common in women (12.49%) than in men (8.28%). The knee was the most commonly recorded site for OA leading to GP consultation. Prevalence by body site was recorded as unspecified joint (7.32%), knee (2.76%), hip (1.17%), wrist/hand (0.52%), and foot/ankle (0.29%). The prevalence of osteoarthritis was highest in Scotland.

The prevalence of rheumatoid arthritis in developed countries is estimated across studies to be approximately 0.5% to 1% of the adult population (Gabriel & Michaud, 2009). Psoriatic arthritis has a prevalence of approximately 0.1% in Caucasian populations (Lembke et al., 2024). The global prevalence of axial spondyloarthritis (axSpA) is estimated to range between 0.36% and 0.70% (Stolwijk et al., 2016). In the United Kingdom, a cross-sectional cohort study in a primary care setting estimated the prevalence of axSpA at approximately 0.15% in the general adult population. This study used contemporary classification criteria and imaging modalities to identify cases within a cohort of patients with low back pain.

The summed prevalence of rare rheumatic diseases, including vasculitis, connective tissue diseases, myositis, and autoinflammatory conditions, is estimated at approximately 28.8 per 10,000 (around 0.29 per 100) (Leyens et al., 2021).

Sociodemographic and clinical characteristics of people with RMDs

We compared sociodemographic and clinical characteristics of those with osteoarthritis, inflammatory arthritis and RAIRDs (the latter being with relevant READ code plus **two or more prescriptions for at least one relevant conventional DMARD**) in Wales, see Table 11.

Individuals with osteoarthritis, rheumatoid arthritis and RAIRDs were more likely to be aged 60 years and above. In contrast a greater proportion of those with psoriatic arthritis and axial spondyloarthritis were in the 18-49 age group. Over two thirds of people with rheumatoid arthritis and RAIRDs were female, and 60% of those with osteoarthritis were female. There was an even sex distribution across those with psoriatic arthritis and almost two thirds of individuals with axial spondyloarthritis were male.

There was an even distribution across deprivation (income domain of WIMD) quintiles across all RMDs. Around one third live in a rural area. There was a high burden of three or more Charlson comorbidities in those with osteoarthritis (32.0%), rheumatoid arthritis (25.3%) and RAIRDs (28.9%). In contrast, only 9.8% of those with axial spondyloarthritis and 14.9% of those with psoriatic arthritis had three or more co-morbidities.

*Table 11. Sociodemographic and clinical characteristics of individuals with osteoarthritis, inflammatory arthritis*and RAIRDs* in Wales at index date. *relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD*

Category	**Classification**	**Rheumatoid arthritis**	**Psoriatic arthritis**	**Axial Spondyloarthritis**	**RAIRDs**	**Osteoarthritis**
		% (n)	% (n)	% (n)	% (n)	% (n)
Sex (female)		68.2 (9769)	52.7 (1775)	31.6 (148)	72.5 (2163)	59.8 (174312)
Age bands (years)	18-29	3.3 (468)	8.9 (301)	15.4 (72)	7.1 (233)	0.5 (1438)
	30-39	6.7 (964)	17.2 (580)	23.7 (111)	7.9 (237)	2.0 (5811)
	40-49	13.9 (1994)	26.8 (901)	23.3 (109)	15.5 (463)	9.0 (26168)
	50-59	23.8 (3402)	23.7 (797)	22.0 (103)	21.3 (635)	22.5 (65579)
	60-69	27.4 (3927)	16.2 (545)	10.9 (51)	26.7 (796)	28.5 (83285)
	>=70	24.9 (3562)	7.2 (244)	4.7 (22)	20.8 (621)	37.5 (109440)
Deprivation quintile	1 - Most deprived	19.9 (2852)	20.2 (679)	21.8 (102)	18.8 (562)	19.1 (55659)
	2	22.3 (3194)	20.5 (690)	21.4 (100)	20.3 (607)	20.3 (59193)
	3	21.6 (3096)	21.2 (713)	20.9 (98)	22.0 (657)	21.7 (63387)
	4	19 (2720)	19.3 (650)	14.7 (69)	19.1 (571)	19.9 (58003)
	5 - Least deprived	17.2 (2455)	18.9 (636)	21.2 (99)	19.7 (588)	19.0 (55479)
Rural/urban classification	Rural	33.7 (4827)	30.8 (1038)	28.0 (131)	34.2 (1022)	32.6 (95219)
	Urban	66.3 (9490)	69.2 (2330)	72.0 (337)	65.8 (1963)	67.4 (196502)
Charlson comorbidities	0	26.7 (3825)	37.5 (1263)	43.8 (205)	22.1 (660)	21.3 (62204)
	1-2	48.0 (6873)	47.6 (1602)	46.4 (217)	49.0 (1463)	46.7 (136305)
	3+	25.3 (3619)	14.9 (503)	9.8 (46)	28.9 (862)	32.0 (93212)

We then examined the characteristic of those with individuals RAIRDs, however, due to issues with low numbers and risk of disclosure, only broad age categories and select characteristics could be extracted from SAIL, see Table 12. Around one third of individuals with lupus were under 40 years old, otherwise most individuals with RAIRDS were over the age of 40, and female. There was a high burden of co-morbidity across all RAIRDs, with almost one third of people with systemic vasculitis having three or more co-morbidities.

Table 12. Selected sociodemographic and clinical characteristics of individuals with RAIRDs in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD), stratified by condition

Sociodemographic and clinical characteristic		**Systemic vasculitis**	**Lupus**	**Sjogren's**	**Systemic sclerosis**	**Polymyositis**	**Dermatomyositis**	**Mixed connective tissue disease**
Age (years)	**< 40**	7.8 (107)	33.3 (236)	8.0 (27)	18.7 (56)	13.2 (17)	14.3 (12)	28.3 (15)
	>=40	92.2 (1266)	66.7 (472)	92.0 (311)	81.3 (244)	86.8 (112)	85.7 (72)	71.7 (38)
Sex (female)		63.4 (871)	84.6 (599)	84.0 (284)	73.3 (220)	65.9 (85)	70.2 (59)	84.9 (45)
Comorbidities	**0**	19.7 (271)	24.7 (175)	20.7 (70)	23.7 (71)	30.2 (39)	26.2 (22)	22.6 (12)
	1-2	46.1 (633)	53.3 (377)	52.7 (178)	50.7 (152)	45.7 (59)	46.4 (39)	47.2 (25)
	3+	**34.2** (469)	**22.0** (156)	**26.6** (90)	**25.7** (77)	**24.0** (31)	**27.4** (23)	**30.2** (16)

Healthcare use in inflammatory arthritis and RAIRDs

Whilst most osteoarthritis is looked after in primary care, people with inflammatory arthritis and rare autoimmune rheumatic conditions who are prescribed disease modifying medications require long term care within specialist rheumatology services.

We examined primary and secondary healthcare use in individuals with inflammatory arthritis and RAIRDs in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) at 0-1 and 4-5 years post index date.

We found that whilst most people with inflammatory arthritis and RAIRDs had at least one outpatient appointment at 0-1 and 4-5 years post index date, 12% of those with IA and 28% of those with RAIRDs had no recorded rheumatology outpatient appointments in the first year post index date, rising to 22% of those with IA and 33% of those with RAIRDs at 4-5 years, see Table 13. However, it is possible that appointments occurred shortly after the one-year time window and were missed.

Proportionally fewer people with RAIRD appear to have rheumatology outpatient appointments compared to those with IA, with a greater proportion having outpatient appointments in other specialties. This may reflect the multi-system nature of their condition and fragmented care provided across multiple specialities. Those with RAIRDs had proportionally more emergency and elective hospital admissions, as well as GP event days than those with inflammatory.

Table 13. Proportion of individuals with inflammatory arthritis and RAIRDs in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) who have at least one record of a healthcare episode (outpatient appointment, hospital admission or GP event) at 0-1 and 4-5 years post index date

		Inflammatory arthritis	RAIRDs
Health care use 0-1 years post index date*			
Outpatient appointments	*Rheumatology*	88.1 (15101)	72.1 (1983)
	Other	60.2 (10323)	83.2 (2290)
Hospital admissions	*Emergency*	12.5 (2143)	27.6 (758)
	Elective	18.8 (3231)	36.0 (989)
GP event days*		82.3 (14118)	89.3 (2457)
Health care use 4-5 years post index date*			
Outpatient appointments	*Rheumatology*	77.9 (9595)	66.6 (1299)
	Other	58.2 (7168)	77.1 (1503)
Hospital admissions	*Emergency*	12.8 (1583)	17.7 (346)
	Elective	21.0 (2588)	28.2 (550)
GP event days*		73.9 (9106)	81.8 (1596)

**GP event days = the number of days on which any 'event' occurs in their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

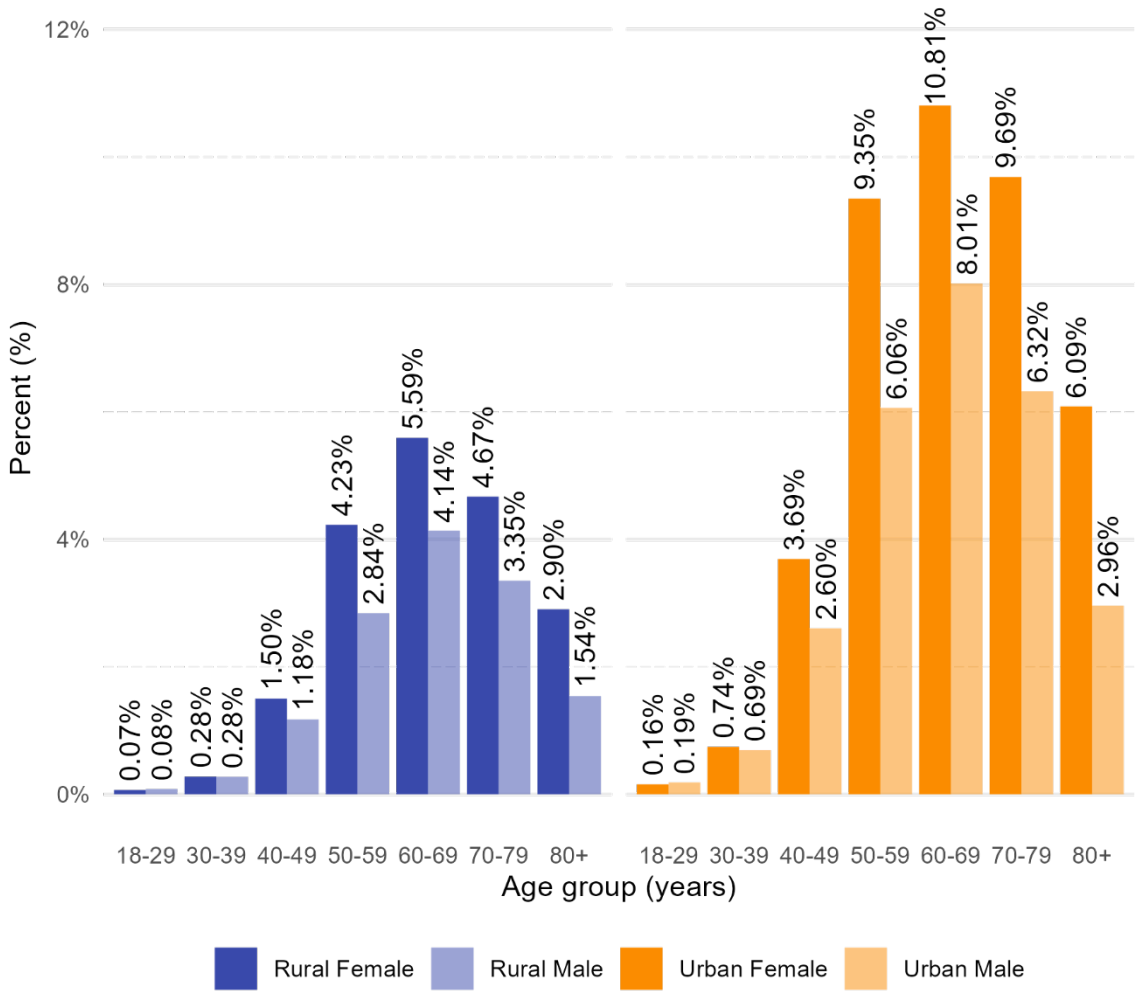
We examined this further by exploring the relationship between travel time to specialist rheumatology services and the amount and type of healthcare use (GP, specialist outpatient attendances and hospital admissions) accessed at 0-1 and 4-5 years post diagnosis (index date) for those with inflammatory arthritis and RAIRDs.

Comparison of characteristics and health outcomes between those living in rural and urban areas

Osteoarthritis

We compared rural and urban dwellers who had at least one relevant code for osteoarthritis (see Appendix 2). Rural dwellers were more likely to have a READ code relating to OA in their electronic medical records (9.16% vs. 8.31%). At diagnosis, hip (4.27% vs 3.27%), lower limb (17.65% vs 15.87%) and hand osteoarthritis (7.40% vs 6.28%) were more commonly recorded in rural dwellers, see Table S1, Appendix 5. In those aged 18-59 years with osteoarthritis, the highest proportion was in urban dwelling males and females. In individuals aged 60 years and above, the highest proportion was found in urban and rural dwelling females, see Figure 7 below and Table S1, Appendix 5.

Figure 7. Geographical distribution of osteoarthritis patients at index date in Wales, by age and sex



Rural dwellers with OA were more likely to have higher incomes and to be in the three least deprived quintiles (income domain) (65.98% vs 52.48%), see Table S1, Appendix 5.

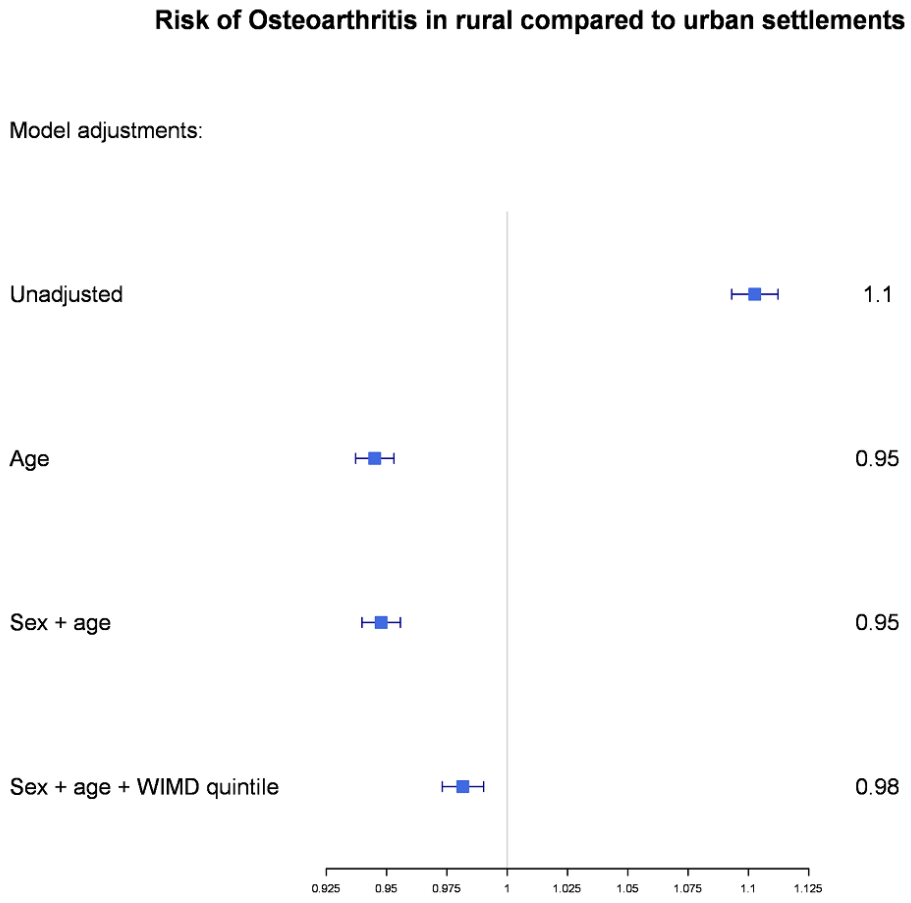
Living in a rural area was associated with a 10% higher risk of OA (RR_{unadj} 1.103, 95% CI: 1.093 to 1.112). However, after adjustment for age, sex and deprivation (income only domain of WIMD) (RR_{adj} 0.982, 95% CI: 0.973 to 0.990), the excess risk disappears and is nearly all explained by age differences between urban and rural populations , see Table 14 and Figure 8 (a).

Table 14. Relative risk of osteoarthritis in rural and urban populations as of 1st July 2018

Adjustment	Risk Ratio	95% Lower CI	95% Upper CI
Unadjusted	1.103	1.093	1.112
Sex	1.102	1.093	1.112
Age	0.945	0.937	0.953
WIMD	1.097	1.087	1.107
Sex + age	0.948	0.940	0.956
Sex + WIMD	1.097	1.087	1.107
Age + WIMD	0.979	0.971	0.988
Sex + age + WIMD	0.982	0.973	0.990

Urban is the reference category. Sex uses male as the reference category.

Figure 8. Risk ratio models of OA in urban and rural areas on 01/07/2018. Urban as the reference category



Baseline clinical characteristics of urban and rural dwellers with osteoarthritis

Compared to urban dwellers, rural dwellers with OA were less likely to be current smokers (24.60% vs 26.47%) and more likely to abstain from alcohol (34.55% vs 30.13%), see Table S1, Appendix 5. Almost one third of both rural and urban populations with osteoarthritis had 3 or more Charlson co-morbidities. However, the rural osteoarthritis population had a lower risk of having at least one Charlson co-morbidity (RR_{unadj} 0.98 (0.97 to 0.98) which persisted after adjusting for age, gender, and income domain quintile of WIMD (RR_{adj} 0.98 (0.98 to 0.99), see Table S3, Appendix 5, and Figure 9 (a) below. There was little overall difference between rural and urban populations in terms of specific co-morbidities: cardiovascular disease, hypertension, diabetes, renal disease, respiratory disease, dementia, and cancer, see Table S1, Appendix 5. However, the rural OA population had a marginally lower risk of hypertension (RR_{adj} 0.977, 95% CI: 0.968 to 0.985), diabetes (RR_{adj} 0.949, (0.929 to 0.970)), cancer (RR_{adj} 0.947, (0.927 to 0.967)) and dementia (RR_{adj} 0.880, (0.867 to 0.894)), and a slightly higher risk of renal disease (RR_{adj} 1.068, (1.042 to 1.095) after adjusting for age, gender, and income domain quintile of WIMD, see Table S3, Appendix 5, and Figure 9 (a) below.

Weak opiates and non-steroidal anti-inflammatories (NSAIDs) were commonly prescribed with 33% and 37% of rural and urban osteoarthritis populations, respectively, having had at least one prescription of weak opiates in the 6 months prior to index date, and 26% of both rural and urban populations prescribed an NSAID, see Table S1, Appendix 5. Strong opiates were rarely prescribed (around 2% of rural and urban populations). Following adjustment for age, gender, and income domain of the WIMD quintile, the rural OA population had a slightly lower risk of weak opiate prescription in the 6 months prior to index date (RR_{adj} 0.950, (0.940 to 0.940), see Table S3, Appendix 5, and Figure 9 (a) below.

At baseline, 3.13% of the rural OA population and 2.54% of the urban OA population had a hip joint replacement, and 2.70% and 2.96% had a knee joint replacement respectively, see Table S1, Appendix 5. Rural dwellers had a higher risk of having had a hip replacement (RR_{adj} 1.184, 95% CI: 1.131 to 1.240), see Figure 9 (a) below.

Association between living in a rural areas and clinical characteristics and outcomes at 5 years after diagnosis

At 5 years after diagnosis, a total of 26,185 people had died (9.53% of the rural and 8.93% of the urban osteoarthritis populations, respectively). The proportion of both rural and urban populations with osteoarthritis and at least one Charlson co-morbidity increased from 77.32% and 79.33% respectively at diagnosis, to 84.30% and 86.02% at 4-5 years following diagnosis, with over 40% having three or more Charlson co-morbidities. However, the rural OA population continued to have a marginally lower risk of having at least one Charlson co-morbidity compared to their urban counterparts (RR_{unadj} 0.980 (0.977 to 0.983) which persisted after adjusting for age, gender, and income domain quintile of WIMD (RR_{adj} 0.988 (0.985 to 0.991), see Table S5, Appendix 5, and Figure 9 (b). There remained no significant overall difference between rural and urban populations in terms of specific co-morbidities: cardiovascular disease, hypertension, diabetes, renal disease, respiratory disease, dementia, and cancer. However, following adjustment for age, sex, and income domain quintile of WIMD, the rural OA population had a marginally lower risk of cancer (RR_{adj} 0.955, (0.939 to 0.972)), diabetes (RR_{adj} 0.957, (0.939 to 0.975)) and dementia (RR_{adj} 0.910, (0.866 to 0.956)) and a slightly higher risk of renal disease (RR_{adj} 1.073, (1.053 to 1.093)). Despite this, the rural OA population had a higher risk of at least moderate frailty after adjustment for age, sex, and the income domain quintile of WIMD (RR_{adj} 1.030 (1.017 to 1.043)), Table S5, Appendix 5.

The proportion of rural and urban OA populations having at least one prescription for non-steroidal anti-inflammatories (NSAIDs) reduced to around 13% in the last six months of the fifth year after index date. Weak opiates were still commonly prescribed (22% of rural population and 25% of urban population), with only 3% of both rural and urban dwellers prescribed strong opiates. Following adjustment for age, sex, and income domain of the WIMD quintile, the rural OA population had a slightly lower risk of receiving a weak opiate prescription (RR_{adj} 0.936, (0.922 to 0.950)), and a slightly higher risk of receiving a strong opiate prescription in the last six months of the fifth year after index date (RR_{adj} 1.059, (1.014 to 1.106)), see Figure 9 (b).

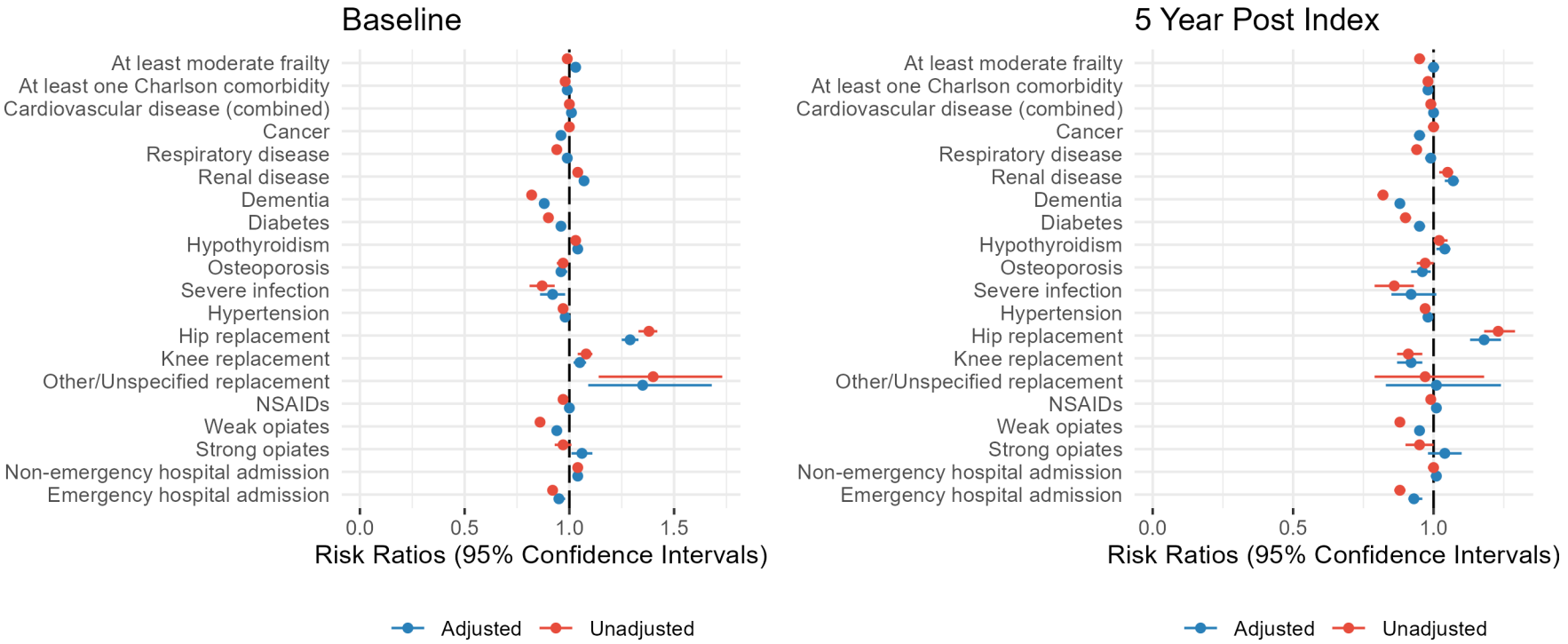
At 4-5 years after diagnosis, the risk of hip replacement surgery (RR_{unadj} 1.375 (1.332 to 1.419), knee (RR_{unadj} 1.077 (1.045 to 1.109) and other joint replacement surgery (RR_{unadj} 1.400 (1.136 to 1.725) was higher in the rural OA population compared to their urban counterparts, which persisted after adjustment for age, gender, and income domain quintile of WIMD (RR_{adj} 1.291 (1.250 to 1.334), RR_{adj} 1.049 (1.017 to 1.082), and RR_{adj} 1.353 (1.088 to 1.683) respectively, see Table S1, Appendix 5, and Figure 9 (b).

Healthcare use

In the year before index date, 98% of both rural and urban osteoarthritis populations had at least one GP event. A smaller proportion of the rural osteoarthritis population had at least one outpatient attendance (54.67% vs 57.89%) and hospital admissions (22.24% vs 23.29%), with no difference in emergency hospital admissions, see Table S1, Appendix 5. Rural dwellers with OA at index date had a slightly lower risk of outpatient visits (RR_{unadj} 0.944 (0.938 to 0.951)), overall hospital admissions (RR_{unadj} 0.955 (0.941 to 0.969)) and emergency hospital admissions (RR_{unadj} 0.879 (0.857 to 0.900)) which persisted after adjustment for age, gender, and income domain of WIMD (RR_{adj} 0.955 (0.948 to 0.962); RR_{adj} 0.980 (0.966 to 0.995); and RR_{adj} 0.932 (0.908 to 0.956), respectively). No differences were seen for non-emergency admissions., see Table S3, Appendix 5, and Figure 9 (a).

In the 4-5 years post-index date, a smaller proportion of the rural OA population had at least one outpatient attendance (49.03% vs 51.27%), with no difference in proportion of overall hospital admissions (22.68% vs 22.98%). The rural OA population continued to have a slightly lower risk of outpatient attendances (RR_{unadj} 0.956 (0.949 to 0.965)) and emergency hospital admissions (RR_{unadj} 0.918 (0.897 to 0.939) which persisted after adjustment for age, gender, and income domain of WIMD (RR_{adj} 0.963 (0.956 to 0.971)) and (RR_{adj} 0.954 (0.932 to 0.977), respectively). However, the risk of non-emergency hospital admission was slightly higher in the rural OA population (RR_{unadj} 1.042 (1.024 to 1.062) and RR_{adj} 1.037 (1.018 to 1.057)), see Table S5, Appendix 5, and Figure 9 (b).

Figure 9. Relationship between living in a rural area and health outcomes at baseline and 5 years post diagnosis for individuals in Wales with osteoarthritis (a) at baseline (up to the day before OA diagnosis) and (b) five years. Additional, supporting data can be found in Tables S3 and S5, Appendix 5

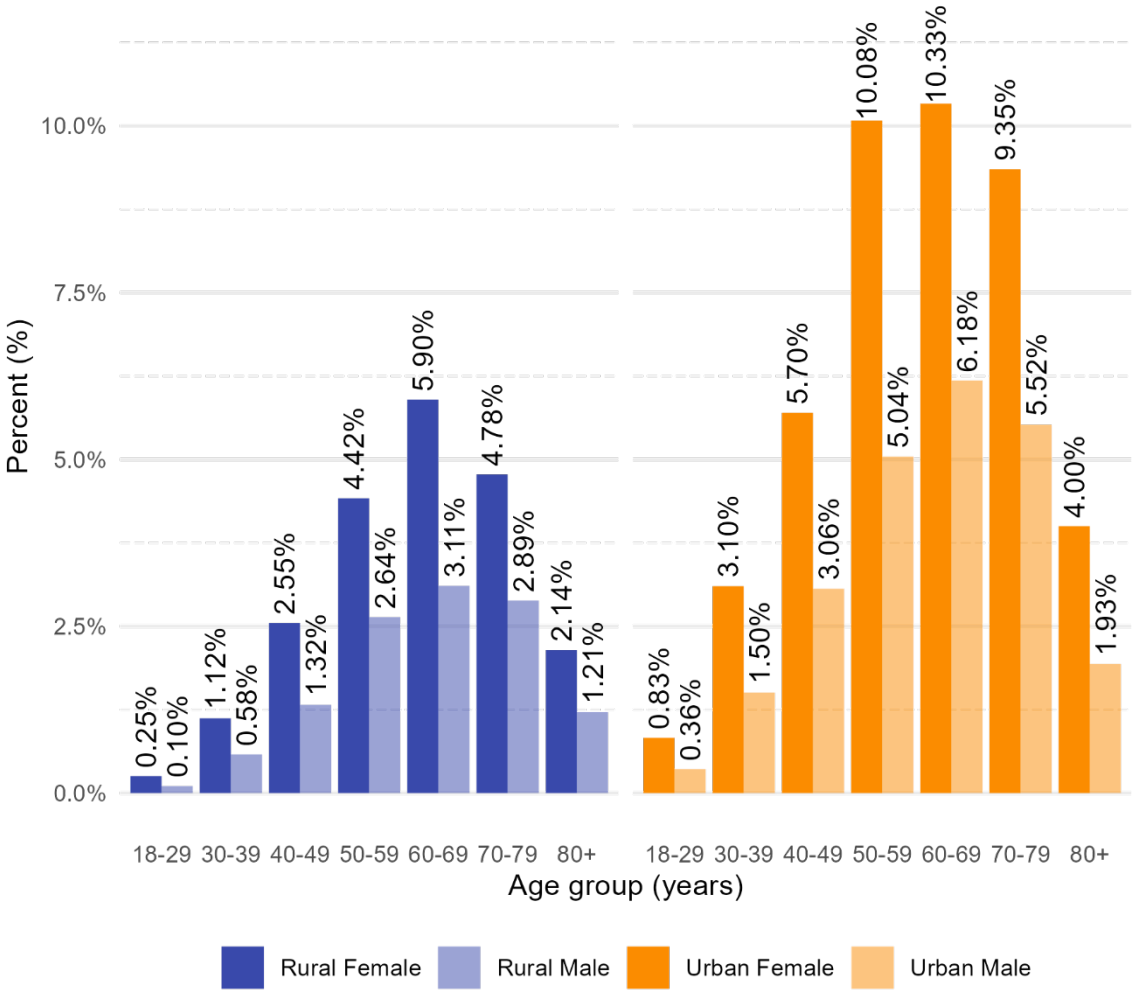


Inflammatory arthritis

We compared rural and urban dwellers who had relevant READ codes for inflammatory arthritis, plus two or more prescriptions for at least one relevant conventional DMARD (methotrexate, sulfasalazine, hydroxychloroquine, leflunomide, azathioprine, mycophenolate) at any point between 1/1/2000 and 23/3/2020, see Appendix 2.

Rural dwellers were slightly more likely to have a READ code relating to inflammatory arthritis in their electronic medical records (0.80% vs. 0.72%). Across all ages with inflammatory arthritis, the proportion was highest in rural and urban dwelling females (see Figure 10 below and Table S6, Appendix 5).

Figure 10. Geographical distribution of inflammatory arthritis patients at index date in Wales, by age and sex



Rural dwellers with inflammatory arthritis were more likely to have higher incomes and to be in the three least deprived quintiles (income domain) (75.11% vs 50.52%), see Table S7, Appendix 5.

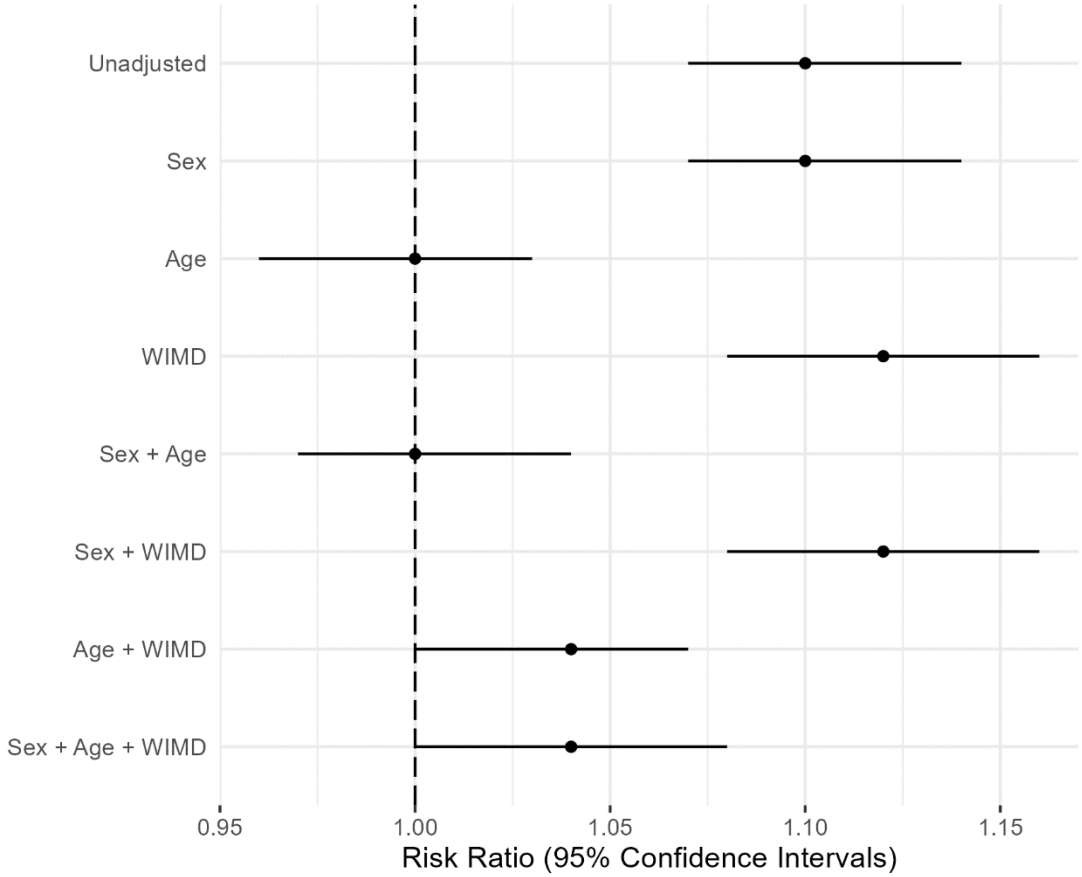
Living in a rural area was associated with a 10% higher risk of inflammatory arthritis (RR_{unadj} 1.10, 95% CI: 1.07 to 1.14). However, after adjustment for age, sex and deprivation (income only domain of WIMD) (RR_{adj} 1.04, 95% CI: 1.00 to 1.08), the excess risk disappears and is nearly all explained by age differences between urban and rural populations, see Table 15 and Figure 11.

Table 15 Relative risk of inflammatory arthritis in rural and urban populations as of 1st July 2018

Adjustment	Risk Ratio	95% Lower CI	95% Upper CI
Unadjusted	1.1	1.07	1.14
Sex	1.1	1.07	1.14
Age	1	0.96	1.03
WIMD	1.12	1.08	1.16
Sex + age	1	0.97	1.04
Sex + WIMD	1.12	1.08	1.16
Age + WIMD	1.04	1	1.07
Sex + age + WIMD	1.04	1	1.08

Urban is the reference category. Sex uses male as the reference category.

Figure 11. Risk of inflammatory arthritis in rural compared to urban settlements



Baseline clinical characteristics of urban and rural dwellers with inflammatory arthritis

Compared to urban dwellers, rural dwellers with inflammatory arthritis were more likely to be ex-smokers (13.10% vs 10.85%) and more likely to abstain from alcohol (36.00% vs 30.54%), see Table S7, Appendix 5. Around 70% of both rural and urban populations with inflammatory arthritis had at least one Charlson co-morbidity at baseline, with 48% having three or more Charlson co-morbidities. However, there was no difference in the risk of having at least one Charlson co-morbidity between rural and urban inflammatory arthritis populations (RR_{unadj} 1.00 (0.99 to 1.02) which persisted after adjusting for age, gender, and income domain quintile of WIMD (RR_{adj} 1.00 (0.98 to 1.02), see Table S8, Appendix 5 and Figure 12 (a) below. Around 10% of both rural and urban populations had at least moderate frailty, but there was no difference between rural and urban dwellers (RR_{adj} 1.05 (0.96 to 1.15).

There was little overall difference between rural and urban populations in terms of specific co-morbidities at baseline: cardiovascular disease, hypertension, diabetes, renal disease, respiratory disease, dementia, cancer and serious infection, see Table S7, Appendix 5, and no difference in risk, see Table S8, Appendix 5.

Opiates were commonly prescribed with 51.35% and 54.33% of rural and urban inflammatory arthritis populations respectively having had at least one prescription of weak opiates in the 6 months prior to index date, and 45.72% of rural and 49.05% of urban populations prescribed a strong opiate, see Table S7, Appendix 5. Surprisingly, NSAIDs were rarely prescribed (1.21% of rural and 1.40% of urban populations). Following adjustment for age, sex, and income domain of the WIMD quintile, the rural inflammatory arthritis population had a slightly lower risk of weak opiate prescription (RR_{adj} 0.96, (0.92 to 0.99)) and NSAIDs (RR_{adj} 0.95, (0.93 to 0.98)) in the 6 months prior to index date, see Table S8, Appendix 5, and Figure 12 (a).

Around 7% of the population with inflammatory arthritis had a hip joint replacement, and 3% had a knee joint replacement at diagnosis, see Table S7, Appendix 5, with rural dwellers having a higher risk of having had a hip replacement (RR_{unadj} 1.27 (1.07 to 1.50)), which persisted after adjustment for age, sex and income domain of WIMD (RR_{adj} 1.24, 95% CI: 1.05 to 1.48), see Figure 12 (a) below.

Association between living in a rural areas and clinical characteristics and outcomes at 4-5 years after diagnosis

At 4-5 years after diagnosis, a total of 154 people had died (0.87% in the rural and 0.84% in the urban inflammatory arthritis populations, respectively). The proportion of both rural and urban populations

with inflammatory arthritis and at least one Charlson comorbidity increased to around 80%, with 35% having three or more Charlson co-morbidities, see Table S9, Appendix 5. However, there was no difference in the risk of having at least one Charlson comorbidity between rural and urban inflammatory arthritis populations (RR_{unadj} 1.02 (1.00 to 1.03), which persisted after adjusting for age, gender, and income domain quintile of WIMD (RR_{adj} 1.01 (1.00 to 1.03), see Table S10, Appendix 5, and Figure 12 (b) below. The proportion of both rural and urban inflammatory arthritis populations with at least moderate frailty increased to around 25%, but there was no difference in risk of frailty between rural and urban dwellers (RR_{adj} 1.04 (0.99 to 1.10).

There remained no significant overall difference between rural and urban populations in terms of specific comorbidities: cardiovascular disease, hypertension, diabetes, renal disease, respiratory disease, dementia, and cancer. However, following adjustment for age, gender, and income domain quintile of WIMD, the rural inflammatory arthritis population had a marginally lower risk of dementia (RR_{adj} 0.92, (0.87 to 0.98)) and serious infection (RR_{adj} 0.83, (0.67 to 1.03)) although there was uncertainty around the latter estimate due to smaller numbers of individuals with serious infections, see Table S10, Appendix 5.

The proportion of rural and urban inflammatory arthritis populations having at least one prescription for non-steroidal anti-inflammatories (NSAIDs) in the last six months of the fifth year after index date increased to 21.99% and 24.19% respectively. Weak opiates were still commonly prescribed, although there were fewer prescriptions compared to diagnosis (27.78% of rural and 30.39% of urban inflammatory arthritis populations respectively), with only 5% of both rural and urban dwellers prescribed strong opiates. However, following adjustment for age, gender, and income domain of the WIMD quintile, there was no difference between rural and urban inflammatory arthritis populations in the risk of receiving an NSAID prescription (RR_{adj} 0.95, (0.90 to 1.01)), weak opiate prescription (RR_{adj} 0.98, (0.93 to 1.03)) or strong opiate prescription (RR_{adj} 0.99, (0.86 to 1.14)) in the last six months of the fifth year after index date, see Figure 12 (b).

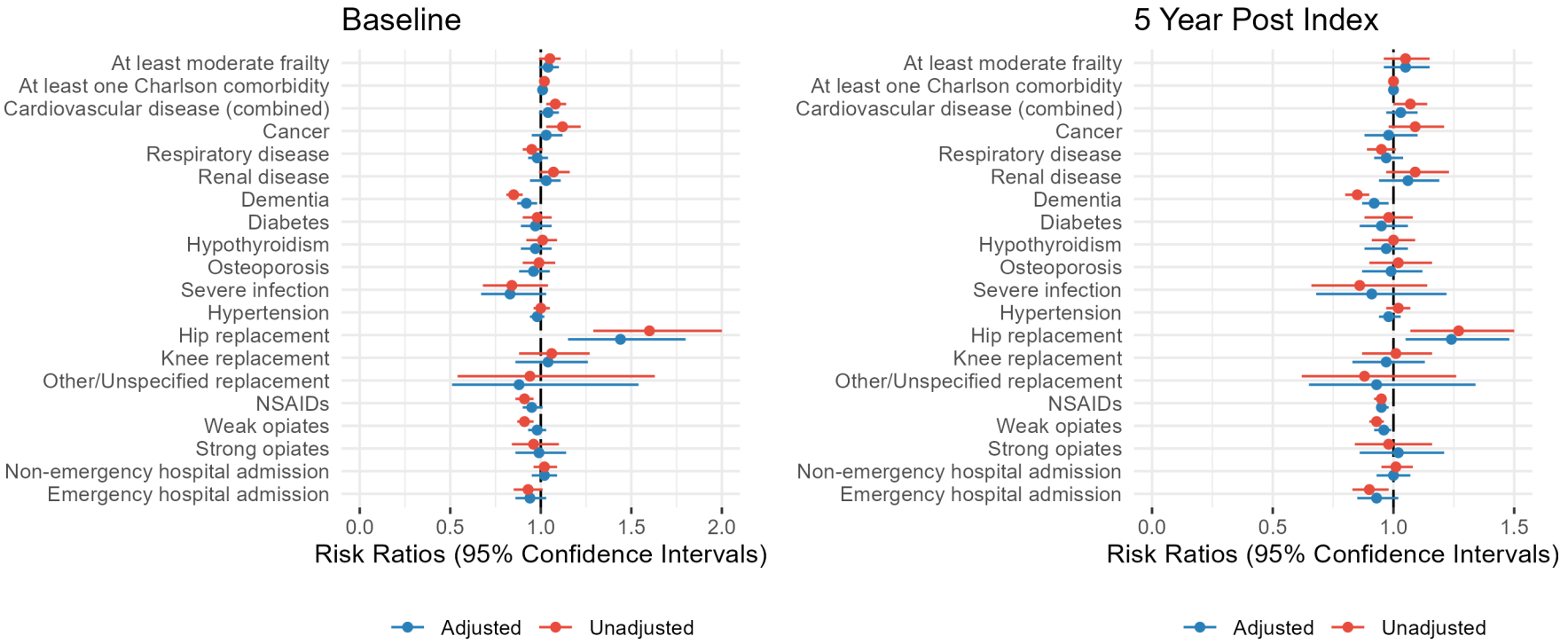
The risk of hip replacement surgery (RR_{unadj}1.60 (1.29 to 2.00) remained higher at 4-5 years following diagnosis in the rural inflammatory arthritis population compared to their urban counterparts, which persisted after adjustment for age, gender, and income domain quintile of WIMD (RR_{adj} 1.44 (1.15 to 1.80). There was no significant difference in the risk of knee joint replacement at 5 years (RR_{adj} 1.04 (0.86 to 1.26), see Figure 12 (b).

Healthcare use

In the year before index date, only 3.5% of both the rural and urban inflammatory arthritis populations had at least one GP event, however, 99% had an outpatient attendance. Over three quarters had at least one hospital admission, with rural dwellers having slightly fewer (78.46%) than urban dwellers (82.22%). There was no difference in emergency hospital admissions between groups, see Table S7, Appendix 5. Rural dwellers with inflammatory arthritis had a slightly lower risk of outpatient visits (RR_{unadj} 0.95 (0.94 to 0.97)), which persisted after adjustment for age, sex, and income domain of WIMD (RR_{adj} 0.96 (0.94 to 0.98). No differences between groups were seen for hospital admissions and emergency admissions, see Table S8, Appendix 5, and Figure 12 (a).

In the 4-5 years post-index date, around 84% of both the rural and urban inflammatory arthritis population had at least one GP event. A slightly smaller proportion of the rural population had at least one outpatient attendance (73.15% vs 78.06%), with no difference in proportion of overall hospital admissions between groups (24.95% vs 25.39%), see Table S9, Appendix 5. The rural inflammatory arthritis population continued to have a slightly lower risk of outpatient attendances (RR_{unadj} 0.94 (0.92 to 0.95)) which persisted after adjustment for age, sex, and income domain of WIMD (RR_{adj} 0.95 (0.93 to 0.97)), see Table S10, Appendix 5, and Figure 12 (b).

Figure 12. Relationship between living in a rural area and health outcomes at baseline and 5 years post diagnosis for individuals in Wales with inflammatory arthritis (a) at baseline and (b) five years. Additional, supporting data can be found in Tables S8 and S10.

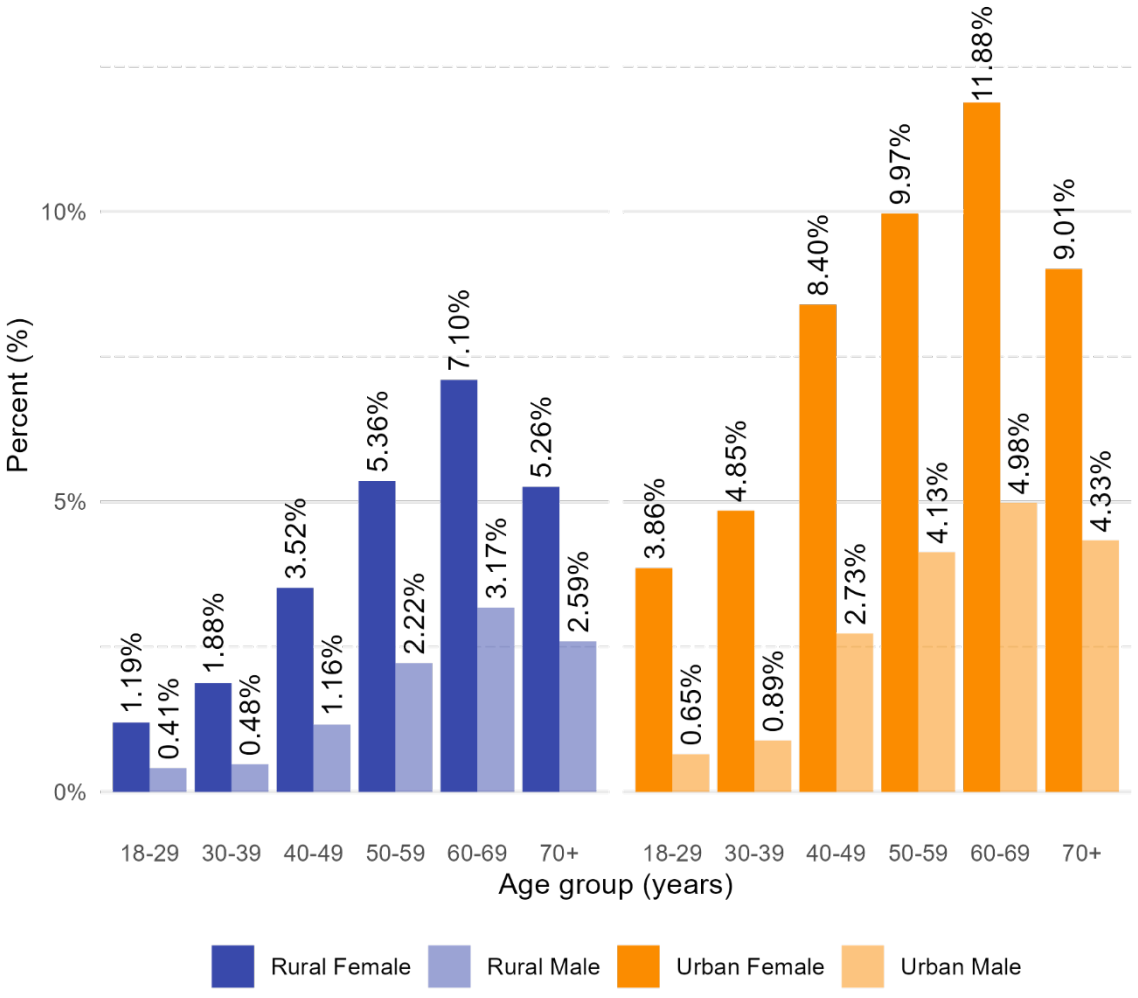


Rare autoimmune rheumatic disorders (RAIRDs)

We compared rural and urban dwellers who had relevant READ codes for rare autoimmune rheumatic disorders (RAIRDS), plus two or more prescriptions for at least one relevant conventional DMARD (methotrexate, sulfasalazine, hydroxychloroquine, leflunomide, azathioprine, mycophenolate) at any point between 1/1/2000 and 23/3/2020, see Appendix 2.

Rural dwellers were slightly more likely to have a READ code relating to RAIRDs in their electronic medical records (0.13% vs. 0.11%). Across all ages with RAIRDs, the proportion was significantly higher in rural and urban dwelling females, see Figure 13 below and Table S11, Appendix 5.

Figure 13. Proportional geographical distribution of RAIRD patients at index date in Wales, by age and sex



Rural dwellers with RAIRDs were more likely to have higher incomes and to be in the three least deprived quintiles (income domain) (77.94% vs 51.52%), see Table S12, Appendix 5.

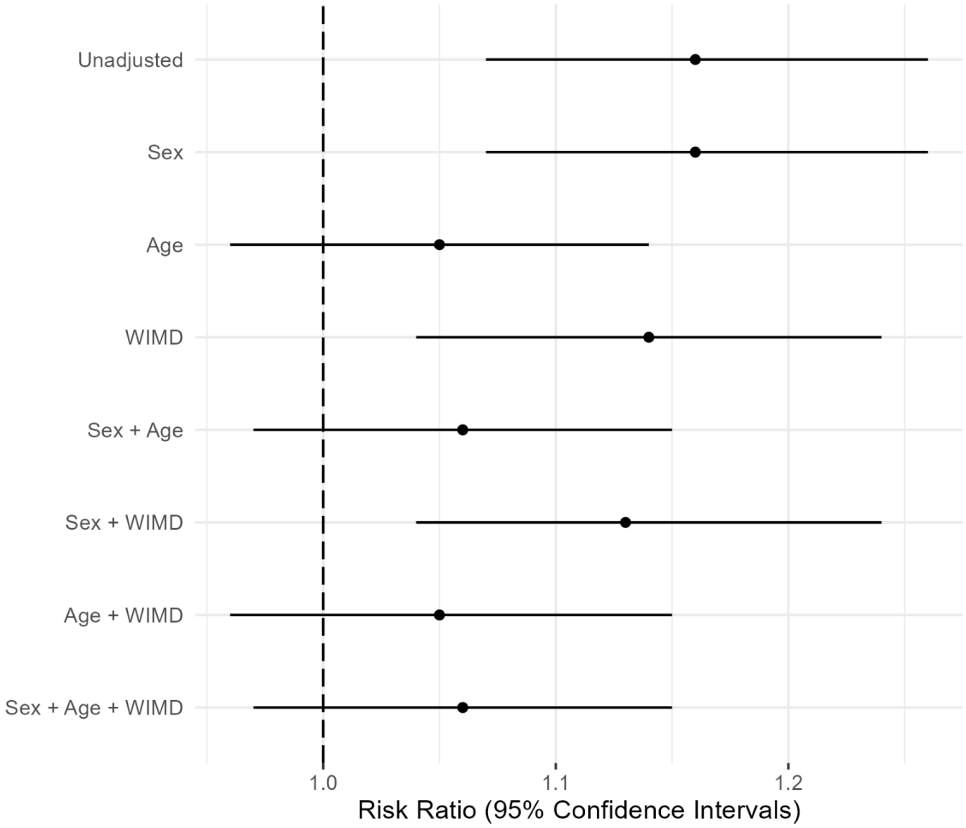
Living in a rural area was associated with a 16% higher risk of RAIRDs (RR_{unadj} 1.16, 95% CI: 1.07 to 1.26). However, after adjustment for age, sex and deprivation (income only domain of WIMD) (RR_{adj} 1.06, 95% CI: 0.97 to 1.15), the excess risk is disappears and is nearly all explained by age differences between urban and rural populations , see Table 16 and Figure 14.

Table 16. Risk of RAIRD in rural compared to urban settlements in Wales

Adjustment	Risk Ratio	95% Lower CI	95% Upper CI
Unadjusted	1.16	1.07	1.26
Sex	1.16	1.07	1.26
Age	1.05	0.96	1.14
WIMD	1.14	1.04	1.24
Sex + age	1.06	0.97	1.15
Sex + WIMD	1.13	1.04	1.24
Age + WIMD	1.05	0.96	1.15
Age + sex + WIMD	1.06	0.97	1.15

Urban is the reference category. Sex uses male as the reference category.

Figure 14. Relative risk of RAIRDs in rural and urban populations in Wales as of 1st July 2018



Baseline clinical characteristics of urban and rural dwellers with RAIRDs

Compared to urban dwellers, rural dwellers with RAIRDs were slightly more likely to be ex-smokers (11.73% vs 10.81%) and more likely to not drink alcohol (37.67% vs 33.26%) or drink alcohol within guidelines (32.80% vs 30.67%), see Table S12, Appendix 5. Almost 80% of both rural and urban populations with RAIRDs had at least one Charlson comorbidity at baseline, with 50.20% of rural dwellers and 48.70% of urban dwellers having three or more Charlson comorbidities. However, there was no difference in the risk of having at least one Charlson comorbidity between rural and urban RAIRD populations (RR_{unadj} 1.01 (0.97 to 1.05) which persisted after adjusting for age, sex, and income domain quintile of WIMD (RR_{adj} 1.00 (0.96 to 1.04), see Table S13, Appendix 5, and Figure 14 (a) below. Around 15% of both rural and urban populations had at least moderate frailty, but there was no difference between rural and urban dwellers (RR_{adj} 1.06 (0.89 to 1.27).

There was little overall difference between rural and urban populations in terms of specific co-morbidities at baseline: cardiovascular disease, cancer, dementia, respiratory disease, renal disease and serious infection. Rural dwellers with RAIRDs had proportionally more diabetes (3.08% vs 1.82%), osteoporosis (14.51% vs 11.90%) and hypothyroidism (34.10% vs 31.65%), and less hypertension (22.46% vs 26.56%), see Table S12, Appendix 5.

The rural RAIRD population had an increased risk of diabetes (with complications) (RR_{unadj} 1.69 (1.05 to 2.73) and hypothyroidism (RR_{unadj} 1.22 (1.01 to 1.48), which persisted after adjusting for age, sex, and income domain quintile of WIMD (RR_{adj} 1.72 (1.00 to 2.97) and RR_{adj} 1.21 (0.99 to 1.48), respectively), albeit with greater uncertainty around the estimates due to small numbers, see Table S12, Appendix 5, and Figure 14 (b) below.

Opiates were commonly prescribed with 26.24% and 29.94% of rural and urban RAIRD populations respectively having had at least one prescription of weak opiates in the 6 months prior to index date, and 35.69% of rural and 41.94% of urban populations prescribed a strong opiate, see Table S12, Appendix 5. Around 4% of both rural and urban populations were prescribed an NSAID. Following adjustment for age, sex, and income domain of the WIMD quintile, the rural RAIRD population had a lower risk of weak opiate prescription (RR_{adj} 0.89, (0.80 to 0.99)) in the 6 months prior to index date, see Table S13, Appendix 5.

Association between living in a rural areas and clinical characteristics and outcomes at 4-5 years after diagnosis

At 4-5 years after diagnosis, a total of 41 people had died (1.69% (n=17) in the rural and 1.25% (n=24) in the urban RAIRD populations, respectively. The proportion of both rural and urban populations with RAIRD and at least one Charlson comorbidity increased to around 90%, with 48% having three or more Charlson comorbidities, see Table S14 , Appendix 5. However, there was no difference in the risk of having at least one Charlson comorbidity between rural and urban RAIRD population (RR_{unadj} 1.02 (0.99 to 1.05), which persisted after adjusting for age, sex, and income domain quintile of WIMD (RR_{adj} 1.01 (0.98 to 1.04), see Table S15 , Appendix 5, and Figure 14 (b) below. The proportion of both rural and urban RAIRD populations with at least moderate frailty increased from around 15% to 28%, but there was no difference in risk of frailty between rural and urban dwellers (RR_{adj} 0.97 (0.86 to 1.09).

Whilst the overall burden of disease was high, there remained no significant overall difference between rural and urban RAIRD populations in terms of specific comorbidities: cardiovascular disease, cancer, respiratory disease and serious infection. However, rural dwellers with RAIRDs had proportionally slightly more diabetes with complications (4.35% vs 3.16%), renal disease (21.64% vs 19.58%), hypertension (43.68% vs 39.89%) and hypothyroidism (16.28% vs 13.53%), and less dementia (29.12% vs 32.42%), see Table S14, Appendix 5. The rural RAIRD population continued to have an increased risk of diabetes (with complications) (RR_{unadj} 1.38 (0.94 to 2.02) and hypothyroidism (RR_{unadj} 1.20 (1.00 to 1.44), which persisted after adjusting for age, sex, and income domain quintile of WIMD (RR_{adj} 1.33 (0.87 to 2.03) and RR_{adj} 1.19 (0.99 to 1.43), respectively), albeit with greater uncertainty around the estimates due to small numbers, see Table S15 , Appendix 5, and Figure 14 (b) below.

The proportion of rural and urban RAIRD populations having at least one prescription for non-steroidal anti-inflammatories (NSAIDs) in the last six months of the fifth year after index date increased to 10.62% and 12.84% respectively, see Table S14, Appendix 5. Weak opiates were still commonly prescribed (23.36% of rural and 27.32% of urban RAIRD populations respectively), with 5.16% of rural and 6.63% of urban dwellers prescribed strong opiates. Rural dwellers with RAIRDs had a lower risk of receiving a weak opioid prescription RR_{unadj} 0.86 (0.75 to 0.98), however, following adjustment for age, sex, and income domain of the WIMD quintile the risk was attenuated (RR_{adj} 0.92, (0.80 to 1.06)). There was no significant difference between rural and urban RAIRD populations in the risk of receiving an NSAID (RR_{adj} 0.89, (0.71 to 1.11)) or strong opiate prescription (RR_{adj} 0.83, (0.6 to 1.17)) in the last six months of the fifth year after index date, see Table S15, Appendix 5, and

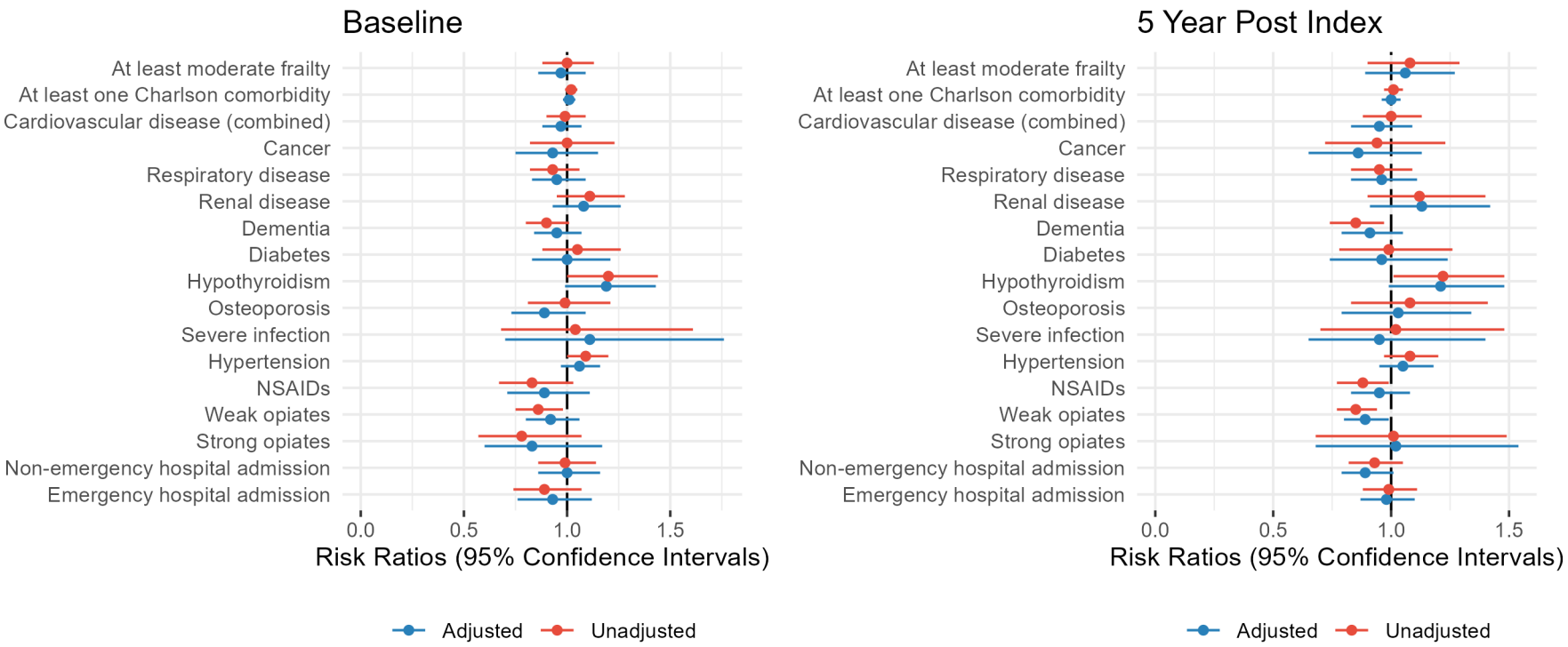
Figure 14 (b).

Healthcare use

In the year before index date, only 3.6% of both the rural and urban RAIRD populations had at least one GP event, however, 99% had an outpatient attendance. Over 80% had at least one hospital admission, with the rural population having slightly fewer (83.30%) than the urban population (85.91%). There was no difference in emergency hospital admissions between groups, see Table S12, Appendix 5. However, there were no significant differences between groups in the risk of GP events, outpatient visits, hospital admissions and emergency admissions, see Table S13, Appendix 5, and Figure 14 (a).

In the 4-5 years post-index date, around 81% of both the rural and urban RAIRD populations had at least one GP event. A slightly smaller proportion of the rural population had at least one outpatient attendance (75.53% vs 79.47%), hospital admission (31.95% vs 33.21%) and emergency hospital admission (14.56% vs 16.37%), see Table S14, Appendix 5. The rural RAIRD population had a slightly lower risk of outpatient attendances (RR_{unadj} 0.95 (0.91 to 0.99)) which persisted after adjustment for age, sex, and income domain of WIMD (RR_{adj} 0.96 (0.92 to 1.00)), albeit with some uncertainty around the estimate, see Table S15, Appendix 5, and Figure 14 (b).

Figure 15. Relationship between living in a rural area and health outcomes at baseline and 5 years post diagnosis for individuals in Wales with RAIRDs (a) at baseline (up to the day before RAIRD diagnosis) and (b) five years. The data can be found in Tables S13 and S15.



Access to specialist RMD services

The priorities of care survey highlighted several issues in accessing care, and those living in rural areas were more likely to report difficulties accessing care. We also found that rural dwellers with inflammatory arthritis were less likely to have an outpatient rheumatology appointment at 4-5 years post diagnosis. Whilst there may be several reasons for this e.g., appointment out with the timeframe or clinically stable, we hypothesised that time to access services may impact on healthcare use (and ultimately health outcomes).

At a population level in Wales we explored this further by measuring time and distance to access elective orthopaedic services and specialist rheumatology services. Furthermore, in people with inflammatory arthritis and RAIRDs who require long-term ongoing specialist care, we wanted to explore their healthcare use and whether longer travel times to access care was associated with reduced healthcare use, and for whom. To do this we:

(a) calculated travel time to orthopaedic and specialist rheumatology services at a population level, and for those with inflammatory arthritis and RAIRDs, time to access specialist services by car and bus.

(b) compared the socio-demographic and clinical characteristics of those with inflammatory arthritis and RAIRDs living greater or less than 60 minutes by car to specialist rheumatology services; and

(c) examined the relationship between travel time to specialist rheumatology services and the amount and type of healthcare use (GP, specialist outpatient attendances and hospital admissions) accessed at 0-1 and 4-5 years post diagnosis (index date).

How we did it

In addition to the methods described in 'Understanding individuals with RMDs – How we did it' to create and analyse the Wales datasets, we used geospatial computer models to calculate, for each household in Wales, access by car (travel time) and bus (travel time and number of changes) to nearest GP, pharmacy and hospital offering rheumatology and orthopaedic services. These were averaged across the lower layer super output area (LSOA) (around 1500 households) within the SAIL databank and included > 1.5 billion household level combinations for GPs, pharmacies and hospitals. We were not permitted to extract individual household level data from SAIL because of the risk of potential disclosure of individuals, therefore individual household data had to be averaged to the LSOA.

Statistical analysis

Descriptive statistics were used to describe the characteristics of each condition cohort and healthcare use, which was also stratified by time greater than 60 minutes to access specialist rheumatology services by car. Logistic regression models were used to quantify relationships between time to access specialist rheumatology services and health outcomes (including number comorbidities, frailty and health care use (GP event days, outpatient attendances, and elective and emergency admissions to hospital). These were adjusted for age, sex and WIMD quintile. Results are given as odds ratios (OR) with 95% CI. Missing data was treated as 'missing data' throughout the study.

All statistical analyses were conducted using R, version 4.1.3.

Travel time to orthopaedic and specialist rheumatology services in Wales

The requirements for access to specialist RMD services depends on the condition and individual care needs. For example, whilst most osteoarthritis is managed in primary care, joint replacement surgery is required for end-stage disease. This is provided by elective orthopaedic services and may require several appointments for assessment and a stay in hospital, followed by rehabilitation. In contrast, people with inflammatory arthritis and rare autoimmune

rheumatic conditions who are prescribed disease modifying medications require long term care within specialist rheumatology services.

The maps below illustrate the average travel times to hospitals providing elective orthopaedic and rheumatology services, by car and bus, for the general population of Wales. In the interactive geospatial tools (see Chapter 3), it is possible to see data at health board level down to individual building level. This illustrates that whilst the average travel time at health board level may be reasonably short, this can hide significant variation in travel times.

Figure 16. Car travel time to hospitals providing elective orthopaedic surgery (Wales). Individual household data, aggregated to LSOA level.

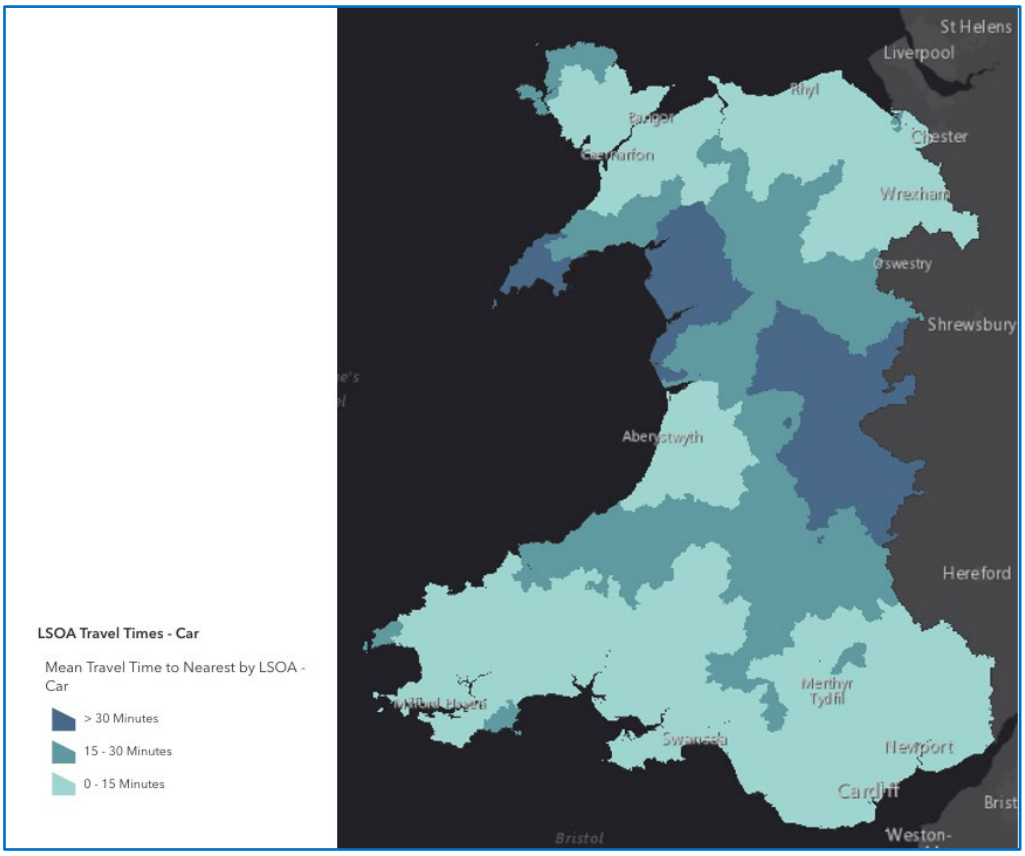


Figure 17. Bus travel time to hospitals providing elective orthopaedic surgery. Individual household data, aggregated to LSOA level.

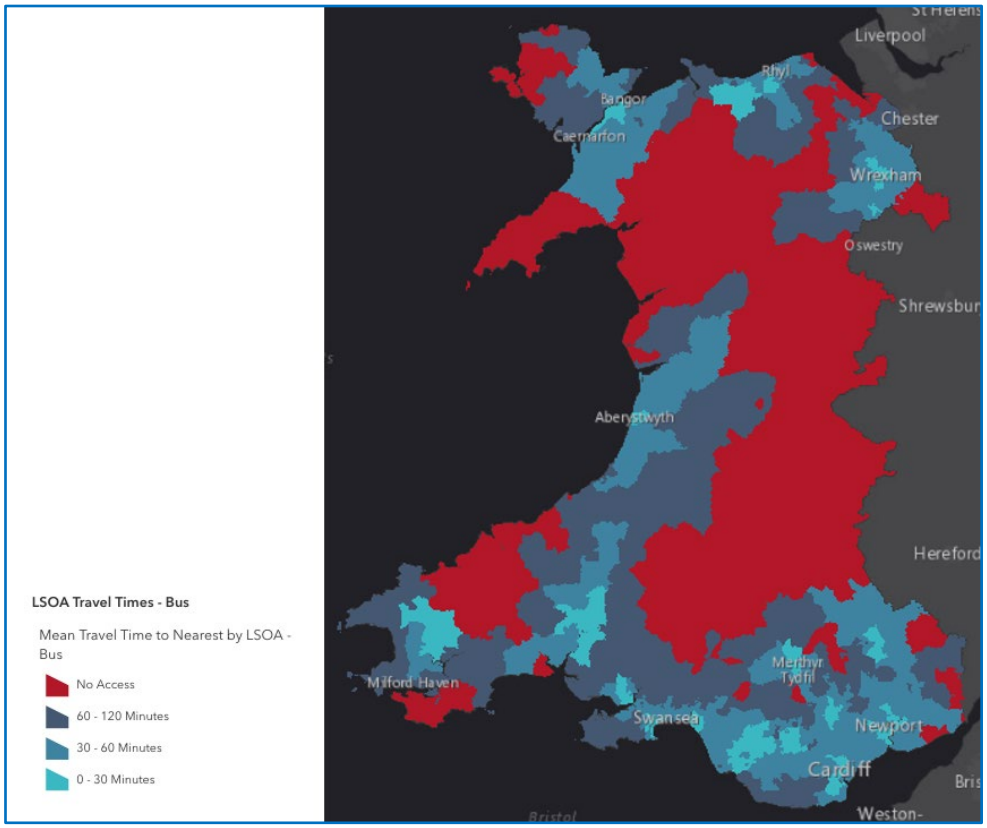


Figure 18. Car travel time to hospitals providing rheumatology services. Individual household data, aggregated to LSOA level.

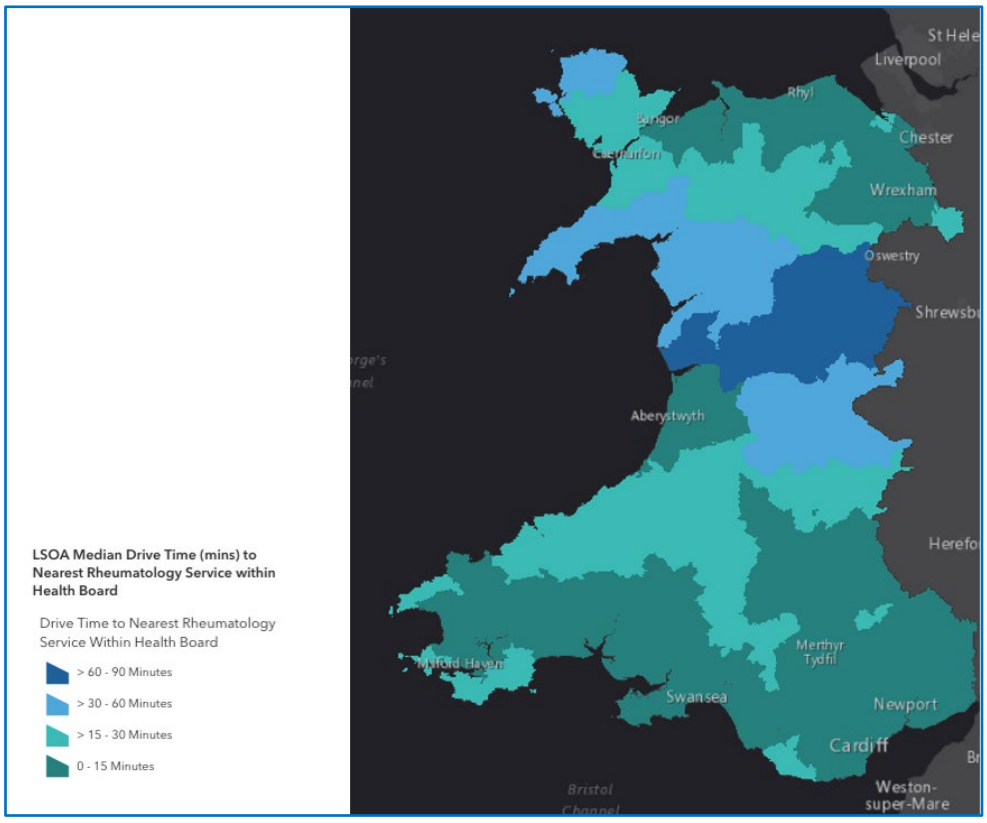
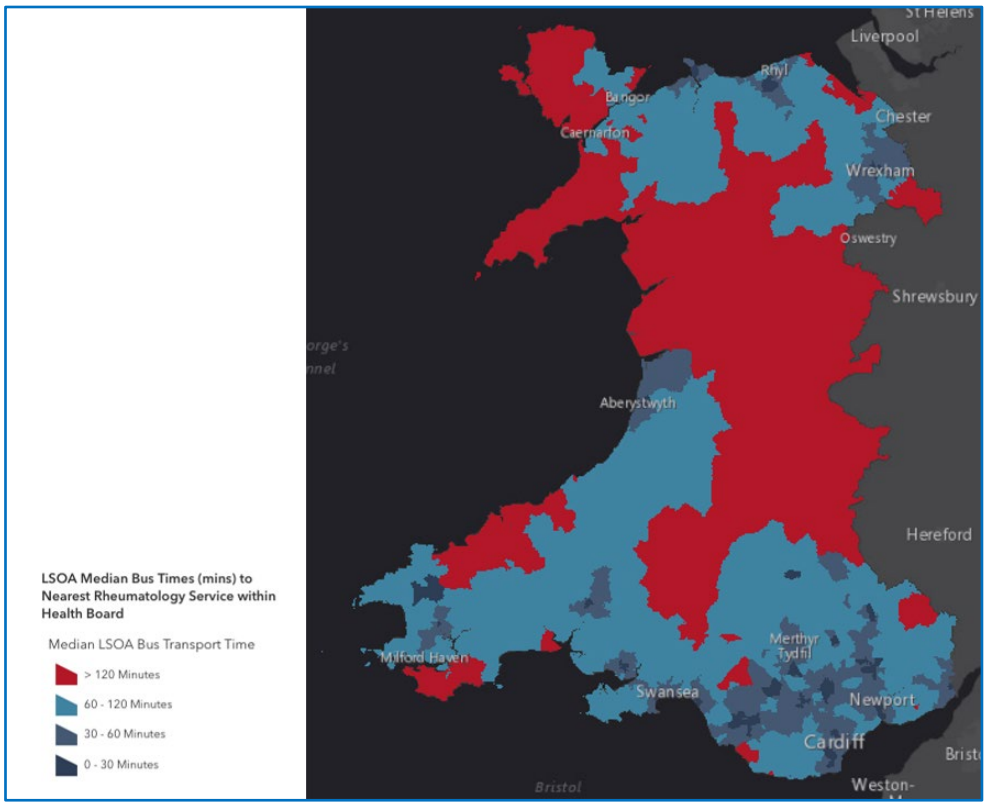


Figure 19. Bus travel time to hospitals providing rheumatology services. Individual household data, aggregated to LSOA level.

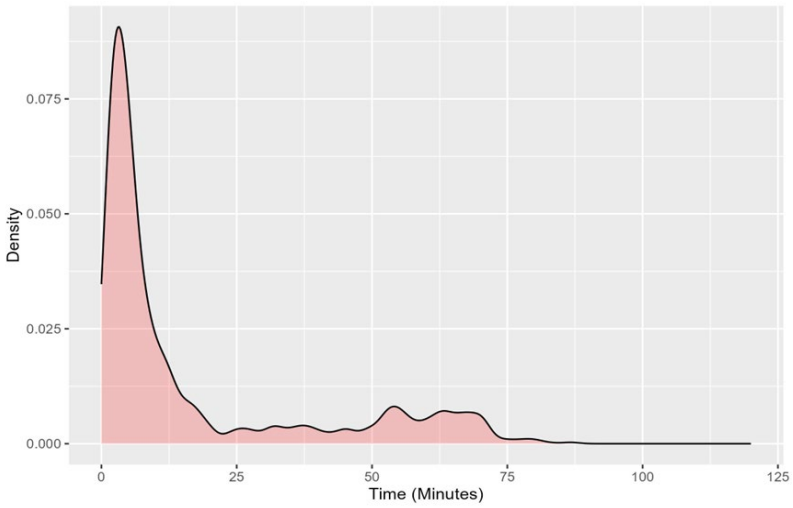


For people in Wales with inflammatory arthritis and RAIRDs, who require ongoing care from specialist services, we went onto examine travel times by car and bus, to their nearest specialist rheumatology services (acknowledging that this may not always reflect where they are cared for). Figure 20 below shows the results for those with inflammatory arthritis. The findings are almost identical for those with RAIRDs (see Appendix 6).

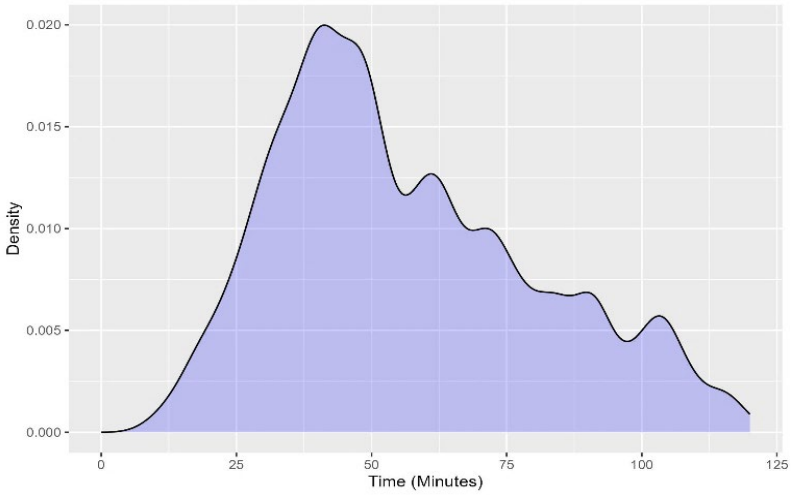
Whilst most people have car travel times within 30 mins of a rheumatology service, 19% of population in Wales do not have access to a car, although car ownership tends to be higher in rural areas (Office for National Statistics, 2023). We have previously shown that many older people rely on friends and family to access healthcare services (Hollick, R. J. et al., 2020a). For many people, bus journeys are long (around one hour) which presents significant challenge for people with limited mobility and multiple health issues. 12% of people with inflammatory arthritis and RAIRDs in Wales do not have access to specialist rheumatology services by bus within 2 hours.

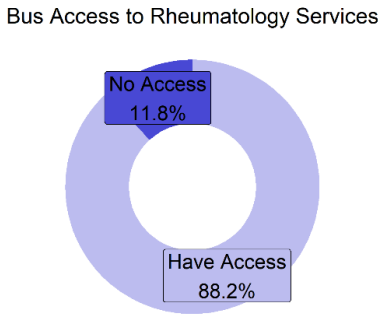
Figure 20. Travel time by (a) car and (b) bus to nearest Rheumatology services for people with inflammatory arthritis (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) in Wales.

(a) Car travel time to nearest Rheumatology services



(b) *Bus travel time to nearest Rheumatology services (no access = not accessible by bus or bus travel time > 2 hours).*





We then went onto explore the relationship between travel time to access specialist rheumatology services and health care use for those with inflammatory arthritis and RAIRDs.

Impact of travel time to rheumatology services on healthcare use in inflammatory arthritis

First, we compared the socio-demographic and clinical characteristics of those with inflammatory arthritis living greater or less than 60 minutes by car to their nearest specialist rheumatology services, see Table 17. Individuals with travel times less than 60 minutes were more likely to be in the 20-39 age group. In contrast a high proportion of those with travel times more than 60 minutes to specialist services were aged 60 years and above. Those with travel times of more than 60 minutes to their nearest specialist services were more likely to be in the least three least deprived quintiles (income domain) (63.4% vs 57.5%) and live in a rural area (68.0% vs 29.6%), specifically Hywel Dda and Powys health boards. However, 32% of those with travel times by car of more than 60 minutes were classified as living in an urban area, highlighting the fact that longer travel times to access healthcare is not exclusive to those living in rural communities. There was no difference in frailty between groups, however those with travel times of more than 60 minutes were more likely to have one or more Charlson comorbidity (73.2% vs 70.6%), with 23% having three or more comorbidities.

Table 17. Socio-demographic and clinical characteristics of individuals with inflammatory arthritis in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD), stratified by travel time by car less than and greater than 60 minutes to nearest specialist rheumatology service

Category		**Travel time by car < 60 mins to nearest specialist rheumatology service**	**Travel time by car > 60 mins to nearest specialist rheumatology service**
		% (n)	% (n)
Sex (female)		64.2 (10598)	67.0 (1094)
Age bands (years)	<=19	0.9 (145)	1.1 (18)
	20-29	3.8 (629)	3.0 (49)
	30-39	9.3 (1531)	7.6 (124)
	40-49	16.5 (2727)	17.0 (277)
	50-59	23.9 (3942)	22.1 (360)
	60-69	24.8 (4102)	25.8 (421)
	70-79	16.3 (2690)	18.6 (304)
	80+	4.6 (754)	4.9 (80)
Deprivation quintile	1 - Most deprived	20.8 (3435)	12.1 (198)
	2	21.7 (3584)	24.5 (400)
	3	20.5 (3385)	32.0 (522)
	4	18.1 (2991)	27.4 (448)
	5 - Least deprived	18.9 (3125)	4.0 (65)
Rural/urban classification	Rural	29.6 (4885)	68.0 (1111)
	Urban	70.4 (11635)	32.0 (522)

Health Board of residence	Abertawe Bro Morgannwg	16.4 (2710)	0 (0)
	Aneurin Bevan	21.8 (3594)	0 (0)
	Betsi Cadwaladr	23.3 (3849)	2.2 (36)
	Cardiff & Vale	13.8 (2273)	0 (0)
	Cwm Taf	12.6 (2077)	0
	Hywel Dda	9.0 (1481)	80.6 (1316)
	Powys	1.3 (217)	11.8 (192)
	Unable to classify	1.9 (319)	5.5 (89)
Frailty	Fit	55.5 (9165)	56.1 (916)
	Mild	34.3 (5666)	34.7 (567)
	Moderate	8.6 (1421)	8.1 (133)
	Severe	1.6 (268)	1.0 (17)
Comorbidities*	0	29.4 (4856)	26.8 (437)
	1-2	47.7 (7877)	49.9 (815)
	3+	22.9 (3787)	23.3 (381)

In terms of healthcare use, a greater proportion of those with **inflammatory arthritis** who lived > 60 mins away by car had no recorded rheumatology outpatient appointments **within the first year** (20.0% vs 11.3%) and at **4-5 years** (32.4% vs 21.1%) post index date, see Table 18 (a) and (b). Similarly, a smaller proportion of people who lived > 60 minutes away by car had 3 or more outpatient appointments within the **first year** (38.7% vs 50.0%) and **4-5 years** (25.8% vs 36.6%) post index date. Overall, those living > 60 minutes away by car had slightly more elective admissions and GP event days than those living within 60 minutes by car from their nearest specialist centre.

Table 18. Proportion of individuals with inflammatory arthritis in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) with 0, 1-2 and 3+ healthcare episodes (outpatient appointment, hospital admission or GP event) stratified by travel time by car less than and greater than 60 minutes to nearest specialist rheumatology service.

a) *in the first-year post index date*

		Travel time by car < 60 mins to nearest specialist service	**Travel time by car > 60 mins to nearest specialist service**
Health care use 0-1 years post index date*			
Outpatient appointment, % (n)	*Rheumatology*		
	0	11.3 (1738)	20.0 (308)
	1-2	30.9 (4820)	41.3 (634)
	3+	58.0 (9052)	38.7 (595)
	Other speciality		
	0	39.5 (6158)	43.3 (666)
	1-2	25.7 (4011)	25.0 (384)
	3+	34.9 (5441)	31.7 (487)
Hospital admissions, % (n)	*Emergency*		
	0	87.4 (13644)	88.5 (1360)
	1-2	11.3 (1762)	10.2 (157)
	3+	1.3 (204)	1.3 (20)
	Elective		
	0	81.5 (12727)	77.3 (1189)
	1-2	15.5 (2418)	18.6 (286)
	3+	3.0 (465)	4.0 (62)
GP event days*, % (n)			
	0	18.0 (2802)	14.8 (227)
	1-2	38.7 (6040)	35.8 (550)
	3+	43.4 (6768)	49.5 (760)

**GP event days = number of days on which any 'event' occurs their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

b) at 4-5 years post index date

		Travel time by car < 60 mins to nearest specialist service	Travel time by car > 60 mins to nearest specialist service
Health care use 4-5 years post index date*			
Outpatient appointment, % (n)	*Rheumatology*		
	0	21.1 (2356)	32.4 (372)
	1-2	42.4 (4734)	41.8 (480)
	3+	36.6 (4085)	25.8 (296)
	Other speciality		
	0	41.9 (4687)	40.8 (468)
	1-2	23.4 (2612)	25.0 (287)
	3+	34.7 (3876)	34.2 (393)
Hospital admissions, % (n)	*Emergency*		
	0	87.1 (9733)	87.7 (1007)
	1-2	11.7 (1302)	11.2 (129)
	3+	1.3 (140)	1.1 (12)
	Elective		
	0	79.4 (8876)	74.8 (859)
	1-2	17.0 (1903)	17.9 (205)
	3+	3.5 (396)	7.3 (84)
GP event days*, % (n)			
	0	26.2 (2931)	24.9 (286)
	1-2	38.6 (4310)	37.5 (430)
	3+	35.2 (3934)	37.6 (432)

**GP event days = number of days on which any 'event' occurs their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

Individuals with **inflammatory arthritis** who lived > 60 minutes away from a specialist rheumatology centre were half as likely to have at least one rheumatology outpatient appointment within the **first year post index date** (OR 0.48, CI 0.43 – 0.54), see Table 19 below. They remained less likely to have had a rheumatology outpatient appointment **at 4-5 years post index date** (OR 0.63, CI 0.55 – 0.73). They also had a greater likelihood of having any hospital admission within the first year (OR 1.28, CI 1.03 – 1.58) and at 4-5 years (OR 1.67, CI 1.35 – 2.04) post index date, driven by an increased likelihood of elective hospital admissions.

Table 19. Relationships between travel time by car greater than 60 minutes to nearest specialist rheumatology service and having at least one health care episode (outpatient appointment, hospital admission and GP event) at 0-1 and 4-5 years post index date for individuals with inflammatory arthritis in Wales. Logistic regression, adjusted for age, sex, deprivation (income only domain of WIMD), comorbidities, and frailty*

		Odds ratio	95% confidence interval
Health care use 0-1 years post index date*			
Outpatient appointments	*All*	0.57	0.51 – 0.64
	Rheumatology	0.48	0.43 – 0.54
	Other	0.88	0.78 – 0.99
Hospital admissions	*All*	1.28	1.03 – 1.58
	Emergency	1.03	0.62 – 1.61
	Elective	1.52	1.14 – 1.98
GP event days*		1.30	1.17 – 1.45
Health care use 4-5 years post index date*			
Outpatient appointments	*All*	0.80	0.71 – 0.91
	Rheumatology	0.63	0.55 – 0.73
	Other	0.98	0.86 – 1.11
Hospital admissions	*All*	1.67	1.35 – 2.04
	Emergency	0.80	0.42 – 1.40
	Elective	2.11	1.64 – 2.70
GP event days*		1.10	0.96 – 1.25

**GP event days = number of days on which any 'event' occurs their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

Impact of travel time to rheumatology services on healthcare use in RAIRDs

We compared the socio-demographic and clinical characteristics of those with RAIRD living more or less than 60 minutes by car to their nearest specialist rheumatology service, see Table 20 below. Individuals with travel times less than 60 minutes were more likely to be in the 20-39 age group. In contrast a high proportion of those with a travel time of more than 60 minutes were aged 60 years and above. Those with travel times more than 60 minutes to their nearest specialist rheumatology service were slightly more likely to be in the three least deprived quintiles (income domain) (63.2% vs 60.6%) and live in a rural area (68.4% vs 30.9%). However, as with inflammatory arthritis, 32% of those with RAIRDs with travel times by car of more than 60 minutes were classified as living in an urban area, highlighting the fact that longer travel times to access healthcare is not exclusive to those living in rural communities. In those living more than 60 minutes away, 58% had at least mild frailty compared to 50% of those living within 60 minutes of their nearest rheumatology service. Similarly, those with travel times of more than 60 minutes were slightly more likely to have one or more Charlson comorbidity (79.2% vs 77.8%), with 30.9% having three or more comorbidities.

Table 20 Socio-demographic and clinical characteristics of individuals with RAIRD in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD), stratified by travel time by car less than and greater than 60 minutes to nearest specialist rheumatology service

Category		**Travel time by car < 60 mins to nearest specialist rheumatology service**	**Travel time by car > 60 mins to nearest specialist rheumatology service**
		% (n)	% (n)
Sex (female)		72.75% (1976)	69.52% (187)
Age bands (years)	<=19	2.57% (71)	3.35% (9)
	20-29	5.26% (143)	3.72% (10)
	30-39	8.21% (223)	5.20% (14)
	40-49	15.46% (420)	15.99% (43)
	50-59	21.47% (583)	19.33% (52)
	60-69	26.62% (723)	27.14% (73)
	70-79	15.72% (427)	19.33% (52)
	80+	4.64% (126)	5.95% (16)
Deprivation quintile	1 - Most deprived	19.22% (522)	14.87% (40)
	2	20.18% (548)	21.93% (59)
	3	20.95% (569)	32.71% (88)
	4	18.63% (506)	24.16% (65)
	5 - Least deprived	21.02% (571)	6.32% (17)
Rural/urban classification	Rural	30.85% (838)	68.40% (184)

	Urban	69.15% (1878)	31.60% (85)
Frailty	Fit	49.63% (1348)	41.64% (112)
	Mild	36.45% (990)	40.15% (108)
	Moderate	11.86% (322)	14.87% (40)
	Severe	2.06% (56)	3.35% (9)
Comorbidities*	0	22.24% (604)	20.82% (56)
	1-2	49.08% (1333)	48.33% (130)
	3+	28.68% (779)	30.86% (83)

Compared to those who lived less than 60 minutes by car from their nearest specialist rheumatology service, a greater proportion of those with **RAIRDs** who lived more than 60 minutes away by car had no recorded rheumatology outpatient appointments within the **first-year post index date** (34.1% vs 27.6%), see Table 21.

Similarly, a smaller proportion of people who lived more than 60 minutes away by car had three or more outpatient appointments within the first year (34.5% vs 50.3%) post index date. Overall, those living more than 60 minutes away by car had slightly more emergency and elective admissions and GP event days than those living within 60 minutes by car from their nearest specialist centre.

We were unable to obtain data from the SAIL databank on healthcare use at 4-5 years post index date for individuals with RAIRDs, stratified by travel time, because of low numbers and concerns about disclosure.

Table 21. Proportion of individuals with RAIRDs in Wales (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) who have had 0, 1-2 and 3+ healthcare episodes (outpatient appointment, hospital admission or GP event) in in the first-year post index date, stratified by travel time by car less than and greater than 60 minutes to nearest specialist rheumatology service

Health care use 0-1 years post index date*		**Travel time by car < 60 mins to nearest specialist service**	**Travel time by car > 60 mins to nearest specialist service**
Outpatient appointment, % (n)	***Rheumatology***		
	0	27.6 (703)	34.1 (87)
	1-2	22.1 (563)	31.4 (80)
	3+	50.3 (1283)	34.5 (88)
	Other speciality		
	0	16.3 (416)	21.2 (54)
	1-2	19.0 (485)	20.0 (51)
	3+	64.7 (1648)	58.8 (150)
Hospital admissions, % (n)	***Emergency***		
	0	72.5 (1848)	69.4 (177)
	1-2	22.9 (584)	25.5 (65)
	3+	4.6 (117)	5.1 (13)
	Elective		
	0	64.1 (1633)	60.8 (155)
	1-2	25.1 (640)	24.7 (63)
	3+	10.8 (276)	14.5 (37)
GP event days*, % (n)			
	0	11.0 (280)	7.8 (20)
	1-2	29.7 (757)	27.5 (70)
	3+	59.3 (1512)	64.7 (165)

**GP event days = number of days on which any 'event' occurs their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

Individuals with **RAIRDs** who lived more than 60 minutes away from a specialist rheumatology service were half as likely to have at least one rheumatology outpatient appointment within the **first-year post index date** (OR 0.46, CI 0.34 – 0.64), see Table 22. There was a trend towards a greater likelihood of having at least one hospital admission but there was uncertainty around the estimates (OR 1.27, CI 0.92 – 1.72).

Table 22. Relationship between travel time by car greater than 60 minutes to nearest specialist rheumatology service and having at least one health care episode (outpatient appointment, hospital admission and GP event) at 0-1 post index date for individuals with RAIRDs. Logistic regression, adjusted for age, sex, deprivation (income only domain of WIMD), comorbidities, and frailty*

		Odds ratio	95% confidence interval
Health care use 0-1 years post index date*			
Outpatient appointments	*All*	0.46	0.34 – 0.64
	Rheumatology	0.51	0.39 – 0.67
	Other	0.73	0.56 – 0.96
Hospital admissions	*All*	1.27	0.92 – 1.72
	Emergency	1.06	0.56 – 1.85
	Elective	1.35	0.91 – 1.94
GP event days*		1.19	0.91 – 1.57

**GP event days = number of days on which any 'event' occurs their primary care record (e.g., examination, blood test, diagnosis code), excluding prescription codes.*

We have previously shown that in people with ANCA vasculitis (a group of RAIRD) who miss more specialist outpatient appointments have more emergency care episodes, highlighting the importance of regular care and support to attend appointments (James et al., November 16, 2024).

Understanding individuals with RMDs in Scotland

In Scotland, there is no national, anonymised primary care dataset, and access to primary care data requires working with a trusted third-party provider. This process demands written permission from individual GP practices, alongside reimbursement for their time, creating practical limitations on data collection. As a result, we initially focused on five health boards—Grampian, Highland, Orkney, Shetland, and the Western Isles—chosen to capture a range of urban, rural, and island healthcare settings.

How we did it

Using the same approach for Wales described above, all people alive and registered with consenting general practices across the five health boards with READ codes for relevant RMDs (see Appendix 2) from 1st January 2008 to 31st October 2022 were identified. Their primary healthcare records were then linked to national datasets for community and emergency care, hospital admissions, outpatient attendances, and prescribing via eDRIS. 1st January 2008 was chosen as the cohort start date as this is when the quality of primary care data in Scotland improved.

However, we encountered several issues which impacted on our ability to analysis the Scotland dataset as intended.

- There were significant delays in obtaining the Scotland data, largely because of the COVID-19 pandemic, as well as issues with the quality of primary care data extracted from the island health boards. The numbers of people coded with RMDs in primary care from the island health boards was very low, and the reasons for this were unclear as we know from clinical experience that there is a high burden of RMDs on the islands. Despite our best efforts, issues with the trusted third-party provider and limited diagnostic data from the island health boards, this could not be resolved.

- Furthermore, due to concerns about potential disclosure of individual information, the Public Benefits and Privacy Panel in Scotland would not allow us to measure at an individual level, the exact distance from postcode of residence to nearest specialist service. The trusted third-party provider of the primary care data was therefore asked to calculate distance (road miles) in bands (0-5; 6-10; 11-20; 21-30; 31-40; 41-50; > 50 miles) from home postcode to registered GP practice and nearest specialist centre providing elective orthopaedic and rheumatology services for all people identified as having an RMD. However, there was a lot of missing data and most people in Grampian and Highlands who lived outside the large urban conurbations had more than 50 miles to travel to access specialist services.

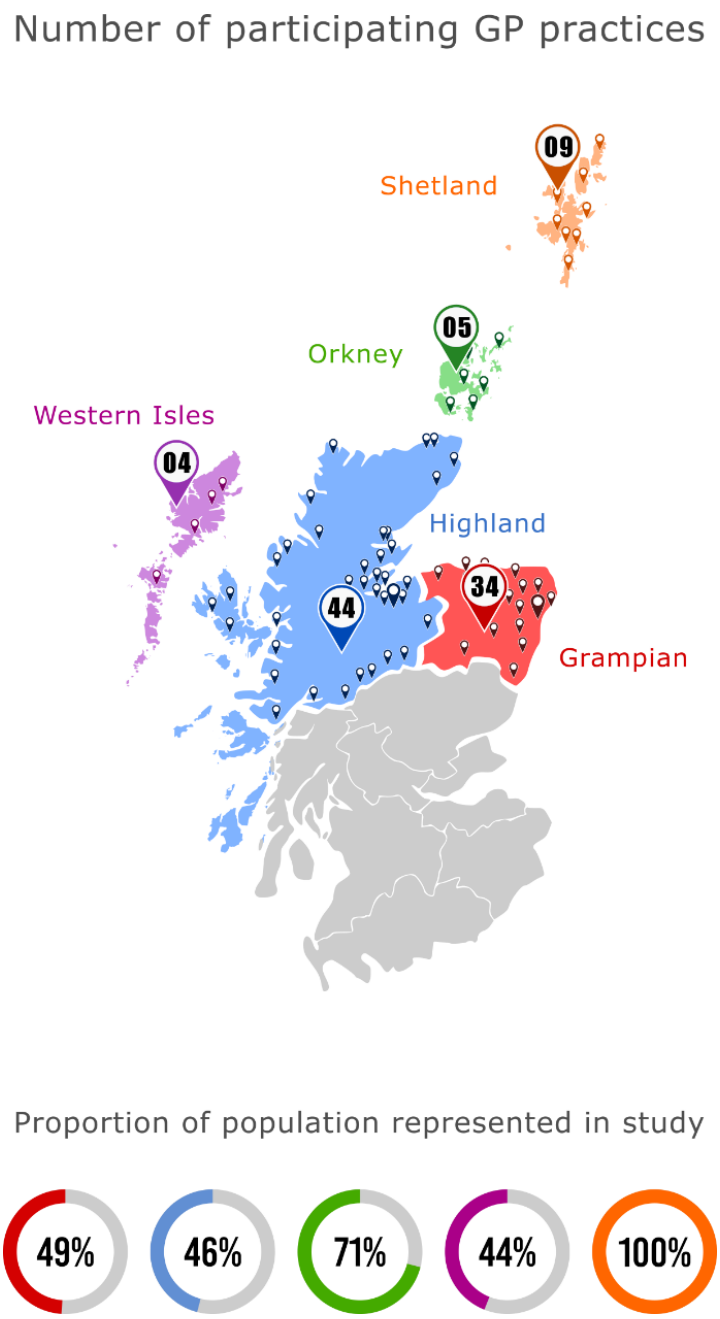
- The prescribing data that we were given was incomplete as we discovered that it excluded sulfasalazine, a commonly used DMARD in the treatment of inflammatory arthritis. This was due to a national issue with the community prescribing (PIS) dataset.

Therefore, for this report we excluded data from Orkney, Shetland, and the Western Isles due to the unresolved data quality issues. We were unable to create a sub-group of individuals with relevant READ codes for inflammatory arthritis and RAIRDs, plus prescriptions for relevant DMARDs, due to issues with the PIS dataset. It was also not possible to conduct a robust analysis of the relationship between travel distance and healthcare use with the current dataset. We focused instead on describing the prevalence and socio-demographic characteristic of people with RMDs in Grampian and Highland.

Grampian is organised into three Integrated Joint Boards (IJBs): Aberdeen City, Aberdeenshire, and Moray. Highland operates as a single IJB. These administrative divisions reflect how healthcare is delivered locally. The data presented here are limited to practices that granted permission, representing, on average, 50% of practices approached. Figure 21 shows the number of GP practices across the five health boards in Scotland that agreed to participate: Grampian (34); Highland (44); Orkney (5); Shetland (9) and Western Isles (4). Below that is the percentage of the population registered with a GP in each health board that this represents. The study population represents just under 50% of

the population of Grampian and the Highlands, recruited from a broad range of practices covering rural and urban communities.

Figure 21. Participating GP practices across 5 health boards in Scotland and percentage of population represented in study



The point prevalence was calculated on 1/7/2022 as the number of individuals alive and registered with a GP with relevant Read codes for osteoarthritis, inflammatory arthritis and RAIRDs, relative to the total number of people registered with participating GP practices (Public Health Scotland, 2020). Descriptive statistics were used to describe the characteristics of each condition cohort: age, sex, deprivation (Scottish Index of Multiple Deprivation) (Scottish Government, 2020) and geographical location. Missing data was treated as missing data throughout the study. All statistical analyses were conducted using R, version 4.1.3.

Approvals for data linkage were obtained from the Public Benefit and Privacy Panel for Health and Social Care, Scotland (1819-0286).

What we found

Prevalence of RMDs in Grampian and Highlands

Osteoarthritis

Within **NHS Grampian**, the prevalence of osteoarthritis was higher (around 10 per 100 people) in Aberdeenshire and Moray which have older, largely rural dwelling populations, compared to Aberdeen City (7 per 100 people), see Table 23.

In **NHS Highland**, the prevalence of osteoarthritis was around 11 per 100, see Table 23.

Whilst the overall prevalence of osteoarthritis was between 10-11% across participating practices in NHS Grampian and Highland, the prevalence was considerably higher in females (around 39%) and males (around 30%) over the age of 65 years, compared to around 2-4% in men and women aged 24-64 years, respectively, see Figure 22.

Inflammatory arthritis and RAIRDs

Within **NHS Grampian**, the prevalence of inflammatory arthritis was almost double in Aberdeenshire and Moray (2.5 per 100) compared to Aberdeen City (1.3 per 100). A similar pattern was seen with RAIRDs with a prevalence of 2.4 per 100 in Aberdeenshire and 2.9 per 100 in Moray, compared to 1.4 per 100 in Aberdeen City, see Table 23.

In **NHS Highland**, the prevalence of inflammatory arthritis and RAIRDs was 2.2 per 100 and 2.4 per 100 persons, respectively, see Table 23.

In females over the age of 65 years, the prevalence of inflammatory arthritis and RAIRDs was considerably higher at 5-7% and 6-8%, respectively. In females aged 24-64 years it was around 1-3%, see Figure 23.

Table 23. Prevalence of RMDs in NHS Grampian and NHS Highland

NHS Grampian		Osteoarthritis	Inflammatory arthritis*	RAIRD*
Aberdeen City	Number of individuals	9581	1682	1816
	Prevalence	7.1%	1.3%	1.4%
Aberdeenshire	Number of individuals	13709	3247	3123
	Prevalence	10.5%	2.5%	2.4%
Moray	Number of individuals	4296	1005	1181
	Prevalence	10.7%	2.5%	2.9%
NHS Highland		**Osteoarthritis**	**Inflammatory arthritis***	**RAIRD***
Number of individuals		9581	3443	1816
Prevalence		11.6%	2.2%	2.4%

** with relevant READ code only*

Figure 22. Prevalence of osteoarthritis in those 24-65 years and > 65 years in NHS Grampian (Aberdeen City, Aberdeenshire and Moray) and NHS Highland

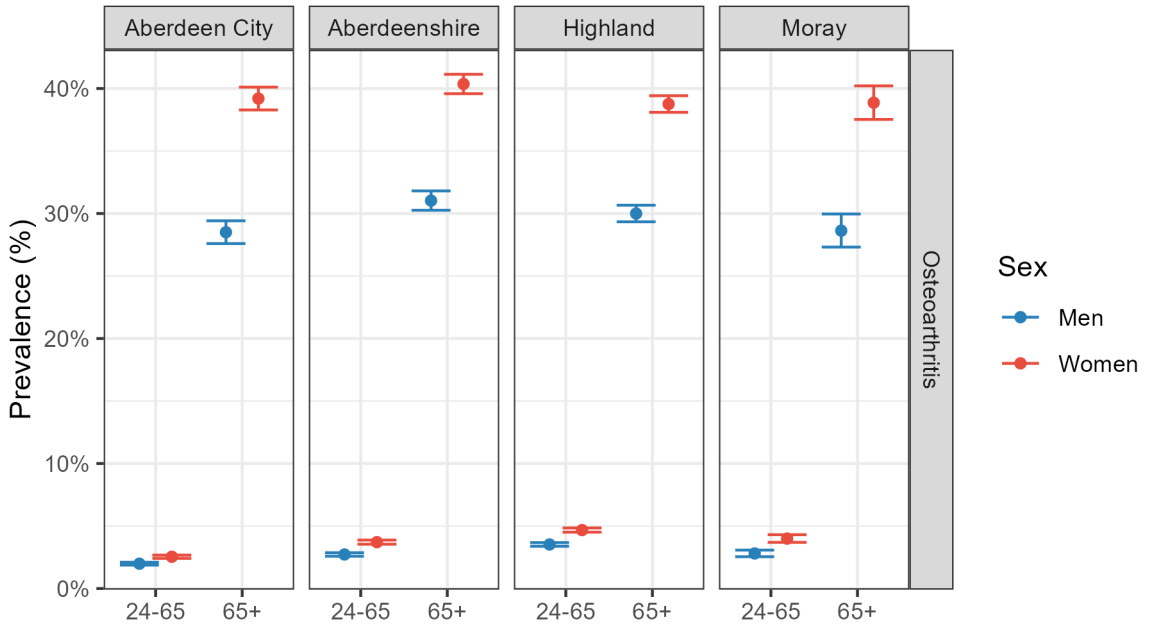
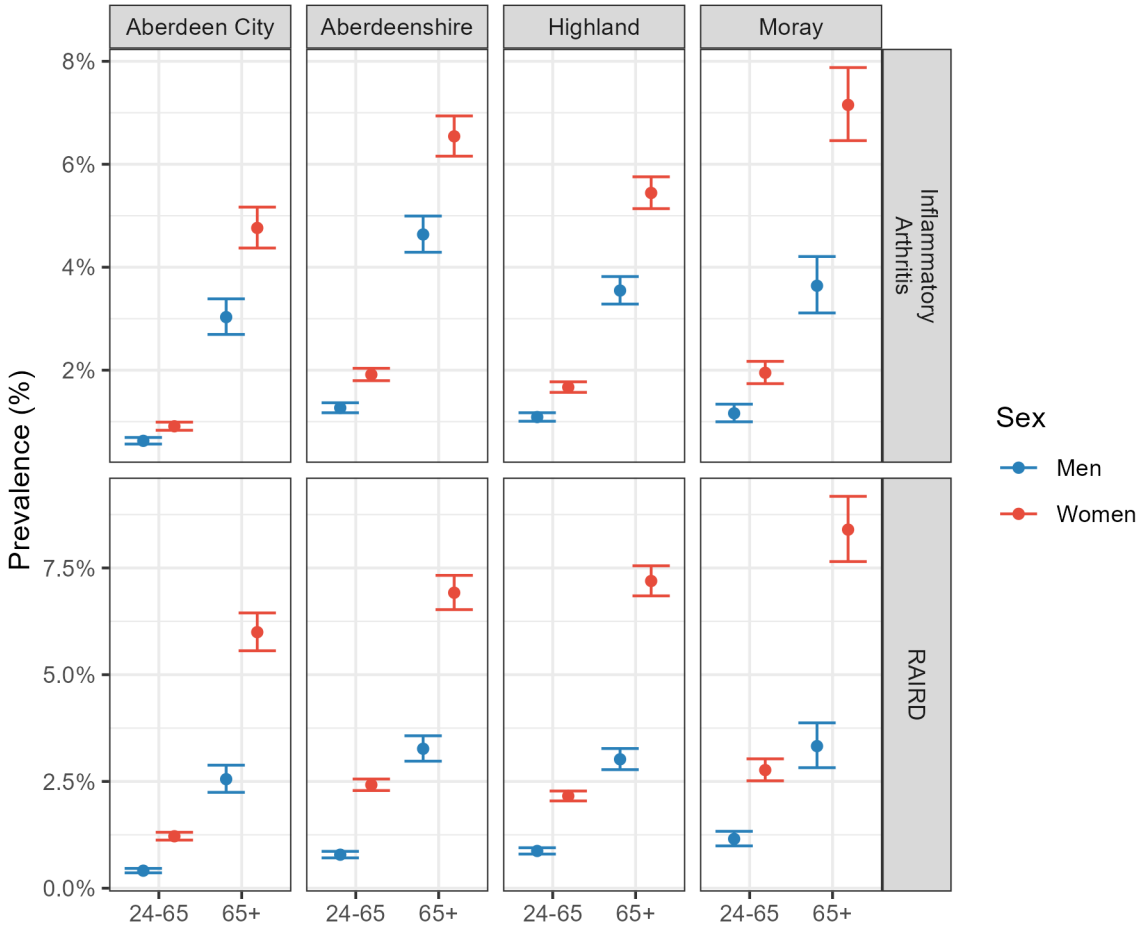


Figure 23. Prevalence of inflammatory arthritis and RAIRDs in those 24-65 years and > 65 years in NHS Grampian (Aberdeen City, Aberdeenshire and Moray) and NHS Highland



Comparison with RMD prevalence estimates from the literature

Our figures for osteoarthritis are in keeping with prevalence estimates from the literature (see Overview of prevalence of RMDs in Wales above). Our prevalence estimates for inflammatory arthritis and RAIRDS in Aberdeenshire, Moray and Highlands are slightly higher, however, these represent individuals with relevant READ codes only and may therefore overestimate the prevalence. In saying that these areas have an older population in whom the prevalence of inflammatory arthritis and RAIRDs is higher.

Sociodemographic characteristics of people with RMDs

Osteoarthritis

In Grampian and Highlands, the median age of the osteoarthritis population was 73-74 years, around 7 and 10 years older, respectively, than that of the inflammatory arthritis and RAIRD populations, see Table 24 - 26, and Table 27 (Aberdeen City, shire, Moray and Highlands).

Over two thirds of the osteoarthritis population were in the three least deprived quintiles, rising to more that 80% in Aberdeenshire and Moray. However, it is important to note that area-based measures of deprivation can overlook hidden deprivation within rural communities.

Just under a half of the population with osteoarthritis living in Aberdeenshire (46%) and Moray (47%) live in a rural area, rising to 54% in the Highlands.

Inflammatory arthritis and RAIRDs

In Grampian and Highlands, the median age of the inflammatory arthritis and RAIRDs population was around 64-66 years, see Table 24 - 27 (Aberdeen City, shire, Moray and Highlands).

@Over two thirds of the inflammatory arthritis population were in the three least deprived quintiles, rising to more than 80% in Aberdeenshire and Moray.

Fifty percent of the population with inflammatory arthritis living in Aberdeenshire and 41% in Moray live in a rural area, rising to 53% in the Highlands. Just under a half of the population with RAIRD living in Aberdeenshire (47%) and Moray (43%) live in a rural area, rising to 55% in the Highlands.

Understanding how many people there are with RMDs in each geographical area and their age distribution is important when planning services, particularly as currently specialist rheumatology services in Grampian are based in Aberdeen City. The Grampian Rheumatology service has one outreach clinic in Moray per month. The Highland Rheumatology service currently has a unit in Dingwall, 11 miles north of Inverness which has five beds, offering inpatients multi-disciplinary rehabilitation care, including physiotherapy, occupational therapy, and hydrotherapy at the adjacent Puffin Pool. It also provides outpatient rheumatology clinics, specialist nurse clinics, and a biologic infusion suite. The Dingwall unit is very important to patients for delivering specialised care in musculoskeletal conditions, improving access to treatments for people living across a wide geographical area, enhancing patient education, and supporting well-being in an area with limited community-based healthcare resources. However, its future is under threat due to insufficient funding to maintain the current hospital premises, and NHS Highland are increasingly prioritising care at home over hospital-based treatment.

Table 24. Socio-demographic characteristics of people with RMDs in Aberdeen City

Characteristic		RMD		
		Osteoarthritis	**Inflammatory arthritis**	**RAIRD**
		n=9581	n=1682	n=1816
Age in years (95% percentiles)		73 [46.5 | 96.8]	64.4 [28.4 | 96.3]	64.8 [24.8 | 93.2]
		% (n)	% (n)	% (n)
Sex (female)		59.80 (5729)	61.20 (1029)	73.50 (1335)
Deprivation quintile	1 - Most deprived	8.60 (823)	10.3 (173)	7.5 (137)
	2	20.72 (1985)	22.77 (383)	20.59 (374)
	3	17.91 (1716)	15.93 (268)	17.13 (311)
	4	14.78 (1416)	14.92 (251)	15.75 (286)
	5 - Least deprived	38 (3641)	36.09 (607)	38.99 (708)
Rural/urban classification	Rural	1.83 (175)	1.55 (26)	2.26 (41)
	Urban	97.32 (9324)	96.91 (1630)	96.42 (1751)

Table 25. Socio-demographic characteristics of people with RMDs in Aberdeenshire

Characteristic		RMD		
		Osteoarthritis	**Inflammatory arthritis**	**RAIRD**
		n=13709	n=3247	n=3123
Age in years (95% percentiles)		74.17 [49.25 | 106.08]	65.33 [29.18 | 98.74]	64.25 [27.33 | 94.5]
		% (n)	% (n)	% (n)
Sex (female)		58.79 (8060)	60.46 (1963)	72.81 (2274)
Deprivation quintile	1 - Most deprived	3.70 (507)	4.93 (160)	3.49 (109)
	2	10.37 (1422)	9.70 (315)	8.84 (276)
	3	23.75 (3256)	21.22 (689)	22.99 (718)
	4	33.38 (4576)	41.33 (1342)	34.93 (1091)
	5 - Least deprived	28.80 (3948)	22.82 (741)	29.75 (929)
Rural/urban classification	Rural	46.24 (6339)	50.35 (1635)	46.88 (1464)
	Urban	53.39 (7319)	49.00 (1591)	52.55 (1641)

Table 26. Socio-demographic characteristics of people with RMDs in Moray

Characteristic		RMD		
		Osteoarthritis	Inflammatory arthritis	RAIRD
		n=4296	n=1005	n=1181
Age in years (95% percentiles)		74 [49.49 | 100.5]	65.83 [31.41 | 98]	64.41 [24.96 | 93.12]
		% (n)	% (n)	% (n)
Sex (female)		60.34 (2592)	66.37 (667)	72.65 (858)
Deprivation quintile	1 - Most deprived	2.21 (95)	2.79 (28)	3.47 (41)
	2	13.13 (564)	15.92 (160)	13.04 (154)
	3	28.33 (1217)	25.57 (257)	23.12 (273)
	4	42.88 (1842)	43.18 (434)	44.79 (529)
	5 - Least deprived	13.45 (578)	12.54 (126)	15.58 (184)
Rural/urban classification	Rural	47.35 (2034)	41.00 (412)	42.85 (506)
	Urban	51.79 (2225)	57.91 (582)	56.22 (664)

Table 27. Socio-demographic characteristics of people with RMDs in Highland

Characteristic		RMD		
		Osteoarthritis	Inflammatory arthritis	RAIRD
		n=18479	n=3443	n=3870
Age in years (95% percentile)		72.75 [48.83 | 92]	65.75 [29.09 | 89.25]	66.21 [27.75 | 90.25]
		% (n)	% (n)	% (n)
Sex (female)		58.56 (10822)	61.84 (2129)	71.96 (2785)
Deprivation quintile	1 - Most deprived	6.33 (1169)	6.59 (227)	6.20 (240)
	2	15.41 (2847)	17.72 (610)	14.94 (578)
	3	38.41 (7097)	38.48 (1325)	39.04 (1511)
	4	32.18 (5946)	31.05 (1069)	33.07 (1280)
	5 - Least deprived	7.68 (1420)	6.16 (212)	6.74 (261)
Rural/urban classification	Rural	54.39 (10051)	53.01 (1825)	55.09 (2132)
	Urban	44.87 (8291)	46.09 (1587)	43.90 (1699)

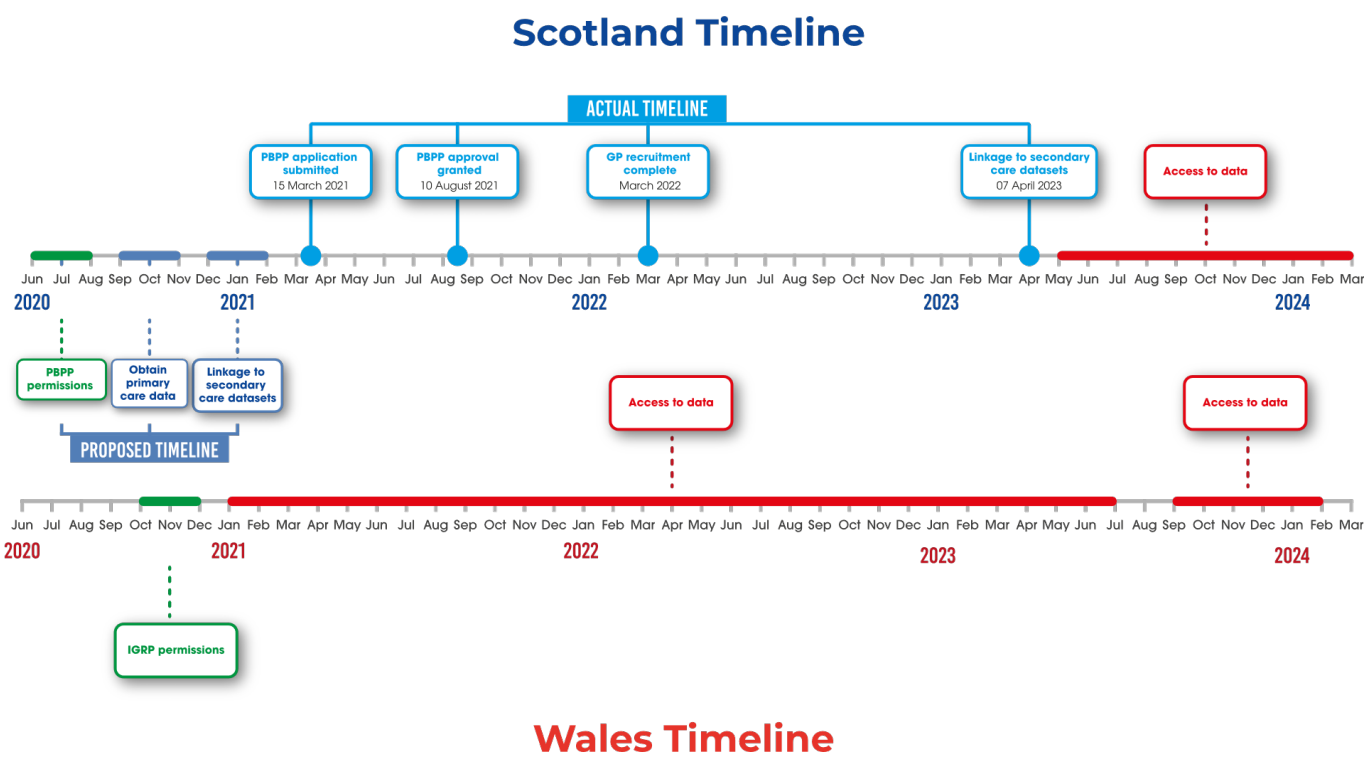
What challenges did we encounter?

Access to administrative healthcare data

The process of accessing and extracting the administrative health data in Scotland and Wales was very different, each with their benefits and downsides. Whilst primary care data for 85% of the Welsh population is available within SAIL for linkage to a range of other national datasets, access to primary care data in Scotland was via a trusted third-party supplier. This required individual practice consent and creation of a highly curated, bespoke dataset. This had advantages, but the process was laborious and time-consuming taking years to create, which going forward represents a major block in terms of reproducibility and scaling. Furthermore, there was no data catalogue or metadata for the primary care dataset in Scotland.

In contrast, the established dataset within SAIL enabled timely access, but there was no option to include bespoke variables. This is reflected in significant differences between the proposed and actual timelines to create the datasets in Scotland and Wales, see Figure 24.

Figure 24. Comparison of proposed and actual timelines between Scotland and Wales



Quality of recording of diagnosis, prescriptions and health care use

Whilst primary care records offers advantages like broad population coverage and longitudinal data, there are well-documented issues with **the completeness and quality of data** (Ferguson et al., 2019; Jordan, K. P. et al., 2010, 2014; Khan et al., 2010b; Scottish Government, 2020; Zghebi et al., 2022)**.** These include variability in diagnostic coding, incomplete records and demographic biases. For example, conditions such as osteoarthritis are often under coded or misclassified due to non-specific presentations and inconsistent documentation. Data is collected in primary care for the purpose of running the practice and delivering care, not for research or service planning, and how this is done varies between practices. The use of specific codes (diagnostic or symptom based) and the way data is recorded varies from practice to practice. Validation studies and algorithms combining diagnostic codes, prescriptions, and referrals can improve reliability, although the accuracy varies across different conditions. However, it is important to note that we do not have data on biologic therapy which is prescribed in secondary care, therefore missing individuals who are on biologic therapy only (without conventional DMARDs). Nevertheless, the prevalence and demographics of the RMD cohorts we identified in Wales were overall in keeping with the published literature, see Overview of prevalence of RMDs in Wales above.

In Scotland, the numbers of people coded with RMDs in primary care from the island health boards was very low, and the reasons for this were unclear. There was no formal process by which we could investigate this with the trusted third-party provider after delivery of the dataset. We experienced significant difficulties in engaging with the trusted third-party provider (TTP) to answer queries and explore gaps identified. Despite our best efforts we were unable to engage with the TTP to resolve the issue. It is also worth noting that whilst we selected health boards with a diverse geographical areas and access to care, rural areas in southern Scotland, with differing characteristics, were not included in this study.

It was difficult to describe healthcare use in primary care because of variability in recording data and additional learning needed around methodology. For example, individual GP appointments were not necessarily recorded in an individual's health record, rather the outcome of a consultation such as a prescription. It was only possible to quantify with certainly the number of primary care episodes (which could be a visit, prescription, blood test, call for text results etc) and the number of days per year on which these occurred.

Coding from secondary care records can also be missed in primary care. For example, in Wales we found people who had joint replacements coded in primary care which were not coded in national datasets and vice versa. Some of these people lived in health boards that bordered England, and so the surgery could have taken place there, or in the private sector, and therefore not recorded in NHS Wales datasets. Understanding these 'border issues' is important when interpreting the data. It is also important to apply caution when using area-based measures of health determinants such as deprivation to explore geographical inequalities in health outcomes, which can underestimate deprivation in rural communities. This highlights the importance of understanding local data collection and potential gaps when interpreting data for service planning and resource allocation to support the local population.

Data extraction

Extracting information about people living in small geographical areas from anonymised national datasets can be difficult due to lower numbers of people and concerns about the potential risk of identification of individual patients. Similar problems were encountered when looking at less common rheumatic conditions, and it was not possible to conduct a stratified analysis by small geographical area in some instances. This highlights a wider issue of balancing potential risks of disclosure with the value of geo-spatial analysis to inform effective person and place-based planning of services.

Outcome data

Whilst joint replacement data was available as a crude outcome measure for those with RMDs, administrative health datasets do not contain condition specific outcome measures. We included healthcare use as an important outcome. However, as described above there are specific challenges with measuring healthcare use in primary care and we

were only able to record ‘GP events’ which may represent an appointment, a prescription, a blood test. Similarly, it is not possible to capture ‘cross-border care’ or that undertaken in the private sector. It is also important to note the methodological issues when examining geospatial differences in health outcomes. For example, area-based measures of deprivation, which are more effective in identifying concentrated poverty in urban areas, often fail to capture the more dispersed patterns of deprivation in rural communities (McCartney et al., 2023).

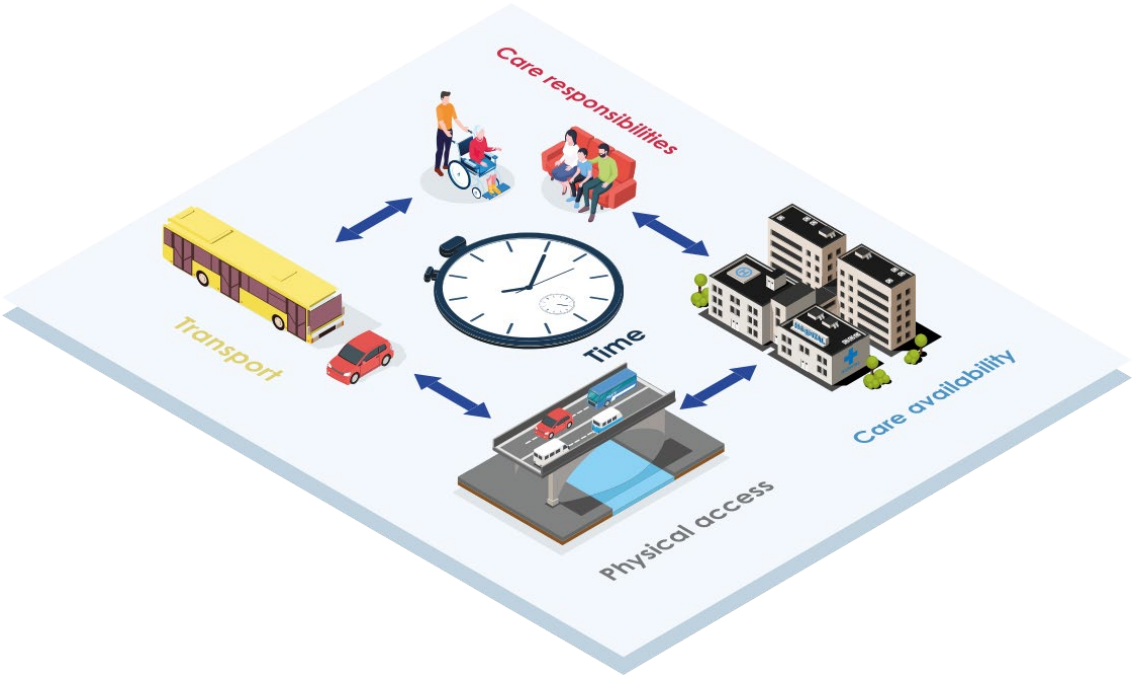
Summary and implications

Summary

In Wales, osteoarthritis, inflammatory arthritis and RAIRD were more prevalent in rural populations, but this was largely be accounted for by differences in population demographics. Similarly, in Scotland, prevalence rates of RMDs were higher in rural areas such as Aberdeenshire and Moray compared to urban areas like Aberdeen City, reflecting demographic patterns.

Overall, there was little difference in co-morbidities between rural and urban populations in Wales with RMDs at index date and 4-5 years following index date, however, people with RMDs had a high burden of comorbidities and frailty, particularly inflammatory arthritis and RAIRDs, underscoring the need for integrated, multidisciplinary care models. Rural dwellers with osteoarthritis and inflammatory arthritis were more likely to have undergone hip replacement surgery.

Travel time appeared to significantly affect healthcare access and outcomes for inflammatory arthritis and RAIRDs in Wales. Individuals living more than 60 minutes by car from a rheumatology centre were half as likely to have at least one outpatient rheumatology appointment within the first year and remained less likely at 4–5 years post-index date. Longer travel times were associated with increased hospital admissions, especially elective admissions. For those relying on public transport, bus journeys often exceeded two hours, creating barriers for people with mobility and health challenges. We have previously shown that for people with ANCA-associated vasculitis, missing specialist outpatient appointments is associated with more emergency care episodes, highlighting the importance of regular follow up for those with complex multi-system RAIRD.



Implications

We faced several challenges in accessing and analysing routinely collected healthcare data, and information governance concerns around geospatial analysis of the data limited the granularity of findings in some instances. This is important to address when considering the future development of sustainable tools to inform service planning. Furthermore, when interpreting the findings to inform service planning it is important to consider the limitation of routinely collected healthcare data, including incomplete or missing data and underrepresentation of certain populations and health outcomes. There are also specific methodological issues to consider when exploring geo-spatial inequities in health, particularly the use of area-based measures of deprivation.

A deep understanding of the local context from patients, carers and professionals, alongside the information gathered from routine health care data provides important insights grounded in patient experience to better support service planning. For example, the data told us that there are differences in healthcare use depending on time to access care for those with inflammatory arthritis and rare rheumatic conditions, but not why. The survey and interview findings provide useful insights to help us understand this better, for example, lack of awareness of services, information not in an accessible format, issues with caring responsibilities, work commitments and reliance on friends and family to access care.

There is a need for further robust, mixed method work, combining routinely collected healthcare data with condition specific outcome measures, alongside the ability to conduct a more granular geographical analysis to fully understand this. However, this is challenging due to small numbers, particularly with rarer conditions, and information governance issues around the potential for disclosure of individual level health information.

Developing interactive geo-spatial tools to support service planning and evaluation

Key messages

We have created a series of interactive tools based on actual as opposed to estimated prevalence of RMDs in Scotland and Wales. These provide important insights to support service planning and compliments the existing extrapolated estimated planning tools such as the MSK calculator. Whilst a more limited set of maps were created using the available data in Scotland, these serve as a prototype for what could be achieved with improved access to data and the findings have already been used to inform discussions about regional service planning.

Deep local contextual knowledge is important to make sense of the data and use it for planning, in particular what the data can and cannot tell us. This includes understanding which groups of people are potentially under-represented and to understand how local parts of the health care system work. The maps are intended as a starting point for discussion to help inform local, regional and national service planning.

How we did it

Wales

Using the prevalence data described in Chapter 3 – Understanding individuals with RMDs in Wales above, we mapped how many people we identified with osteoarthritis, inflammatory arthritis and rare rheumatic conditions, and the number of individuals who have had a joint replacement (count and percentage prevalence), in each health board and primary care cluster across Wales.

We also mapped the prevalence of RMDs in relation to area-based measures of deprivation (income component of the Welsh Index of Multiple Deprivation (WIMD) and geography (living in a rural or urban area).

We examined the prevalence of RMDs in the working age population (18 to 65 years old) and those over the age of 65 years, to help target support for those who wish to work.

Finally, we visually compared estimated travel times by car and public transport to the nearest hospitals providing elective orthopaedic care and specialist rheumatology services in Wales at Health Board and Lower Super Output Area (LSOA) levels (a small census area comprising of around 1500 households) to help to understand the potential impacts of rural access.

Scotland

In Scotland, using the data in Chapter 3 – Understanding individuals with RMDs in Scotland above, we were able to create more limited maps which highlighted the prevalence and sociodemographic characteristics of people with RMDs in participating general practices in Highland and Grampian health boards (and within Grampian, across Aberdeen City, Aberdeenshire and Moray integrated health and social care boards).

What we built

Wales StoreyMaps

We combined this information into a series of interactive maps to support local, regional and national service planning in Wales. The maps are freely available online at the links below:

RHEUMAPS Wales: Osteoarthritis (arcgis.com)

RHEUMAPS Wales: Inflammatory Arthritis (arcgis.com)

RHEUMAPS Wales: Rare autoimmune rheumatic disorders (arcgis.com)

Scan to open on your phone

Osteoarthritis

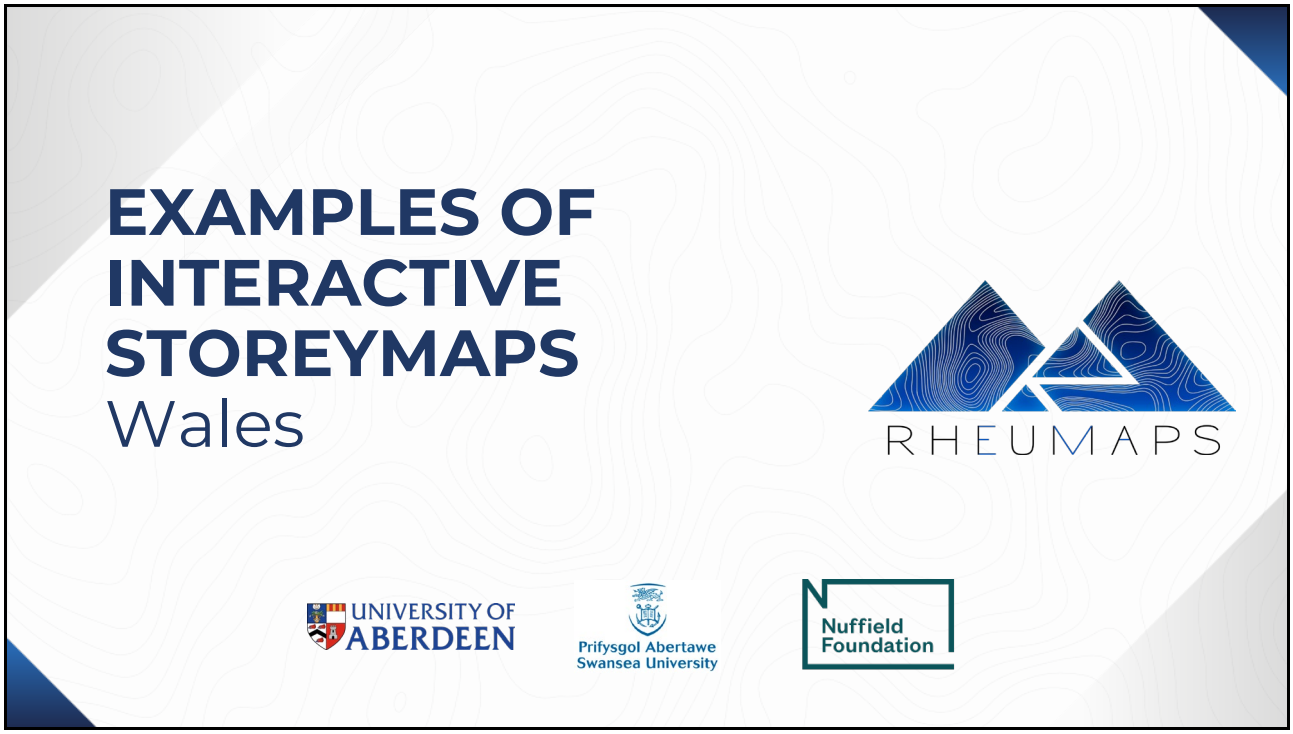
Scan to open on your phone

Inflammatory arthritis

Scan to open on your phone

Rare autoimmune rheumatic disorders

The following slideshow illustrates some of the features of the interactive maps created for Wales. Please **click on the image below to open the presentation**. However, the live interactive maps (see links above) enable you to drill down into more detailed information for each area such as health board or primary care cluster.



Click the image above to open a slideshow of interactive map examples

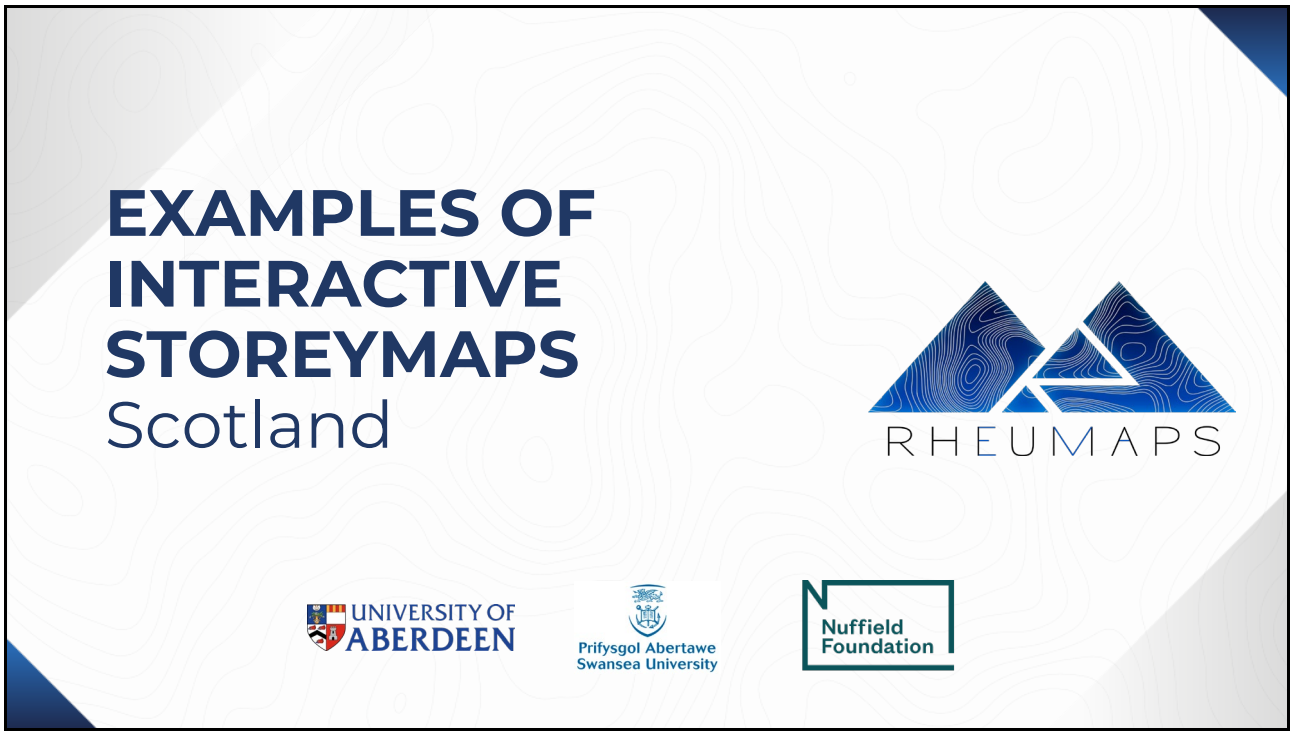
Scotland StoreyMaps

The maps for Scotland can be found here:

[RHEUMAPS Scotland: Osteoarthritis, inflammatory arthritis and rare autoimmune rheumatic disorders (arcgis.com)]

The Scotland maps are not as detailed as the Welsh maps, however, they serve as a useful prototype for what could be achieved. They have already been used to inform discussions about regional service planning.

Please **click on the image below to open a slideshow of examples of the Scotland StoreyMap**:



Click the image above to open a slideshow of interactive map examples

What challenges did we encounter?

We encountered significant challenges in extracting geo-spatial prevalence and health outcome data (including co-morbidities, joint replacement and healthcare use) from the SAIL databank.

As well as concerns about the potential for disclosure, particularly for rarer conditions stratified by small geographical area, more overarching concerns were raised by the SAIL databank team about the potential for health data at health board and primary care cluster level to be used for 'performance management.' Each application to extract data was reviewed independently by a different member of the SAIL team, resulting in multiple queries, re-submissions and inconsistencies in decision making, which created significant delays on each occasion.

Whilst we encountered significant problems with the Scotland dataset (see Chapter 3 Understanding individuals with RMDs in Scotland), we did not have issues with disclosure of data to produce the maps, albeit with limited data compared to those in Wales.

At the workshops, key stakeholders in primary and secondary care also stressed the importance of interpreting and using the maps in context, particularly when comparing prevalence and outcomes across health boards and primary care clusters. As highlighted in Chapter 3 Overview of prevalence of RMDs in Wales, Powys was given as an example of a health board on the border between Wales and England where a significant proportion of healthcare was delivered by other health boards, or in England which was not recorded in Welsh national datasets. Therefore, lower estimates in Powys (as measured by Welsh national datasets) does not necessarily reflect lower disease burden. Similarly, it is also important to note that the primary care health data covers approximately 85% of the Welsh population, with poorer coverage in some rural areas.

The maps also represent data from one point in time and to inform real time service planning and measure change, they need to be updated on a rolling basis.

Summary and implications

Summary

We have created a series of interactive tools based on actual as opposed to estimated prevalence of RMDs in Scotland and Wales, which provide important insights to support service planning. This compliments the existing extrapolated estimated planning tools such as the MSK calculator. Whilst a more limited set of maps were created using the available data in Scotland, these serve as a prototype for what could be achieved with improved access to data and the findings have already been used to inform discussions about regional service planning.

Implications

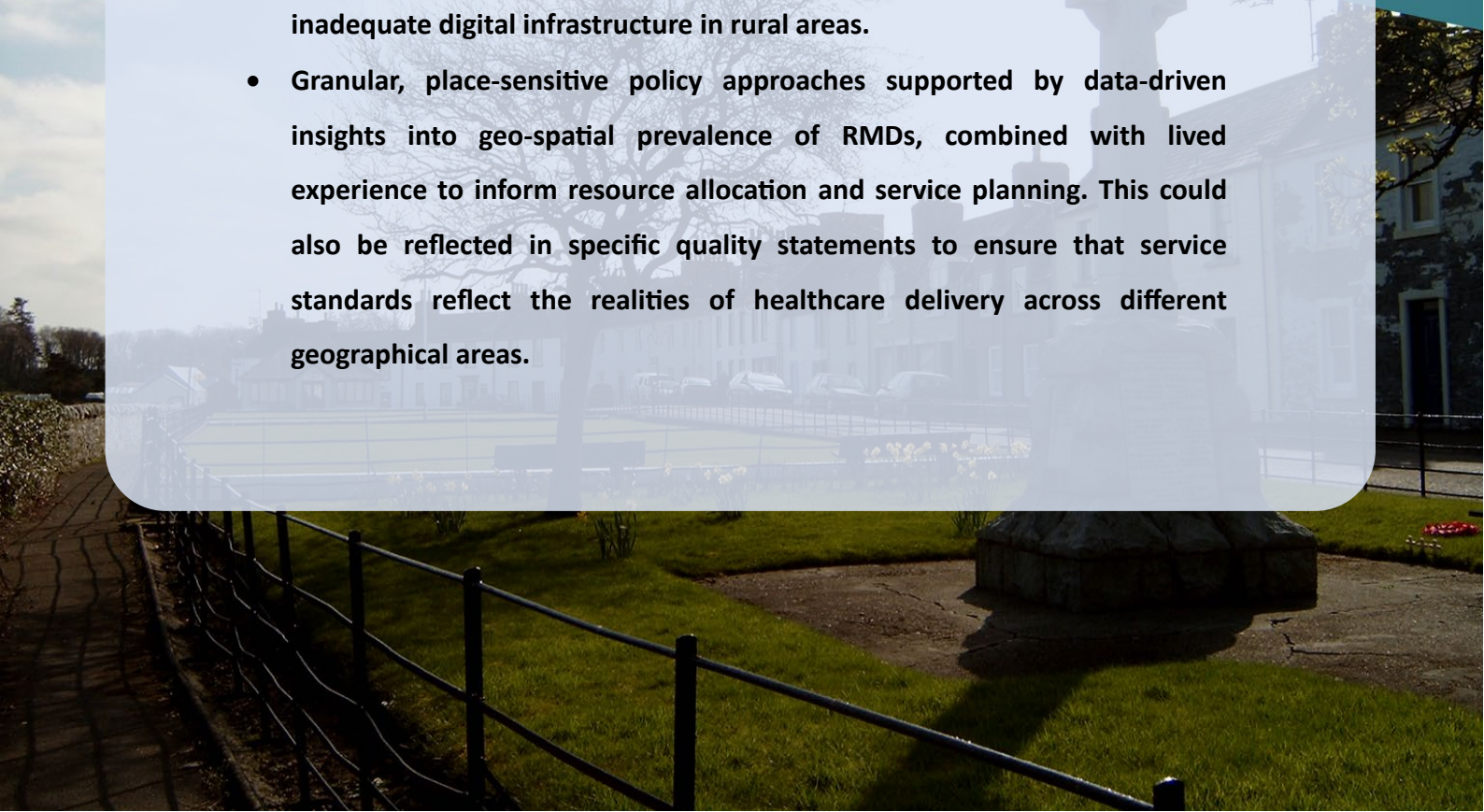
Deep local contextual knowledge is important to make sense of the data and use it for planning, in particular what the data can and cannot tell us. This includes understanding which groups of people are potentially under-represented and to understand how local parts of the health care system work. The maps are intended as a **starting point for discussion** to help inform local, regional and national service planning.

Review of place-based policies

Key messages

The findings from the review provide important context within which to consider the wider study findings, and support development of evidence-based person and place-based health policies within a learning healthcare context, specifically:

- **Better cross-sectoral integration of health, housing, transport and infrastructure policies, employing nuanced, place-sensitive approaches that recognize the heterogeneity of different geographical regions while maintaining coherence across policy domains. Such approaches could, for example, help address workforce challenges and encourage healthcare workers to 'move and stay' in rural communities.**
- **Ensuring that health policies are not 'spatially blind.' For example, 'rural proofing' could be used as a mitigation tool to address the unintended consequences of centralised services, limited public transport, and inadequate digital infrastructure in rural areas.**
- **Granular, place-sensitive policy approaches supported by data-driven insights into geo-spatial prevalence of RMDs, combined with lived experience to inform resource allocation and service planning. This could also be reflected in specific quality statements to ensure that service standards reflect the realities of healthcare delivery across different geographical areas.**



Across the RHEUMAPS study we have brought together rich data to better support person- and place-based care for people living with RMDs. We have identified **priorities for care** across different groups of people with a broad range of RMDs, and the resources and components of service that are important to support these; measured the **prevalence of RMDs** and health outcomes across different geographical areas in Wales and Scotland; and created **interactive maps** to provide timely and accessible data as a starting point for discussion to inform local, regional, and national service planning.

We found that access to care was a challenge for many people living with rheumatic and musculoskeletal conditions regardless of their location, however, these challenges can disproportionately affect those living in rural communities who tend to be older and have multiple health conditions. It is therefore essential that health policy considers both person- and place-based approaches to support equitable access to care no matter where someone lives.

In this chapter we provide an overview of the approach to rural healthcare policy in Scotland and Wales over the past 20 years, identify gaps, and consider ongoing and future policy directions. This provides an important strategic context for supporting person and place-based care for people living with RMDs (specifically rural health inequalities), and highlights opportunities to use our study findings to inform future policymaking.

How we did it

We conducted a rapid review of academic publications, publicly available policy documents and other grey literature that either explicitly mentioned or were exclusively concerned with urban-rural health inequalities in Scotland and Wales and which was published within the last 20 years. The search strategy was designed to identify academic outputs, government publications and good quality grey literature such as that published by reputable charities and third sector organisations. We used databases such as Google Scholar, Scopus and PubMed, government websites, and use of search engines identified additional relevant content. The reference lists and other content of identified documents were also used to identify more potentially relevant publications.

A total of 126 documents were identified and reviewed, comprising 62 policy documents, 40 academic publications and 24 items of grey literature, as summarised in Table 28. The full list of documents can be found in Appendix 7. These were narratively synthesised allowing for key themes to be identified.

Table 28. Documents analysed as part of place-based policy review, stratified per country and type

Document type	Scotland	Wales
Policy documents	38	24
National	*19*	*14*
Regional	*19*	*10*
Academic literature	32	8
Grey literature	18	6
TOTAL	**88**	**38**

Policy evolution in Scotland and Wales

The timelines of significant health policies in Scotland (see Figure 25) and Wales (see Figure 26) below illustrate key general healthcare policies, specific rural healthcare policies and health service delivery policies. For example, Scotland's "Delivering for Remote & Rural Health Care" (Donnelly, 2008) and Wales' "Rural Health Plan"(Welsh Assembly Government, 2009) highlight attempts to address rural healthcare challenges. It is important to note that the policies noted represent what we consider to be the key policies; they do not represent all policies introduced during the timeframe.

Figure 25. Timeline of significant health policies in Scotland: key general healthcare policies (blue), specific rural healthcare policies (yellow) and health service delivery policies (green).

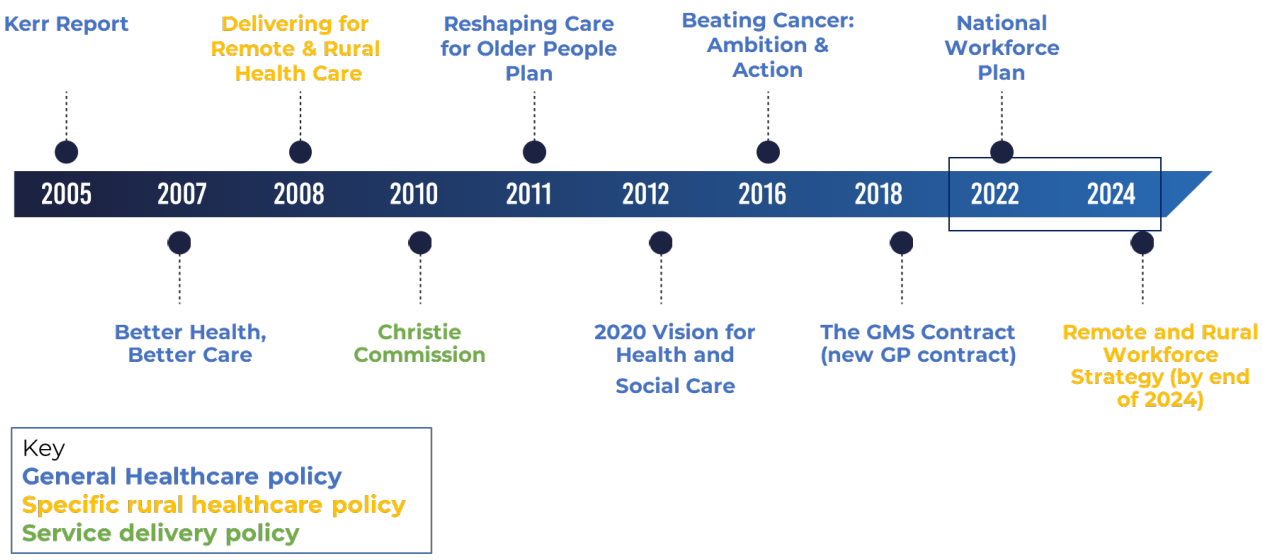
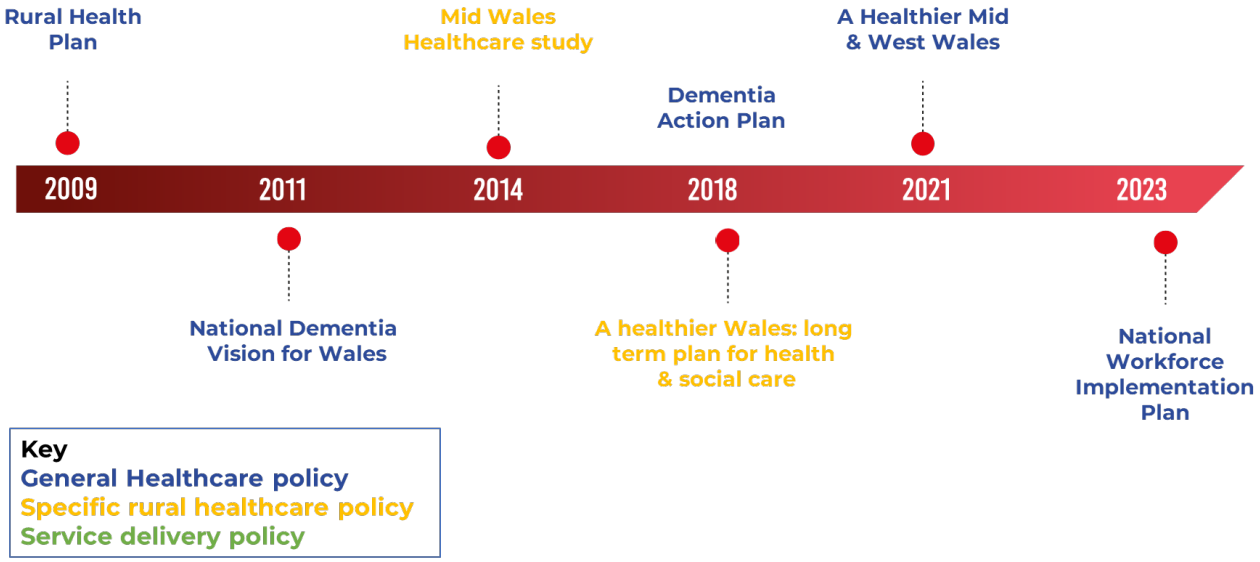


Figure 26. Timeline of significant health policies in Wales: key general healthcare policies (blue), specific rural healthcare policies (yellow) and health service delivery policies (green).



Key themes in rural healthcare policy

In 2005, the Kerr report (NHS Scotland, 2005) was published by an independent advisory group. This set out proposals intended to guide a twenty-year plan for NHS Scotland and specifically recognised the importance of addressing rural health needs:

'Rural communities face particular challenges in terms of transport, access to services and the sustainability of local communities. We need to recognise these differences and describe models of care to meet rural needs.'

Across the intervening years, similar themes are evident across policy documents and the academic literature in both Scotland and Wales:

1. **Staffing, recruitment, retention, and training**

2. **Health and socioeconomic inequalities**

3. **Access to healthcare** (including mobility, accessibility, and the role of technology).

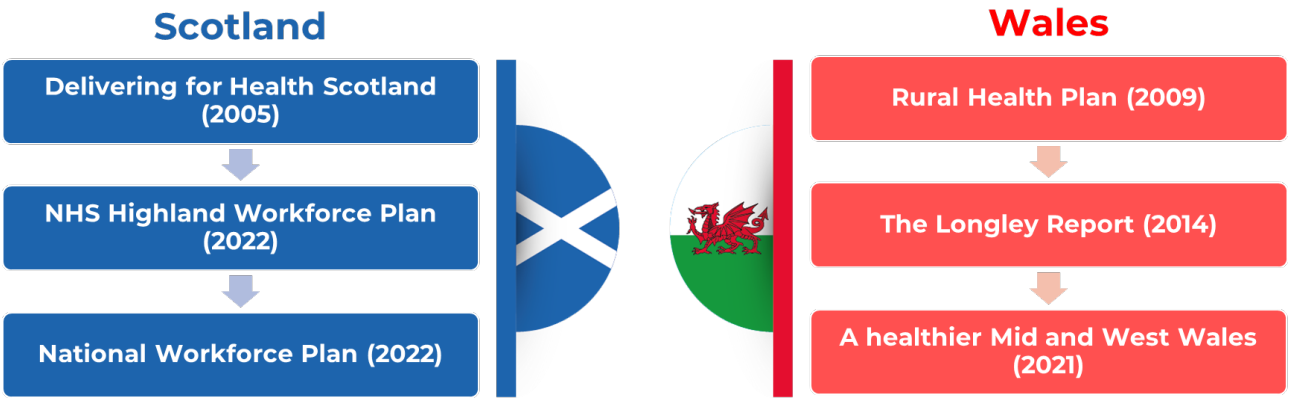
These themes were reiterated as key concerns for rural health and care in the recently published report of the Scottish Parliament Health, Social Care and Sport Committee's inquiry into healthcare in remote and rural areas (October 2024) (Scottish Government, 2024b). Although focused on the Scottish context, the challenges facing rural healthcare delivery in Scotland discussed in this report are relevant to other remote and rural areas across the nations of the UK.

We consider each of these themes in turn below, comparing the policy approach in Scotland and Wales and evidence from the academic literature.

Staffing Challenges in Rural Healthcare

The workforce challenge in terms of recruiting, retaining and upskilling/training healthcare staff and its contribution to urban-rural health inequalities has been repeatedly recognised in policy priorities in Scotland and Wales across the past twenty years, see Figure 27 below.

Figure 27. Recognition of rural healthcare workforce challenges in policy priorities in Scotland and Wales in the past 20 years



The focus has largely been on the medical workforce. For example, in Wales, a specific aim of the 2009 "Rural Health Plan" (Welsh Assembly Government, 2009)was to introduce innovative approaches to workforce development, recognising that this can limit progress elsewhere to improve health. However, 5 years later, the 2014 Longley report (Longley et al., 2014) recognised a wide scope of practice, lack of professional support, heavy workloads, lack of infrastructure and limited resources as ongoing issues facing rural healthcare staff. Roles such as the 'rural generalist worker' were proposed but we could not find evidence of implementation or any evaluation of this new role. In Scotland the 2022 NHS Highland Workforce Plan cited workforce challenges as 'remaining unchanged' and an "ongoing priority which is not accounted for in existing funding models" (NHS Highland, 2022). This is despite, for example the Scottish Rural Medicine Collaborative (SRMC) having been active in developing ways to improve recruitment and retention of primary care staff in remote rural and island areas of Scotland, supporting a specific training route for rural GPs in Scotland. In addition, efforts have been made nationally to support relocation to rural practice costs and Golden Hellos and NHS Education for Scotland's Remote and Rural Healthcare Education Alliance

(RRHEAL) has designed and delivered healthcare education to professionals in rural areas. A limitation to better addressing recruitment, retention and training challenges in rural practice appears to be the lack of systematic evidence about the impacts of initiatives such as those cited above – and initiatives introduced elsewhere in the UK, evidence which would be useful for future developments in Scotland, Wales and beyond.

Research has tended to focus on rural general practice recruitment. Despite the importance of this, there is an evidence gap concerning recruitment (and retention and training) of other professionals who deliver healthcare in rural contexts, such as nurses, pharmacists, psychologists, physiotherapists etc. and those working in the third sector.

Conclusions from a recent study in Scotland based on 56 interviews with doctors at various career stages and a discrete choice questionnaire completed by 480 doctors, were that the focus should shift from "recruitment and retention" to "moving and staying"(Maclaren et al., 2024). It found that stereotypes about rural healthcare environments as unattractive workplaces can compound these challenges, and that more proactive efforts to encourage doctors at different stages of their life and career to think about remote and rural practice could widen the pool of those interested in living and working in rural places. The authors suggested that promoting positive narratives and integrating rural policy with broader rural infrastructure and housing strategies could help attract more healthcare professionals to positions in rural areas.

However, our research found that health-related policy overlooks the attributes and needs of the rural communities in which healthcare professionals would live and work. School-level education, transport infrastructure, local services and the availability of housing can all influence decisions to move to and stay in a job serving a rural community. To be successful, efforts to address the workforce challenge need to be 'joined up' with other policy areas.

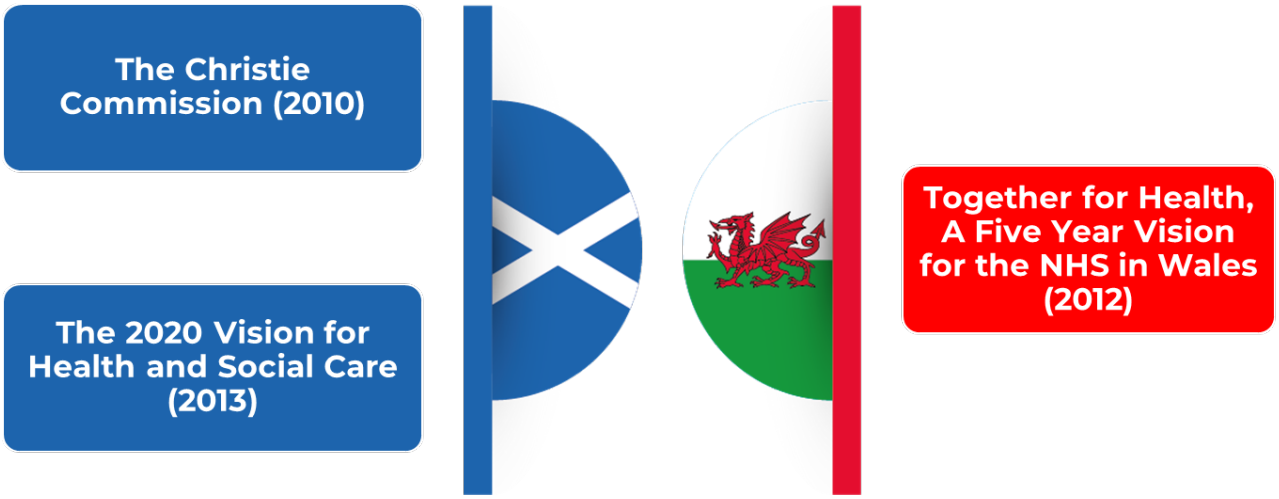
Understanding health inequalities

There is evidence of geographical differences in disease and outcomes from this study and the wider literature. In this study, we have demonstrated that the higher prevalence of osteoarthritis and inflammatory arthritis in rural areas in Wales is largely accounted for by an older rural population. Joint replacements were more common in rural osteoarthritis and inflammatory arthritis populations and for those with inflammatory arthritis and RAIRDs, who require long-term specialist care, travel time of more than 60 minutes by car to a specialist centre was associated with fewer outpatient visits. Other studies have also suggested disparities in health outcomes for those with RMDs living in rural areas. For example, in a systemic review of the literature we have shown that rural-dwellers have higher incidence and present later with more advanced osteoarthritis and have more hip-replacements (Hollick, Rosemary J. & Macfarlane, 2021). Scottish rural residents with axial spondylarthritis are older, more likely to have worked in manual jobs, and suffer a greater impact on work productivity (Hollick, Rosemary J. et al., 2020). In cancer, there is evidence that rural residents have poorer outcomes than urban residents (Carriere et al., 2018) but the picture is complex, and uncertainty exists about the cause. For example, travel burden is associated with more rapid cancer diagnosis and treatment following GP referral even after adjustment for advanced disease; however, these patients also experienced a survival disadvantage compared with those living nearer their cancer treatment centre (Turner et al., 2017).

However, methodological issues, such as the reliance on small, single-centre studies, inconsistent definitions of rurality, and inadequate adjustment for confounders like deprivation, can limit the robustness of some of the evidence on rural health outcomes. Additionally, area-based measures of deprivation, which are more effective in identifying concentrated poverty in urban areas, often fail to capture the more dispersed patterns of deprivation in rural communities (McCartney et al., 2023).

Despite these known spatial inequalities, the policy documents we identified tended to refer to broad, overarching principles about addressing inequalities, see Figure 28, with inconsistent recognition of a rural dimension, actionable steps or evidence of the implementation of solutions to address urban-rural differences . For example, neither Scotland's "2020 Vision for Health and Social Care" (NHS Scotland & Scottish Government, 2012) nor Wales' "Together for Health" (Welsh Government, 2011) explicitly address rural-specific health disparities.

Figure 28. Key policies addressing health inequalities in Scotland and Wales



The lack of recognition of geographical inequalities in policy priorities or funding allocations may partly stem from the methodological challenges inherent in studying rural health disparities and the dominance of urban-centric care models. The 2018 Scottish General Medical Services (GMS) Contract for GPs (British Medical Association & Scottish Government, 2018) is a good example of a response to a service delivery challenge that was primarily designed with urban practices in mind and which, in consequence, has created new challenges for rural areas. Key changes included shifting certain responsibilities, such as vaccinations and secondary care-ordered blood tests, back to health boards; these services are now delivered through centralised hubs for efficiency. However, this has proven inconvenient for rural patients, as hubs are often located in urban centres at a distance from home. Another change was the introduction of multi-disciplinary teams, with funding provided to GP practices to recruit additional staff such as physiotherapists and pharmacists. While urban practices benefited, rural areas struggled to attract and retain these professionals, often losing funding as a result. The contract also introduced peripatetic staff employed by health boards to support practices. However, these arrangements have been criticised by rural practices as they lack management control over staff and has led to issues such as missed visits to remote areas, further reducing manpower. Many rural practices argue that the previous system, which allowed them to manage their own teams, was far more effective. Addressing these methodological and systemic biases is important to ensure equitable policy and funding that accounts for the unique challenges of different geographical populations.

Mobility and accessibility to health services

The RHEUMAPS study and others (Asthana & Halliday, 2004; Hollick, R. J. et al., 2020b; Shergold & Parkhurst, 2012) have highlighted some of the additional challenges faced by those living in rural areas to access healthcare, including:

- Long and complex journeys
- Limited or non-existent public transport
- High travel costs and reliance on access to a car to access services.

We also found evidence of impact of travel burden on access to health care and outcomes, including cancer mortality (Turner et al., 2017), uptake of lung cancer screening (Cavers et al., 2022), chronic pain (Jebara et al., 2023; Kingstone et al., 2020), and dementia care (Arsenault-Lapierre et al., 2023).

Policies like National Concessionary Transport in Scotland and Wales provide free travel for people aged 60 years and above and, in Scotland, those aged 5-21, and for those living with a disability, but their benefits can be negated for

those who live in areas with limited – or no – public transport services. Community car schemes help with travel to healthcare, but we heard from stakeholders that they are not always well publicised and can therefore be underused and they are not available in all rural areas. Meeting the financial costs of travelling to a medical appointment, by bus or private vehicle, can be challenging for rural patients, especially for those living furthest away from specialist services. The recently published Scottish Parliament Health, Social Care and Sport Committee's inquiry into healthcare in remote and rural areas (October 2024) (Scottish Government, 2024b) noted this and called for a consistent approach to the reimbursement of travel costs incurred by patients across Scottish Health Boards to be introduced.

We found little evidence of a joined-up policy approach, linking transport and healthcare policy, as illustrated by the quote below from someone living with dementia in rural Wales.

> **You took my license off me, then suggested I go to a memory cafe 20 miles away. I would love to go, but how? There's only one bus a day now.**
>
> **Person with dementia**
> **(Alzheimer's Society Cymru, 2017)**

(Horton, 2017)

You can also hear from our patient partner Michelle talking about the challenges of accessing healthcare services in Scotland, which is available online at https://youtu.be/MZlrCig1Szw.

Michelle Stevenson discusses her experience of the challenges in accessing healthcare services in rural Scotland

The role of technology

Digital health technologies have been increasingly presented in healthcare policies as a solution to improve access to healthcare for rural populations. This policy focus appeared a few years earlier in Scotland than it did in Wales. However, success remains constrained by inadequate infrastructure. For example, in Scotland, the 2008 "Delivering for remote and rural healthcare" policy (Donnelly, 2008) referenced the introduction of a "world-class IT infrastructure,". Although considerable progress has been made over the past decade to reduce urban-rural digital divides inadequate ICT infrastructure continues to constrain the use of a variety of eHealth applications by patients and medical professionals in rural areas. Data published by the UK telecommunications regulator, Ofcom, in 2024 reported that (a) 15.5% of rural Scotland lacked outdoor 4G access from any operator and 11% of residential premises across rural Scotland were unable to get *decent* (>10Mps download speed) broadband. In Wales, the 2023 policy 'Building Capacity through Community Care' (Welsh Government, 2023) outlined a goal to adopt an all-Wales approach to telecare but it recognised that certain geographic regions and populations remain digitally underserved, with nearly 10,000 homes and business unable to access >10Mps download speed, often in the hardest to reach parts of Wales (Ofcom, 2024b).

While the use of eHealth technologies can provide opportunities to improve rural health care, its widespread adoption risks exacerbating inequalities for the most isolated and disadvantaged rural populations in Wales (Honeyman et al., 2020) and Scotland (Audit Scotland, 2024). Our patient partners made it very clear that digital solutions were not a panacea, and many individuals report uncertainty in using the internet for health-related tasks. This can be due to limited digital literacy, infrastructure and connectivity limitations, a physical impairment making it difficult to use an e-Health application or device and/or inability to afford tele-health devices or the internet connection enabled devices required to make use of many e-Health applications.

Ongoing and future developments in rural health policy

Having reviewed the approach to rural health policy over the past 20 years, we then considered ongoing and future policy directions in Wales and Scotland.

The National Clinical Framework in Wales

The *National Clinical Framework: A Learning Health and Care System for Wales*, published in 2021, provides a roadmap for improving patient outcomes and delivering resilient healthcare services. It sets out how services should be planned and developed, based on 'an application of prudent and value-based healthcare principle. These include:

1. **Person-centred care**: Placing individuals and their specific needs at the centre of healthcare planning.

2. **Integration of services**: Bridging gaps between community and specialist health and social care systems for seamless and equitable service delivery.

3. **Leveraging data and digital technologies**: Utilizing innovation to plan, monitor, and deliver healthcare.

The framework establishes broad goals for the health system, delivering care that can support people to stay well, self-manage their condition and provide where necessary, appropriate specialist support. This includes making best use of all professionals, providers and sectors. For example, it acknowledges the role of primary care clusters in providing a local population footprint to better plan integration of local community services and care closer to home.

Scotland's emerging rural focus

Since devolution Scotland has addressed rural issues through "rural mainstreaming," where rural considerations are integrated into broader policy frameworks. However, recent initiatives indicate a shift towards a more explicit focus on rural challenges (Scottish Government, 2018a, 2024a):

1. **The Islands (Scotland) Act 2018:** This requires public bodies to undertaken Island Community Impact Assessments when considering the introduction of new policies. This has implications for health boards such as NHS Grampian and NHS Highland who provide healthcare to both island and mainland communities.
2. **Rural Proofing Commitment (2022)**: Scotland has committed to applying a "rural lens" to policies under its *National Strategy for Economic Transformation*. This aligns with findings from this study, which highlight the need for rural-specific data and targeted interventions to address inequities.
3. **Rural Lens Application (2023)**: The application of a rural lens to ongoing policies underscores the importance of explicitly considering rural realities, including workforce challenges, mobility barriers, and infrastructure needs.
4. **Rural Delivery Plan (By 2026)**: Announced by Scotland's First Minister in April 2023, this plan aims to demonstrate how government initiatives address rural needs. The emphasis on integrating rural considerations into all aspects of government policy reflects recognition of the need for better cross-sector integration.

These offer an opportunity to address some of the identified gaps in rural staffing, health inequalities, and access to care. Alongside this the Scottish Government is developing a National Clinical Framework, drawing on the approach taken in Wales. This is due to be launched in 2025.

Balancing integration and differentiation in policy

The review findings support the concept that place-based health policy often emerges as a "by-product" of general health policy (Jordan, G. & Halpin, 2006) Broader reforms often do not consider the unique delivery challenges in rural contexts, such as those related to transport and digital infrastructure. Balancing coherence in large budget areas like housing, health, and transport with rural-specific needs remains a persistent challenge. As Atterton et al. note (Atterton et al., 2024) policymakers face a dilemma between:

• **Differentiation**: Developing standalone rural health policies to address specific rural needs; and

• **Integration**: Embedding rural considerations within general health policies to maintain system-wide coherence.

A significant risk of the latter approach is **spatial blindness**—where place-based attributes affecting policy delivery are overlooked. To address this, mechanisms like 'rural proofing' provides opportunities to explicitly consider policy implications for rural communities.

What challenges did we encounter?

The review process and subsequent discussions at key stakeholder workshops highlighted several challenges in conducting a robust and credible rapid policy review. The review was intended to provide a broad overview of the trajectory of place-based policy development over time, illustrated by key policies, as opposed to a detailed assessment of every policy published within the past 20 years.

Some policymakers questioned the omission of certain health policies and the inclusion of older policies. We found that policy development is often siloed in health policy, rural policy and/or medical condition specific policy, which

creates difficulties in identifying and synthesising the content and in identifying transferrable lessons from other areas. For example, a new cancer strategy was highlighted during the workshop within the “care and wellbeing” space that explicitly considered rurality as a factor in health inequality. We found that older policies can still hold valuable insights for future policy development, with a temporal perspective helping to explain why services are currently delivered in the way that they are. They also provide an important antidote to ‘wheel reinvention,’ illustrating common themes and consistent gaps over time. However, they can be difficult to access with many only available in paper form.

Discussions around technology and rural health revealed differing perspectives between healthcare decision makers and those with lived experience. For example, some policymakers downplayed potential barriers, suggesting that older adults’ use of technology has increased improved significantly since the Covid-19 pandemic. While longitudinal data about internet use published by, for example, Ofcom and the Office for National Statistics does report greater digital engagement among older adults now compared to a decade ago, certain dimensions of ageing—particularly among the “oldest old”—can still present significant barriers to e-Health adoption. Similarly, our care priorities survey and interviews highlighted the challenges faced by young women with children who may struggle to find the time and privacy required for e-consultations. Digital infrastructure limitations as a systemic barrier was notably overlooked. Our patient partners were also clear that digital solutions were not a panacea (there is still a need for in person care) and more widespread adoption of eHealth could potentially widen inequalities. This raises the question of whether discussions around use of digital technology tend to focus too narrowly on user engagement while neglecting the complex interaction of factors, including infrastructural constraints, that influence access. Within Scotland, there was also a misperception amongst some policymakers that access issues were now only an issue for island communities when the reality is that geographically remote mainland communities are also underserved. For example, Ofcom's Connected Nations 2024 interactive report data include the percentage of households unable to get decent broadband (10 Mbit/sec or better) by Scottish local authority areas: Perth and Kinross - 6%; Aberdeenshire - 9%; Argyll and Bute - 9%; Highland - 9%; Western Isles - 13%; Shetland - 15%; Orkney - 17%. Whilst the proportion is higher in island communities, within the islands there are big differences between the main settlements and those who live in dispersed communities and in the 'main' islands and the smaller isles (Ofcom, 2024a).

The review and subsequent discussions highlighted the importance of thoroughness, methodological clarity, and responsiveness to both emerging and overlooked issues. It also underscored the need for a nuanced understanding using data from multiple perspectives, particularly in relation to digital technology, the importance of patient and public input into policy development, and the identification of relevant policies located across different time and policy spaces, to maximise learning.

Summary and implications

The findings from the review provide important context within which to consider the wider study findings, and support development of evidence-based person and place-based health policies within a learning healthcare context, specifically:

- **Better cross-sectoral integration** of health, housing, transport and infrastructure policies, employing nuanced, place-sensitive approaches that recognize the heterogeneity of different geographical regions while maintaining coherence across policy domains. Such approaches could, for example, help address workforce challenges and encourage healthcare workers to 'move and stay' in rural communities.
- **Ensuring that health policies are not 'spatially blind.'** For example, 'rural proofing' could be used as a mitigation tool to address the unintended consequences of centralised services, limited public transport, and inadequate digital infrastructure in rural areas.
- **Granular, place-sensitive policy approaches** supported by data-driven insights into geo-spatial prevalence of RMDs, combined with lived experience to inform resource allocation and service planning. This could also be reflected in specific quality statements to ensure that service standards reflect the realities of healthcare delivery across different geographical areas.

Chapter 4 - Key achievements and lessons learned from the RHEUMAPS study

The RHEUMAPS study has explored priorities for care and services needed to meet these for people without MD's; provided insights into the prevalence of RMDS, who and where people are, health outcomes including healthcare use across different geographical areas in Scotland and Wales; and developed tools to enable us to use local geo-spatial data derived from our administrative health data systems, along with lived experience data from patients and service providers, as a starting point to help us understand and plan person- and place-based care needs more accurately. A review of place-based health policy in Scotland and Wales has provided context within which to consider study findings and support development of evidence-based person and place-based care.

A summary of the key findings and lessons learned were shared at national workshops in Wales and Scotland, offering opportunities for validation, collaboration, and sense-making with stakeholders. We considered these in the context of a learning healthcare system (Hardie et al., 2022), see Figure 29, which is based on cycle of: asking questions; analysing data and synthesising with other knowledge; identifying and agreeing potential improvements; making and delivering service change; and generating data. This approach is intended to create the basis for monitoring for changes in the population, and evaluation of service redesign or changes to care pathways.

Figure 29. Key achievements and lessons from RHEUMAPS project workstreams

These discussions underscored the importance of contextualising data within lived experiences and local healthcare delivery. Our findings demonstrate that a complex interplay of factors influences whether services effectively support individuals living with RMDs in meeting their care priorities, including their access to and use of healthcare. A deep understanding of the local context from patients, carers and professionals, alongside the information gathered from routine health care data, provides important insights grounded in patient experience to better support local service planning. Stakeholders also highlighted the need to understand both the potential and limitations of routine healthcare data for service planning, including incomplete or missing data and underrepresentation of certain populations and health outcomes, and the importance of ensuring adequate resources and robust information governance to enable detailed geospatial analysis.

The outputs from these discussions was synthesised together and considered under the following themes (see Figure 30): identifying a common set of priorities for care across a broad range of RMDs; combining administrative healthcare data with lived experience; careful translation of administrative data into insights for service planning; effective person and place-based policies; improving the quality of administrative healthcare data; and creating a sustainable data platform to inform service planning.

Figure 30. Summary of the key lessons from RHEUMAPS project

Identifying a common set of priorities across RMDs

We have identified **a common set of care priorities** across a broad range of RMDs, focused around remaining physically active, better pain and fatigue management, participation in work and engagement in social activities with family and friends.

Co-designed with our patient partners, the survey and interviews explored key issues for people living with a broad range of RMDs. Almost half of those surveyed were dissatisfied with the ability of services to enable them to meet their care priorities. Younger adults, those with non-inflammatory conditions, and those who are out of work due to illness were more likely to be dissatisfied with services. Notably, those living in rural areas were not more likely to be dissatsified with services, although they were more likely to report difficulties accessing services.

However, it wasn't just lack of specific services and resources that were the problem, many people didn't know where to go for help that was available and a clear need was identified to better 'join the dots' across existing community, health and social care resources.

Combining administrative healthcare data with lived experience

A significant achievement was the creation of RMD datasets including primary and hospital-based care covering around 85% of the population in Wales and accessing routinely collected primary care data from > 50% of the population across five health boards in Scotland, covering diverse geographical areas. For the first time we have brought together geospatial health data to map the prevalence of broad range of rheumatic and musculoskeletal conditions.

In Wales and Scotland, osteoarthritis and inflammatory arthritis were more common in rural areas, largely due to older populations. While comorbidities were similar between rural and urban populations, inflammatory arthritis and RAIRDs carried a high burden of comorbidities and frailty, highlighting the need for integrated care models. Rural residents with osteoarthritis and inflammatory arthritis were more likely to undergo hip replacement surgery. In Wales, longer travel times to rheumatology services significantly reduced access to outpatient care and increased hospital admissions, with public transport creating further barriers due to lengthy journey times.

We found that combining digitally collected routine health care data with lived experience is a powerful tool to support service planning and improve care. The survey and interviews offered critical insights, helping to guide the analysis of administrative data and explain findings, such as variations in healthcare use based on travel time for those with inflammatory arthritis and rare rheumatic conditions.

Working at the scale relevant to the decisions being made is also important. That means carefully analysing the data and bringing lived experiences in at a local level when the decisions are about local services; or at a national level when it is about national strategy. The integrated datasets created through RHEUMAPS provide a unique platform of data that can be used to further explore health outcomes and health inequalities in Scotland and Wales. These are currently being incorporated into future research.

Careful translation of administrative data into insights for planning

We are surrounded by more and more digital information, and it is tempting to think that it is easy to translate these data into useful information to plan and improve healthcare. However, we have highlighted the significant challenges of translating data collected from service operational activity into meaningful information for service planning.

It is important to understand the context of the services, including where and why the data was collected as well as what might be missing. Without this understanding we risk suboptimal service planning. Combining both quantitative and qualitative data provides different perspectives, and the workshops highlighted the importance of a contextual understanding of local services. Together this serves as a starting point for discussion.

Support from highly skilled qualitative, geography and spatial data scientists, who can draw on cutting edge methodology in the context of an in-depth understanding of the wider health care context and NHS systems, is essential to achieving this. This includes employing the principles of open and reproducible science to facilitate code sharing and transparent and reproducible analyses.

Effective policies to support person and place-based care delivery

We have gathered evidence of differing outcomes, including satisfaction with services, ability to access healthcare and healthcare use, along with differences in clinical outcomes such as joint replacement across different groups of people with RMDs living in different places. We have shown that multiple factors interact determine access to and satisfaction with care.

Effective place-based policies to support health therefore need to be underpinned by high quality, and detailed data from many different sources. High quality, granular and nuanced data from multiple sources, that goes beyond a simple, binary, rural-urban analysis, is necessary to better understand the complex interaction of factors that influencing people's ability to access to care. This will provide much needed evidence to support the development and implementation of effective place-based policies which recognise the diversity of geographical contexts and populations.

Improve quality of administrative healthcare data

Improving data curation is critical before we can exploit the full benefits of our health care data. If we don't ensure that the underlying data is of high quality, well documented, and includes information on how and why it was collected, as well as what might be missing, there is a risk that technologies like Artificial Intelligence in healthcare could worsen health inequalities rather than improve them.

To support planning effectively, we need to improve the overall quality of routinely collected administrative healthcare data, gather better contextual information, and develop sustainable planning tools based on population level health care data and integrated across community, emergency and hospitalised care settings. This will enable us to obtain a more complete picture and ensure equitable service planning and evaluation to meet the needs of local populations living with RMDs.

Sustainable data platform to inform service planning

We have created RMD datasets to facilitate this, and interactive tools (see maps for Wales (for osteoarthritis, inflammatory arthritis and RAIRDS, and Scotland (all RMDs)) to help service providers better understand MSK health, health care use and potential inequalities at local, regional and national levels and plan services accordingly. Whilst there are important limitations to consider, this is an important step towards a data informed approach to better inform policy and service development to meet the needs of local populations.

Importantly, we have also learnt important lessons to inform sustainable ways of doing so in the future, specifically how to replicate and sustain this going forward, and what the data can and cannot tell us (see Exploring priorities for care - What challenges did we encounter and Understanding individuals with RMDs - What challenges did we encounter). The differing approaches to the collation and use of routine healthcare data in Wales and Scotland provided important opportunities for cross-border learning, particularly around access to a bespoke primary care data via a third-party provider in Scotland versus a national primary care dataset in Wales, and information governance issues around the geo-spatial analysis of administrative healthcare data which significantly delayed extraction of data.

A key point to emerge from workshops and engagement with policymakers was how we can take forward the methods and learning from the study to create usable, reproducible and sustainable interactive maps going forward to support real time service planning. The study has generated important lessons when considering how to do this. For example, there needs to be clear, nationally agreed information governance protocols to enable timely extraction of geo-spatial prevalence and outcome data from national health databases to support real time service planning and bridge the gap between research and clinical practice.

The study has also provided the opportunity to share learning across chronic long-term conditions. For example, the geo-spatial computer models used to calculate time to access orthopaedic and rheumatology services by car and bus were initially developed for use in cancer intelligence and during COVID-19 to understand vaccine equity. Novel application of the methodology to other long-term conditions such as RMDS is important as these represent a significant burden on the healthcare system in an ageing population.

Support from highly skilled applied qualitative, geography and spatial data scientists who straddle academia and the NHS is essential to achieving this, with the ability to draw on cutting edge methodology in the context of an in-depth understanding of the wider health care context and NHS systems.

Chapter 5 - Policy and practice recommendations

Bringing together our analysis, discussions and insights, we have suggested a series of recommendations to support person and place care for people with RMDs.

✓ **Support to better meet the care priorities of people living with rheumatic and musculoskeletal conditions**

It is important to ensure that the service solutions developed are relevant to the care needs of local populations, particularly those we identified whose care priorities are not currently being met, including younger adults, people who are not working due to their RMD, those who have longer to travel to access specialist care, and those with non-inflammatory RMDs.

- *Improved access to information and services*
  - Comprehensive and relevant information must be available in a timely and accessible way, particularly pain and fatigue, to meet the needs of people with a broad range of RMDs.
  - Development of a framework for understanding and sharing pathways and resources across community, health and social care to improve patient outcomes.
  - Access and pathways to existing services and resources should be evaluated in the context of local population needs and geography and used to support local, regional and national service planning.
- *Support to work*
  - Development of strategies to improve awareness and access to work-related support for people with RMDs.
  - Better signposting between RMD charity websites providing work resources and to external resources, greater use of positive patient stories, and clearer language.

- *Support to participate in social and community-based activities*
  - Development of effective pathways to community-based resources to support people living with RMDs who struggle to achieve their desired levels participate in social and community-based activities.

- *Support for self-management*

  - Sustainable community-based self-management programmes should be developed and evaluated to enable people to manage their long-term conditions from initial diagnosis, and as part of their overall treatment plan.

  - Development of an overarching policy framework for sustainable self-management support for long-term conditions to enable early access to visible support and ensure equitable and sustainable resourcing.

✓ **Support to enable better and sustainable use of national healthcare data to inform service planning and evaluation across a broad range of RMDs**

Moving data from research to real time to inform service planning presents several challenges that need to be overcome. The following recommendations consider the infrastructure, resources, methods and information governance issues that need to be addressed to support this within a learning healthcare system.

- Strategies to improve the quality of routinely collected healthcare data – transparent coding, understanding purpose of data collection, and support for creation of a data catalogue and metadata for new datasets.

- Agreed information governance protocols to enable timely extraction of granular geo-spatial prevalence and outcome data from national health databases to inform service planning.

- Future work should include methods that combine administrative health data with lived experience and an understanding of the context in which health data is collected and used.

- Opportunities to ensure research technical code is curated, shared and acknowledged for future use, supporting open and reproducible science.

- Support for more pluralistic multi-method RMD research that leverages the diverse health and social care contexts across the devolved nations of the UK, and across other long-term conditions to maximise opportunities for shared learning.

- Career development opportunities to facilitate health data scientists working in academia and those working with national health services to learn from each other.

Chapter 6 - Impact

We have engaged with key stakeholders throughout the study and are actively working to use our research findings and recommendations to drive change through strategic and practical activities focused on supporting people with RMDs. This includes the organisations with responsibility for running the main data repositories in Scotland and Wales (SAIL and Research Data Scotland), healthcare decision makers in the devolved nations and third sector organisations.

These conversations aim to improve how researchers access data, improve the quality of data and inform the development of better cataloguing of the important information needed to make good and safe use of spatially referenced health data to inform service planning. They will also inform how data might to be integrated 'real time' to support ongoing health care planning and evaluation based upon a learning healthcare system approach.

Below are some examples demonstrating how the findings from this study are being applied in practice.

Case Example 1: Informing Priorities in Wales

In Wales, we are collaborating with the NHS Wales Musculoskeletal Strategic Network to shape development of person- and place-based services for those with RMDs. This includes an initiative to update and expand the interactive maps we have developed to direct quality Improvement support and guide strategic service planning of RMD services in Wales.

Case Example 2: Advancing Data Access in Scotland

Research Data Scotland leads gateway access to public sector (including health) data for research in Scotland. We are discussing how the lessons learned from the RHEUMAPS study, including the barriers and opportunities offered by our data environment in Scotland, can be used to better support translation of research data science into operational use to inform service planning. This includes improved access and use of primary care data and the curation, sharing, and recognition of research technical code to ensure it can be reused in the future, thereby supporting a sustainable research ecosystem.

Case Example 3: Geo-Spatial Data to Support Service Planning

In partnership with Versus Arthritis, we are applying the lessons from the RHEUMAPS study around the use of geo-spatial prevalence data on RMDs to support development of similar work across the UK's devolved nations. This also provides an opportunity to share knowledge and learning on the visualisation of this data to better support local and regional service planning, enabling more targeted and effective approaches to addressing RMD conditions.

Case Example 4: Improving Work-Related Resources for People with MSK Conditions

Versus Arthritis have already leveraged our research, alongside two recent surveys, to refine their approach to work-related information and support. This has resulted in several impactful actions:

- Website Redesign: The "work" content on their website has been rewritten to include new links to external resources.
- Self-Management Resource Development: Progress is underway to create a Work Adjustment self-management resource.
- Employer-Focused Resources: Additional information for employers and workplace professionals is being added to their website.
- Health Practitioner Training: Messaging on work is being embedded within Core Skills training for health practitioners.
- Upskilling Staff and Volunteers: Versus Arthritis is equipping its local delivery staff and volunteers with knowledge on work-related rights and support.

Chapter 7 - Future research

Whilst we have initially focused on osteoarthritis, inflammatory arthritis and rare autoimmune rheumatic conditions (RAIRDs), our approach can be extended to the other RMDs. We have already begun to look at people with fibromyalgia in Wales, as an example of a chronic pain conditions, to understand more about their health, prescribed medications and health care use.

We have already built upon some of the work from RHEUMAPS in the recently funded BRUCES study – Building Rural-Urban healthCare Equity for Scotland. Funded by the Chief Scientist Office, Scotland. BRUCES aims to understand how and why health and healthcare for people living in different types of rural communities differs from those living in urban areas, and how we can improve it.

The project will look at important rural health inequalities, how they are caused, and effective ways to address them. Ultimately, it will support the delivery of existing policy and inform the design of future rural and island policy, promoting social justice and enhancing the wellbeing of all Scotland's residents, regardless of where they live.

Research will focus initially on three common health issues: cancer, musculoskeletal conditions and frailty, which will give insight into acute and longer-term conditions across different age groups and health conditions treated locally and in specialist centres.

The musculoskeletal work is based on the RHEUMAPS Scottish dataset where we will undertake a more nuanced geographical analysis, sensitive not only to urban rural differences, but also to the heterogeneity of rural regions. We will also build upon the findings from our review of healthcare delivery in rural Scotland and Wales.

Other areas of future research to be identified from our findings include:

- ✓ Developing an evidence-based framework to understand and share pathways and resources across community, health and social care to enable people living with RMDs to live and work well.
- ✓ Examining whether differences in access to care are associated with poorer health outcomes.

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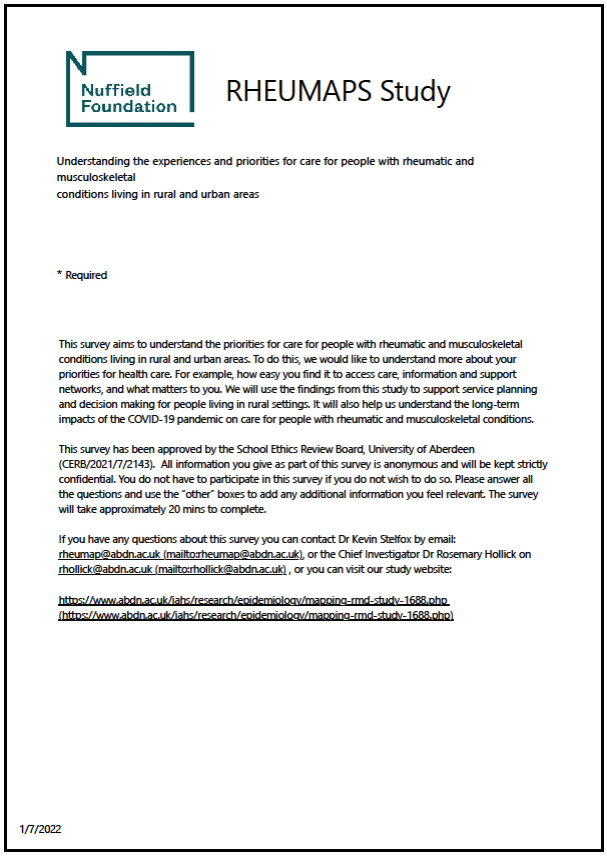
Appendices

Appendix 1: Priorities of care survey

Click on the image below to open a PDF copy of the survey.



Nuffield Foundation

RHEUMAPS Study

Understanding the experiences and priorities for care for people with rheumatic and musculoskeletal
conditions living in rural and urban areas

* Required

This survey aims to understand the priorities for care for people with rheumatic and musculoskeletal conditions living in rural and urban areas. To do this, we would like to understand more about your priorities for health care. For example, how easy you find it to access care, information and support networks, and what matters to you. We will use the findings from this study to support service planning and decision making for people living in rural settings. It will also help us understand the long-term impacts of the COVID-19 pandemic on care for people with rheumatic and musculoskeletal conditions.

This survey has been approved by the School Ethics Review Board, University of Aberdeen (CERB/2021/7/2143). All information you give as part of this survey is anonymous and will be kept strictly confidential. You do not have to participate in this survey if you do not wish to do so. Please answer all the questions and use the "other" boxes to add any additional information you feel relevant. The survey will take approximately 20 mins to complete.

If you have any questions about this survey you can contact Dr Kevin Stelfox by email: rheumap@abdn.ac.uk (mailto:rheumap@abdn.ac.uk), or the Chief Investigator Dr Rosemary Hollick on rhollick@abdn.ac.uk (mailto:rhollick@abdn.ac.uk) , or you can visit our study website:

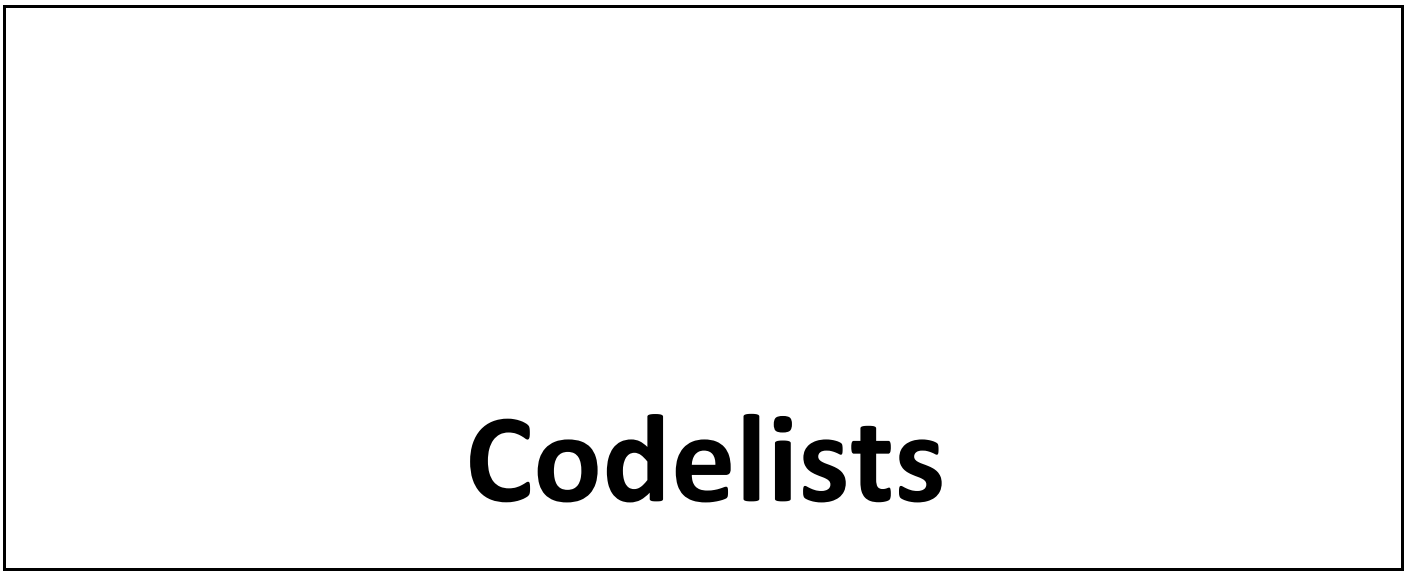
https://www.abdn.ac.uk/iahs/research/epidemiology/mapping-rmd-study-1688.php. (https://www.abdn.ac.uk/iahs/research/epidemiology/mapping-rmd-study-1688.php)

1/7/2022

Appendix 2: Code lists

Click on the image below to open a copy of the code lists used in the RHEUMAPS study.

Version 2 READ codes (Chisholm J. The Read clinical classification. BMJ [Internet]. 1990 Apr 28;300(6732):1092. Available from: https://pubmed.ncbi.nlm.nih.gov/2344534)



Appendix 3: Rural-urban classification

Label	Description	Urban/Rural
D1	Rural town and fringe	Rural
D2	Rural town and fringe in a sparse setting	Rural
E1	Rural village and dispersed housing	Rural
E2	Rural village and dispersed housing in a sparse setting	Rural
C1	Urban city and town	Urban
C2	Urban city and town in a sparse setting	Urban

Appendix 4: Electronic frailty domains

Deficit	Description	Deficit	Description
1	Activity limitation	19	Ischaemic heart disease
2	Anaemia & haematinic deficiency	20	Memory & cognitive problems
3	Arthritis	21	Mobility and transfer problems
4	Atrial fibrillation	22	Osteoporosis
5	Cerebrovascular disease	23	Parkinsonism & tremor
6	Chronic kidney disease	24	Peptic ulcer
7	Diabetes	25	Peripheral vascular disease
8	Dizziness	26	Polypharmacy
9	Dyspnoea	27	Requirement for care
10	Falls	28	Respiratory disease
11	Foot problems	29	Skin ulcer
12	Fragility fracture	30	Sleep disturbance
13	Hearing impairment	31	Social vulnerability
14	Heart failure	32	Thyroid disease
15	Heart valve disease	33	Urinary incontinence
16	Housebound	34	Urinary system disease
17	Hypertension	35	Visual impairment
18	Hypotension / syncope	36	Weight loss & anorexia

Appendix 5: Supplementary tables

Table S1. Sociodemographic and clinical characteristics of urban and rural osteoarthritis populations in Wales at index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Sex	**Female**	118,190	60.15	56,122	58.94	-1.21 (-1.70, -0.71)
Age group (years)	**18-19**	57	0.03	23	0.02	0.00 (-0.78, 0.77)
	20-29	942	0.48	416	0.44	-0.04 (-0.81, 0.73)
	30-39	4,194	2.13	1,617	1.70	-0.44 (-1.20, 0.33)
	40-49	18,366	9.35	7,802	8.19	-1.15 (-1.89, -0.41)
	50-59	44,952	22.88	20,627	21.66	-1.21 (-1.90, -0.53)
	60-69	54,906	27.94	28,379	29.80	1.86 (1.21, 2.51)
	70-79	46,698	23.76	23,397	24.57	0.81 (0.13, 1.48)
	80+	26,386	13.43	12,959	13.61	0.18 (-0.54, 0.90)
Deprivation quintile	**1 - Most deprived**	49,031	24.95	6,627	6.96	-17.99 (-18.71, -17.27)
	2	44,338	22.56	14,856	15.60	-6.96 (-7.66, -6.26)
	3	37,554	19.11	25,833	27.13	8.02 (7.35, 8.69)
	4	29,574	15.05	28,429	29.86	14.81 (14.14, 15.48)
	5 - Least deprived	36,004	18.32	19,475	20.45	2.13 (1.44, 2.82)
Smoking status	**Never smoked**	60,912	31.00	28,419	29.85	-1.15 (-1.80, -0.51)
	Ex-smoker	79,472	40.44	41,331	43.41	2.96 (2.38, 3.55)
	Smoker	52,004	26.47	23,423	24.60	-1.87 (-2.54, -1.20)
	Unknown	4,113	2.09	2,047	2.15	0.06 (-0.71, 0.82)
Alcohol intake	**Non-drinker**	59,204	30.13	32,901	34.55	4.42 (3.79, 5.06)
	Within guidelines	66,092	33.63	32,001	33.61	-0.03 (-0.66, 0.60)
	Above guidelines	18,813	9.57	8,168	8.58	-1.00 (-1.73, -0.26)
	Unknown	52,392	26.66	22,150	23.26	-3.40 (-4.07, -2.73)
Frailty	**At least moderate**	26,462	13.47	12,225	12.84	-0.63 (-1.35, 0.09)
	Fit	96,761	49.24	48,497	50.93	1.69 (1.14, 2.23)
	Mild	73,278	37.29	34,498	36.23	-1.06 (-1.68, -0.45)
	Moderate	21,784	11.09	10,053	10.56	-0.53 (-1.26, 0.20)
	Severe	4,678	2.38	2,172	2.28	-0.10 (-0.86, 0.67)
Charlson comorbidities	**At least one**	155,893	79.33	73,624	77.32	-2.01 (-2.38, -1.65)
	1-2	91,834	46.73	44,471	46.70	-0.03 (-0.60, 0.53)
	3+	64,059	32.60	29,153	30.62	-1.98 (-2.62, -1.34)
Comorbidities	***Cardiovascular disease (combined)**	62,486	31.80	30,325	31.85	0.05 (-0.59, 0.69)
	Cardiac arrhythmia	23,556	11.99	12,444	13.07	1.08 (0.36, 1.80)
	CVD	46,020	23.42	21,620	22.71	-0.71 (-1.39, -0.04)
	Myocardial infarction	10,878	5.54	5,029	5.28	-0.25 (-1.01, 0.50)
	Valvular disease	8,640	4.40	4,157	4.37	-0.03 (-0.79, 0.73)
	Congestive heart disease	9,445	4.81	4,566	4.80	-0.01 (-0.77, 0.74)
	Cataracts	29,690	15.11	13,986	14.69	-0.42 (-1.14, 0.29)
	Cancer	34,684	17.65	16,777	17.62	-0.03 (-0.73, 0.67)
	Cerebrovascular disease	16,038	8.16	7,510	7.89	-0.27 (-1.02, 0.47)
	Respiratory disease	45,455	23.13	20,683	21.72	-1.41 (-2.09, -0.73)
	Dementia	5,608	2.85	2,423	2.54	-0.31 (-1.07, 0.45)

	Diabetes (with complications)	9,756	4.96	4,473	4.70	-0.27 (-1.02, 0.49)
	Diabetes	33,741	17.17	14,805	15.55	-1.62 (-2.33, -0.91)
	Metastatic tumour	1,367	0.70	685	0.72	0.02 (-0.75, 0.79)
	Mild liver disease	1,589	0.81	703	0.74	-0.07 (-0.84, 0.70)
	Moderate liver disease	538	0.27	232	0.24	-0.03 (-0.80, 0.74)
	Paraplegia	1,299	0.66	565	0.59	-0.07 (-0.84, 0.70)
	Peptic ulcer	9,167	4.67	4,310	4.53	-0.14 (-0.89, 0.62)
	Peripheral vascular disease	7,295	3.71	3,348	3.52	-0.20 (-0.96, 0.56)
	Renal disease	29,081	14.80	14,693	15.43	0.63 (-0.08, 1.34)
	****Dementia_**	58,606	29.82	23,274	24.44	-5.38 (-6.05, -4.72)
	Hypertension	96,377	49.05	45,121	47.39	-1.66 (-2.22, -1.10)
	Hypothyroidism	22,311	11.35	11,129	11.69	0.33 (-0.39, 1.06)
	Osteoporosis	14,771	7.52	6,912	7.26	-0.26 (-1.00, 0.49)
	Venous thromboembolism	10,853	5.52	5,417	5.69	0.17 (-0.59, 0.92)
	Severe infection	1,825	0.93	756	0.79	-0.13 (-0.91, 0.64)
Analgesia	**NSAIDs**	51,742	26.33	24,781	26.02	-0.31 (-0.97, 0.36)
	Weak opiates	72,891	37.09	31,210	32.78	-4.32 (-4.95, -3.69)
	Strong opiates	4,303	2.19	1,987	2.09	-0.10 (-0.87, 0.66)
Healthcare use	**GP Events**	193,760	98.61	94,025	98.75	0.14 (0.05, 0.23)
	Outpatient visits	113,755	57.89	52,060	54.67	-3.22 (-3.73, -2.70)
	Hospital Admission	45,758	23.29	21,174	22.24	-1.05 (-1.73, -0.37)
	Emergency hospital admission	32,111	16.34	15,505	16.28	-0.06 (-0.77, 0.65)
	Non-emergency hospital admission	19,342	9.84	8,234	8.65	-1.20 (-1.93, -0.46)
Joint replacement	**Hip**	4,992	2.54	2,978	3.13	0.59 (-0.18, 1.35)
	Knee	5,813	2.96	2,575	2.70	-0.25 (-1.02, 0.51)
	Other/Unspecified	303	0.15	142	0.15	-0.01 (-0.78, 0.77)
OA type	**Hip**	6,430	3.27	4,066	4.27	1.00 (0.24, 1.76)
	Knee	32,507	16.54	15,137	15.90	-0.65 (-1.35, 0.06)
	Lower limb (foot & ankle)	31,187	15.87	16,802	17.65	1.77 (1.07, 2.48)
	Hand	12,339	6.28	7,047	7.40	1.12 (0.38, 1.87)
	Upper limb	6,881	3.50	3,870	4.06	0.56 (-0.20, 1.32)
	Spine	332	0.17	312	0.33	0.16 (-0.61, 0.93)
	Other/Unspecified	120,908	61.53	56,818	59.67	-1.86 (-2.35, -1.37)
	*****Non-hip/knee**	154,251	78.50	75,403	79.19	0.69 (0.34, 1.05)

**Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.*

***Alternative dementia coding which uses a code list from Sarica, et al to identify patients.*

****Combined OA types which are neither hip nor knee – also includes unspecified types.*

Table S2. Geographical distribution of OA patients at index date in Wales, by age and sex

Age band (years) @ index date	Geographical distribution of OA patients at index date in Wales, by age and sex							
	Urban				Rural			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
18-29	542	0.19%	457	0.16%	246	0.08%	193	0.07%
30-39	2,026	0.69%	2,168	0.74%	806	0.28%	811	0.28%
40-49	7,598	2.60%	10,768	3.69%	3,428	1.18%	4,374	1.50%
50-59	17,686	6.06%	27,266	9.35%	8,290	2.84%	12,337	4.23%
60-69	23,381	8.01%	31,525	10.81%	12,063	4.14%	16,316	5.59%
70-79	18,444	6.32%	28,254	9.69%	9,774	3.35%	13,623	4.67%
80+	8,634	2.96%	17,752	6.09%	4,491	1.54%	8,468	2.90%

Table S3. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic use, healthcare use and joint replacement for the Welsh population with a diagnosis of osteoarthritis at index date.

Category	Detail	Unadjusted			Adjusted		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate**	0.953	0.935	0.973	1.003	0.983	1.023
Charlson Comorbidities	**At least one**	0.975	0.971	0.979	0.984	0.980	0.988
Comorbidities	***Cardiovascular disease**	0.994	0.981	1.008	1.001	0.988	1.015
	Cardiac arrhythmia	1.105	1.077	1.134	1.067	1.040	1.095
	CVD	0.959	0.943	0.975	0.981	0.965	0.997
	Myocardial infarction	0.939	0.905	0.975	0.962	0.926	1.000
	Valvular disease	0.965	0.921	1.011	0.941	0.896	0.987
	Congestive heart disease	0.941	0.899	0.985	0.969	0.924	1.015
	Cataracts	0.954	0.932	0.977	0.946	0.925	0.968
	Cancer	0.997	0.977	1.018	0.947	0.927	0.967
	Cerebrovascular disease	0.936	0.906	0.966	0.949	0.918	0.981
	Respiratory disease	0.937	0.922	0.951	0.987	0.971	1.003
	Dementia	0.869	0.798	0.945	0.883	0.810	0.963
	Diabetes (with complications)	0.942	0.902	0.983	0.990	0.946	1.035
	Diabetes	0.899	0.881	0.918	0.949	0.929	0.970
	Metastatic tumour	0.952	0.785	1.156	0.914	0.747	1.117
	Mild liver disease	0.889	0.799	0.990	0.913	0.816	1.020
	Moderate liver disease	0.921	0.758	1.120	1.000	0.811	1.232
	Paraplegia	0.848	0.756	0.952	0.909	0.806	1.026
	Peptic ulcer	0.972	0.936	1.009	1.012	0.973	1.053
	Peripheral vascular disease	0.914	0.870	0.960	0.952	0.905	1.002
	Renal disease	1.046	1.021	1.072	1.068	1.042	1.095
	****Dementia_**	0.816	0.804	0.828	0.880	0.867	0.894
	Hypertension	0.967	0.958	0.976	0.977	0.968	0.985
	Hypothyroidism	1.022	0.998	1.046	1.036	1.011	1.061
	Osteoporosis	0.970	0.938	1.003	0.955	0.923	0.988
	Venous thromboembolism	1.001	0.964	1.040	1.009	0.970	1.050
	Severe infection	0.855	0.786	0.930	0.925	0.847	1.011
Analgesia	**NSAIDs**	0.988	0.976	1.001	1.009	0.995	1.022
	Weak opiates	0.884	0.874	0.893	0.950	0.940	0.961
	Strong opiates	0.953	0.904	1.004	1.039	0.984	1.097
Healthcare use	**GP Events**	1.001	1.001	1.002	1.002	1.001	1.003
	Outpatient visits	0.944	0.938	0.951	0.955	0.948	0.962
	Hospital Admission	0.955	0.941	0.969	0.980	0.966	0.995
	Non-emergency hospital admission	0.996	0.979	1.014	1.006	0.988	1.025
	Emergency hospital admission	0.879	0.857	0.900	0.932	0.908	0.956
Joint replacements	**Hip**	1.231	1.177	1.287	1.184	1.131	1.240
	Knee	0.914	0.873	0.957	0.916	0.874	0.961
	Other/Unspecified	0.967	0.792	1.180	1.015	0.828	1.244

OA type	**Hip**	1.305	1.256	1.356	1.217	1.171	1.266
	Knee	0.961	0.944	0.978	0.966	0.948	0.984
	Lower limb (foot & ankle)	1.112	1.093	1.131	1.076	1.057	1.095
	Hand	1.179	1.146	1.212	1.123	1.091	1.156
	Upper limb	1.161	1.117	1.206	1.142	1.097	1.188
	Spine	1.939	1.662	2.263	1.763	1.505	2.066
	Other/Unspecified	0.970	0.964	0.976	0.988	0.982	0.995
	******Non-hip/knee***	*1.009*	*1.005*	*1.013*	*1.013*	*1.009*	*1.017*

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.

**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.

***Combined OA types which are neither hip nor knee – also includes unspecified types.

Table S4. Clinical characteristics of urban and rural osteoarthritis populations in Wales at 4-5 years from index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Frailty	**At least moderate frailty**	50,587	26.19	24,256	25.89	-0.30 (-0.97, 0.38)
	Fit	58,779	30.43	28,987	30.94	0.51 (-0.14, 1.16)
	Mild	83,796	43.38	40,434	43.16	-0.22 (-0.81, 0.37)
	Moderate	38,113	19.73	18,233	19.46	-0.27 (-0.97, 0.43)
	Severe	12,474	6.46	6,023	6.43	-0.03 (-0.78, 0.73)
Charlson comorbidities	**At least one Charlson comorbidity**	166,161	86.02	78,972	84.30	-1.72 (-2.02, -1.42)
	0	27,001	13.98	14,705	15.70	1.72 (1.00, 2.44)
	1-2	80,474	41.66	39,388	42.05	0.39 (-0.21, 0.98)
	3+	85,687	44.36	39,584	42.26	-2.1 (-2.69, -1.51)
Comorbidities	***Cardiovascular disease**	60,507	31.32	29,437	31.42	0.10 (-0.55, 0.75)
	Cardiac arrhythmia	22,721	11.76	12,060	12.87	1.11 (0.38, 1.84)
	CVD	44,531	23.05	20,959	22.37	-0.68 (-1.37, 0.01)
	Myocardial infarction	10,453	5.41	4,834	5.16	-0.25 (-1.01, 0.51)
	Valvular disease	8,327	4.31	4,025	4.30	-0.01 (-0.78, 0.75)
	Congestive heart disease	8,875	4.59	4,283	4.57	-0.02 (-0.78, 0.74)
	Cataracts	28,776	14.90	13,583	14.50	-0.40 (-1.12, 0.32)
	Cancer	33,577	17.38	16,280	17.38	0.00 (-0.71, 0.71)
	Cerebrovascular disease	15,401	7.97	7,260	7.75	-0.22 (-0.97, 0.53)
	Respiratory disease	44,658	23.12	20,332	21.70	-1.42 (-2.1, -0.73)
	Dementia	5,235	2.71	2,291	2.45	-0.26 (-1.04, 0.51)
	Diabetes (with complications)	9,534	4.94	4,377	4.67	-0.26 (-1.02, 0.50)
	Diabetes	33,000	17.08	14,485	15.46	-1.62 (-2.34, -0.91)
	Metastatic tumour	1,219	0.63	621	0.66	0.03 (-0.74, 0.81)
	Mild liver disease	1,549	0.80	688	0.73	-0.07 (-0.84, 0.71)
	Moderate liver disease	518	0.27	223	0.24	-0.03 (-0.81, 0.75)
	Paraplegia	1,247	0.65	545	0.58	-0.06 (-0.84, 0.71)
	Peptic ulcer	8,914	4.61	4,182	4.46	-0.15 (-0.91, 0.61)
	Peripheral vascular disease	6,972	3.61	3,213	3.43	-0.18 (-0.95, 0.59)
	Renal disease	28,149	14.57	14,250	15.21	0.64 (-0.08, 1.36)
	****Dementia_**	57,626	29.83	22,917	24.46	-5.37 (-6.04, -4.70)
	Hypertension	94,383	48.86	44,230	47.22	-1.65 (-2.21, -1.08)
	Hypothyroidism	21,945	11.36	10,921	11.66	0.30 (-0.44, 1.03)
	Osteoporosis	14,357	7.43	6,737	7.19	-0.24 (-0.99, 0.51)
	Venous thromboembolism	10,565	5.47	5,278	5.63	0.16 (-0.59, 0.92)
	Severe infection	2,884	1.49	1,214	1.30	-0.20 (-0.97, 0.58)
Analgesia	**NSAIDs**	25,338	13.12	11,947	12.75	-0.36 (-1.09, 0.36)
	Weak opiates	49,106	25.42	20,505	21.89	-3.53 (-4.22, -2.85)
	Strong opiates	6,611	3.42	3,111	3.32	-0.10 (-0.87, 0.67)
Healthcare use	**GP Events**	154,530	80.00	74,621	79.66	-0.34 (-0.69, 0.01)
	Outpatient visits	99,035	51.27	45,927	49.03	-2.24 (-2.8, -1.69)
	Hospital Admission	44,391	22.98	21,243	22.68	-0.30 (-0.99, 0.38)
	Non-emergency hospital admission	29,204	15.12	14,764	15.76	0.64 (-0.08, 1.36)

	Emergency hospital admission	21,475	11.12	9,558	10.20	-0.91 (-1.65, -0.18)
Joint replacement	**Hip**	20,535	10.63	12,014	12.82	2.19 (1.46, 2.93)
	Knee	9,091	4.71	6,062	6.47	1.76 (1.01, 2.52)
	Other/Unspecified	55	0.03	29	0.03	0.00 (-0.78, 0.78)
OA type	**Hip**	218	0.11	148	0.16	0.05 (-0.73, 0.83)
	Knee	1,475	0.76	880	0.94	0.18 (-0.60, 0.95)
	Lower limb (foot & ankle)	5,785	2.99	2,674	2.85	-0.14 (-0.91, 0.63)
	Hand	5,429	2.81	2,850	3.04	0.23 (-0.54, 1.00)
	Upper limb	2,175	1.13	1,196	1.28	0.15 (-0.63, 0.93)
	Spine	1,417	0.73	776	0.83	0.09 (-0.68, 0.87)
	Other/unspecified	59	0.03	57	0.06	0.03 (-0.74, 0.80)
	***Non-hip/knee**	9,194	4.76	4,627	4.94	0.18 (-0.58, 0.94)
Mortality	**Deaths**	17,254	8.93	8,931	9.53	0.60 (-0.14, 1.34)

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.

**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.

***Combined OA types which are neither hip nor knee – also includes unspecified types.

Table S5. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic use, healthcare use and joint replacement for the Welsh population with a diagnosis of osteoarthritis at 4-5 years from index date.

Category	Detail	Unadjusted			Adjusted for age, sex and WIMD quintile		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate frailty**	0.989	0.976	1.001	1.030	1.017	1.043
Charlson comobidities	**At least one Charlson comorbidity**	0.980	0.977	0.983	0.988	0.985	0.991
Comorbidities	***Cardiovascular disease**	1.003	0.990	1.013	1.008	0.997	1.019
	Cardiac arrhythmia	1.094	1.068	1.113	1.063	1.041	1.085
	CVD	0.971	0.956	0.983	0.991	0.977	1.005
	Myocardial infarction	0.954	0.924	0.986	0.974	0.942	1.008
	Valvular disease	0.997	0.958	1.029	0.966	0.930	1.003
	Congestive heart disease	0.995	0.964	1.033	1.013	0.977	1.051
	Cataracts	0.973	0.954	0.990	0.963	0.945	0.981
	Cancer	1.000	0.982	1.015	0.955	0.939	0.972
	Cerebrovascular disease	0.972	0.941	0.992	0.981	0.955	1.008
	Respiratory disease	0.939	0.925	0.953	0.991	0.976	1.006
	Dementia	0.902	0.851	0.935	0.910	0.866	0.956
	Diabetes (with complications)	0.947	0.914	0.979	0.995	0.960	1.003
	Diabetes	0.905	0.890	0.922	0.957	0.939	0.975
	Metastatic tumour	1.050	0.944	1.133	1.031	0.934	1.139
	Mild liver disease	0.916	0.836	0.997	0.955	0.870	1.048
	Moderate liver disease	0.888	0.763	1.038	0.932	0.789	1.100
	Paraplegia	0.901	0.813	0.990	0.963	0.867	1.068
	Peptic ulcer	0.967	0.937	1.005	1.004	0.967	1.042
	Peripheral vascular disease	0.950	0.910	0.986	0.990	0.949	1.033
	Renal disease	1.044	1.024	1.062	1.073	1.053	1.093
	****Dementia_**	0.820	0.809	0.830	0.881	0.869	0.893
	Hypertension	0.966	0.958	0.974	0.976	0.968	0.984
	Hypothyroidism	1.026	1.008	1.052	1.042	1.019	1.065
	Osteoporosis	0.968	0.939	0.993	0.962	0.935	0.989
	Venous thromboembolism	1.030	0.998	1.063	1.035	1.001	1.070
	Severe infection	0.868	0.813	0.929	0.917	0.856	0.983
Analgesia	**NSAIDs**	0.972	0.953	0.993	1.002	0.981	1.023
	Weak opiates	0.861	0.849	0.874	0.936	0.922	0.950
	Strong opiates	0.970	0.931	1.013	1.059	1.014	1.106
Healthcare use	**GP Events**	0.996	0.993	1.001	0.999	0.995	1.003
	Outpatient visits	0.956	0.949	0.965	0.963	0.956	0.971
	Hospital Admission	0.987	0.973	1.002	0.988	0.983	1.013
	Non-emergency hospital admission	1.042	1.024	1.062	1.037	1.018	1.057
	Emergency hospital admission	0.918	0.897	0.939	0.954	0.932	0.977
Mortality	**Deaths**	0.953	0.987	1.012	0.993	0.934	1.056
Joint replacement	**Hip**	1.375	1.332	1.419	1.291	1.250	1.334
	Knee	1.077	1.045	1.109	1.049	1.017	1.082
	Other/Unspecified	1.400	1.136	1.725	1.353	1.088	1.683

OA type	**Hip**	1.230	1.132	1.337	1.176	1.080	1.281
	Knee	0.953	0.911	0.997	0.965	0.921	1.012
	Lower limb (foot & ankle)	1.082	1.035	1.132	1.066	1.018	1.117
	Hand	1.134	1.057	1.216	1.097	1.020	1.180
	Upper limb	1.129	1.035	1.232	1.106	1.012	1.210
	Spine	1.992	1.384	2.867	1.813	1.255	2.619
	Other/Unspecified	1.038	1.003	1.074	1.030	0.994	1.067
	***N**on-hip/knee**	1.067	1.042	1.094	1.052	1.026	1.079

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.
***Combined OA types which are neither hip nor knee – also includes unspecified types.

Table S6. Geographical distribution of inflammatory arthritis patients at index date in Wales, by age and sex

Age band (years) @ index date	Geographical distribution of inflammatory arthritis patients at index date in Wales, by age and sex							
	Urban				Rural			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
18-29	55	0.36%	127	0.83%	16	0.10%	39	0.25%
30-39	231	1.50%	476	3.10%	89	0.58%	172	1.12%
40-49	470	3.06%	875	5.70%	203	1.32%	391	2.55%
50-59	774	5.04%	1,547	10.08%	405	2.64%	678	4.42%
60-69	949	6.18%	1,586	10.33%	477	3.11%	905	5.90%
70-79	848	5.52%	1,435	9.35%	443	2.89%	733	4.78%
80+	297	1.93%	614	4.00%	186	1.21%	329	2.14%

Table S7. Sociodemographic and clinical characteristics of urban and rural inflammatory arthritis populations in Wales at index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Sex	**Female**	7809	64.53%	3817	63.95%	-0.58%
Age group (years)	**18-19**	63	0.52%	17	0.28%	-0.24%
	20-29	505	4.17%	173	2.90%	-1.27%
	30-39	1217	10.06%	438	7.34%	-2.72%
	40-49	2026	16.74%	978	16.38%	-0.36%
	50-59	2854	23.58%	1448	24.26%	0.67%
	60-69	2965	24.50%	1558	26.10%	1.60%
	70-79	1912	15.80%	1082	18.13%	2.33%
	80+	559	4.62%	275	4.61%	-0.01%
Deprivation quintile	**1 - Most deprived**	3098	25.60%	492	8.24%	-17.36%
	2	2890	23.88%	994	16.65%	-7.23%
	3	2357	19.48%	1627	27.26%	7.78%
	4	1763	14.57%	1824	30.56%	15.99%
	5 - Least deprived	1993	16.47%	1032	17.29%	0.82%
Smoking status	**Never smoked**	867	7.16%	434	7.27%	0.11%
	Ex-smoker	1313	10.85%	782	13.10%	2.25%
	Smoker	1107	9.15%	548	9.18%	0.03%
	Unknown	8814	72.84%	4205	70.45%	-2.39%
Alcohol intake	**Non-drinker**	3696	30.54%	2149	36.00%	5.46%
	Within guidelines	3815	31.53%	1953	32.72%	1.19%
	Above guidelines	925	7.64%	403	6.75%	-0.89%
	Unknown	3665	30.29%	1464	24.53%	-5.76%
Frailty	**At least moderate**	1212	10.02%	627	10.50%	0.49%
	Fit	6742	55.71%	3259	54.60%	-1.12%
	Mild	4147	34.27%	2083	34.90%	0.63%
	Moderate	1019	8.42%	535	8.96%	0.54%
	Severe	193	1.59%	92	1.54%	-0.05%
Charlson comorbidities	**At least one**	8582	70.92%	4254	71.27%	0.35%
	1-2	3519	29.08%	1715	28.73%	-0.35%
	3+	5791	47.86%	2877	48.20%	0.34%
Comorbidities	***Cardiovascular disease (combined)**	2791	23.06%	1377	23.07%	0.00%
	Cardiac arrhythmia	2127	17.58%	1124	18.83%	1.25%
	CVD	571	4.72%	319	5.34%	0.63%
	Myocardial infarction	1618	13.37%	849	14.22%	0.85%
	Valvular disease	402	3.32%	197	3.30%	-0.02%
	Congestive heart disease	200	1.65%	105	1.76%	0.11%
	Cataracts	199	1.64%	83	1.39%	-0.25%
	Cancer	681	5.63%	357	5.98%	0.35%
	Cerebrovascular disease	876	7.24%	471	7.89%	0.65%
	Respiratory disease	432	3.57%	232	3.89%	0.32%
	Dementia	2642	21.83%	1238	20.74%	-1.09%
	Diabetes (with complications)	25	0.21%	15	0.25%	0.04%

	Diabetes	262	2.17%	133	2.23%	0.06%
	Metastatic tumour	1116	9.22%	537	9.00%	-0.23%
	Mild liver disease	[Redacted]	NA%	NA	NA%	NA%
	Moderate liver disease	53	0.44%	28	0.47%	0.03%
	Paraplegia	[Redacted]	NA%	NA	NA%	NA%
	Peptic ulcer	34	0.28%	21	0.35%	0.07%
	Peripheral vascular disease	439	3.63%	215	3.60%	-0.03%
	Renal disease	205	1.69%	113	1.89%	0.20%
	****Dementia_**	753	6.22%	405	6.79%	0.56%
	Hypertension	2748	22.71%	1151	19.28%	-3.43%
	Hypothyroidism	3689	30.49%	1851	31.01%	0.53%
	Osteoporosis	1248	10.31%	615	10.30%	-0.01%
	Venous thromboembolism	699	5.78%	352	5.90%	0.12%
	Severe infection	436	3.60%	260	4.36%	0.75%
Analgesia	**NSAIDs**	169	1.40%	72	1.21%	-0.19%
	Weak opiates	6574	54.33%	3065	51.35%	-2.98%
	Strong opiates	5936	49.05%	2729	45.72%	-3.33%
Healthcare use	**GP Events**	424	3.50%	206	3.45%	-0.05%
	Outpatient visits	12010	99.25%	5922	99.21%	-0.04%
	Hospital Admission	9950	82.22%	4683	78.46%	-3.77%
	Emergency hospital admission	3215	26.57%	1534	25.70%	-0.87%
	Non-emergency hospital admission	2178	18.00%	1085	18.18%	0.18%
Joint replacement	**Hip**	859	7.10%	447	7.49%	0.39%
	Knee	339	2.80%	212	3.55%	0.75%
	Other/Unspecified	[Redacted]	NA%	NA	NA%	NA%

Table S8. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic use, healthcare use and joint replacement for the Welsh population with a diagnosis of inflammatory arthritis at index date.

Category	Detail	Unadjusted			Adjusted		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate**	1.05	0.96	1.15	1.05	0.96	1.15
Charlson Comorbidities	**At least one**	1	0.99	1.02	1	0.98	1.02
Comorbidities	***Cardiovascular disease**	1.07	1	1.14	1.03	0.97	1.1
	Cardiac arrhythmia	1.13	0.99	1.29	1.06	0.92	1.21
	CVD	1.06	0.98	1.15	1.04	0.97	1.13
	Myocardial infarction	0.99	0.84	1.17	0.98	0.83	1.17
	Valvular disease	1.06	0.84	1.35	1.01	0.78	1.3
	Congestive heart disease	0.85	0.66	1.09	0.8	0.61	1.05
	Cataracts	1.06	0.94	1.2	0.95	0.84	1.08
	Cancer	1.09	0.98	1.21	0.98	0.88	1.1
	Cerebrovascular disease	1.09	0.93	1.27	1.02	0.87	1.21
	Respiratory disease	0.95	0.89	1.01	0.97	0.92	1.04
	Dementia	1.22	0.64	2.31	1.1	0.56	2.15
	Diabetes (with complications)	1.03	0.84	1.27	0.98	0.79	1.22
	Diabetes	0.98	0.88	1.08	0.95	0.86	1.06
	Metastatic tumour	NA	NA	NA	NA	NA	NA
	Mild liver disease	1.07	0.68	1.69	1.02	0.63	1.64
	Moderate liver disease	NA	NA	NA	NA	NA	NA
	Paraplegia	1.25	0.73	2.16	1.33	0.74	2.39
	Peptic ulcer	0.99	0.85	1.17	0.97	0.82	1.14
	Peripheral vascular disease	1.12	0.89	1.4	1.05	0.83	1.33
	Renal disease	1.09	0.97	1.23	1.06	0.94	1.19
	****Dementia_**	0.85	0.8	0.9	0.92	0.87	0.98
	Hypertension	1.02	0.97	1.07	0.98	0.94	1.03
	Hypothyroidism	1	0.91	1.09	0.97	0.88	1.06
	Osteoporosis	1.02	0.9	1.16	0.99	0.87	1.12
	Venous thromboembolism	1.21	1.04	1.41	1.16	0.99	1.36
	Severe infection	0.86	0.66	1.14	0.91	0.68	1.22
Analgesia	**NSAIDs**	0.95	0.92	0.97	0.95	0.93	0.98
	Weak opiates	0.93	0.9	0.96	0.96	0.92	0.99
	Strong opiates	0.98	0.84	1.16	1.02	0.86	1.21
Healthcare use	**GP Events**	1	1	1	1	1	1
	Outpatient visits	0.95	0.94	0.97	0.96	0.94	0.98
	Hospital Admission	0.97	0.92	1.02	0.97	0.92	1.02
	Non-emergency hospital admission	1.01	0.95	1.08	1	0.93	1.07
	Emergency hospital admission	0.9	0.83	0.98	0.93	0.85	1.02
Joint replacements	**Hip**	1.27	1.07	1.5	1.24	1.05	1.48
	Knee	1.01	0.87	1.16	0.97	0.83	1.13
	Other/Unspecified	0.88	0.62	1.26	0.93	0.65	1.34

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.

Table S9. Clinical characteristics of urban and rural inflammatory arthritis populations in Wales at 4-5 years from index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Frailty	At least moderate frailty	2924	24.37%	1510	25.52%	1.15%
	Fit	3616	30.14%	1582	26.74%	-3.40%
	Mild	5459	45.50%	2825	47.74%	2.25%
	Moderate	2293	19.11%	1161	19.62%	0.51%
	Severe	631	5.26%	349	5.90%	0.64%
Charlson comorbidities	At least one Charlson comorbidity	9559	79.66%	4802	81.16%	1.49%
	0	2440	20.34%	1115	18.84%	-1.49%
	1-2	5341	44.51%	2723	46.02%	1.51%
	3+	4218	35.15%	2079	35.14%	-0.02%
Comorbidities	*Cardiovascular disease	2895	24.13%	1548	26.16%	2.03%
	Cardiac arrhythmia	917	7.64%	529	8.94%	1.30%
	CVD	2142	17.85%	1112	18.79%	0.94%
	Myocardial infarction	532	4.43%	277	4.68%	0.25%
	Valvular disease	335	2.79%	181	3.06%	0.27%
	Congestive heart disease	375	3.13%	171	2.89%	-0.24%
	Cataracts	1173	9.78%	594	10.04%	0.26%
	Cancer	1365	11.38%	755	12.76%	1.38%
	Cerebrovascular disease	650	5.42%	344	5.81%	0.40%
	Respiratory disease	2955	24.63%	1390	23.49%	-1.14%
	Dementia	118	0.98%	62	1.05%	0.06%
	Diabetes (with complications)	417	3.48%	211	3.57%	0.09%
	Diabetes	1489	12.41%	717	12.12%	-0.29%
	Metastatic tumour	54	0.45%	37	0.63%	0.18%
	Mild liver disease	74	0.62%	43	0.73%	0.11%
	Moderate liver disease	20	0.17%	10	0.17%	0.00%
	Paraplegia	45	0.38%	23	0.39%	0.01%
	Peptic ulcer	517	4.31%	266	4.50%	0.19%
	Peripheral vascular disease	309	2.58%	168	2.84%	0.26%
	Renal disease	1453	12.11%	766	12.95%	0.84%
	**Dementia_	3283	27.36%	1384	23.39%	-3.97%
	Hypertension	4511	37.59%	2234	37.76%	0.16%
	Hypothyroidism	1420	11.83%	704	11.90%	0.06%
	Osteoporosis	1271	10.59%	620	10.48%	-0.11%
	Venous thromboembolism	617	5.14%	381	6.44%	1.30%
	Severe infection	282	2.35%	117	1.98%	-0.37%
Analgesia	NSAIDs	2903	24.19%	1301	21.99%	-2.21%
	Weak opiates	3646	30.39%	1644	27.78%	-2.60%
	Strong opiates	633	5.28%	300	5.07%	-0.21%
Healthcare use	GP Events	10087	84.07%	4949	83.64%	-0.42%
	Outpatient visits	9366	78.06%	4328	73.15%	-4.91%
	Hospital Admission	3046	25.39%	1476	24.95%	-0.44%
	Non-emergency hospital admission	2106	17.55%	1063	17.97%	0.41%

	Emergency hospital admission	1441	12.01%	658	11.12%	-0.89%
Mortality	**Deaths**	102	0.84%	52	0.87%	0.03%
Joint replacement	**Hip**	176	1.47%	139	2.35%	0.88%
	Knee	326	2.72%	170	2.87%	0.16%
	Other/Unspecified	39	0.33%	18	0.30%	-0.02%

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.

Table S10. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic use, healthcare use and joint replacement for the Welsh population with a diagnosis of inflammatory arthritis at 4-5 years from index date.

Category	Detail	Unadjusted			Adjusted for age, sex and WIMD quintile		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate frailty**	1.05	0.99	1.11	1.04	0.99	1.1
Charlson comorbidities	**At least one Charlson comorbidity**	1.02	1	1.03	1.01	1	1.03
Comorbidities	***Cardiovascular disease**	1.08	1.03	1.14	1.04	0.99	1.1
	Cardiac arrhythmia	1.17	1.06	1.3	1.07	0.97	1.19
	CVD	1.05	0.99	1.12	1.03	0.97	1.1
	Myocardial infarction	1.06	0.92	1.22	1.05	0.91	1.22
	Valvular disease	1.1	0.92	1.31	1.03	0.85	1.24
	Congestive heart disease	0.92	0.77	1.11	0.87	0.72	1.04
	Cataracts	1.03	0.94	1.13	0.95	0.86	1.04
	Cancer	1.12	1.03	1.22	1.03	0.95	1.12
	Cerebrovascular disease	1.07	0.95	1.22	1.03	0.9	1.17
	Respiratory disease	0.95	0.9	1.01	0.98	0.93	1.04
	Dementia	1.07	0.78	1.45	0.97	0.71	1.35
	Diabetes (with complications)	1.03	0.87	1.21	1.01	0.85	1.2
	Diabetes	0.98	0.9	1.06	0.97	0.89	1.06
	Metastatic tumour	1.39	0.92	2.11	1.35	0.87	2.09
	Mild liver disease	1.18	0.81	1.71	1.18	0.79	1.74
	Moderate liver disease	1.01	0.47	2.16	1.1	0.48	2.51
	Paraplegia	1.04	0.63	1.71	1.15	0.68	1.94
	Peptic ulcer	1.04	0.9	1.21	1.02	0.88	1.19
	Peripheral vascular disease	1.1	0.92	1.33	1.03	0.85	1.25
	Renal disease	1.07	0.99	1.16	1.03	0.94	1.11
	****Dementia_**	0.85	0.81	0.9	0.92	0.87	0.98
	Hypertension	1	0.96	1.05	0.98	0.94	1.02
	Hypothyroidism	1.01	0.92	1.09	0.97	0.89	1.06
	Osteoporosis	0.99	0.9	1.08	0.96	0.88	1.05
	Venous thromboembolism	1.25	1.11	1.42	1.21	1.06	1.37
	Severe infection	0.84	0.68	1.04	0.83	0.67	1.03
Analgesia	**NSAIDs**	0.91	0.86	0.96	0.95	0.9	1.01
	Weak opiates	0.91	0.87	0.96	0.98	0.93	1.03
	Strong opiates	0.96	0.84	1.1	0.99	0.86	1.14
Healthcare use	**GP Events**	0.99	0.98	1.01	1	0.99	1.01
	Outpatient visits	0.94	0.92	0.95	0.95	0.93	0.97
	Hospital Admission	0.98	0.93	1.04	0.99	0.93	1.04
	Non-emergency hospital admission	1.02	0.96	1.09	1.02	0.95	1.09
	Emergency hospital admission	0.93	0.85	1.01	0.94	0.86	1.03
Joint replacement	**Any**	1.24	1.08	1.42	1.18	1.03	1.36
	Hip	1.6	1.29	2	1.44	1.15	1.8
	Knee	1.06	0.88	1.27	1.04	0.86	1.26
	Shoulder	NA	NA	NA	NA	NA	NA

	Other/Unspecified	0.94	0.54	1.63	0.88	0.51	1.54

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a code list from Sarica, et al to identify patients.

Table S11. Geographical distribution of RAIRD patients at index date in Wales, by age and sex.

Age band (years) @ index date	Geographical distribution of RAIRD patients at index date in Wales, by age and sex							
	Urban				Rural			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
18-29	19	0.65%	113	3.86%	12	0.41%	35	1.19%
30-39	26	0.89%	142	4.85%	14	0.48%	55	1.88%
40-49	80	2.73%	246	8.40%	34	1.16%	103	3.52%
50-59	121	4.13%	292	9.97%	65	2.22%	157	5.36%
60-69	146	4.98%	348	11.88%	93	3.17%	208	7.10%
70+	127	4.33%	264	9.01%	76	2.59%	154	5.26%

Table S12. Sociodemographic and clinical characteristics of urban and rural RAIRD populations in Wales at index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Sex	**Female**	1405	73.02%	712	70.78%	-2.25%
Age group (years)	**18-19**	20	1.04%	6	0.60%	-0.44%
	20-29	112	5.82%	41	4.08%	-1.75%
	30-39	168	8.73%	69	6.86%	-1.87%
	40-49	326	16.94%	137	13.62%	-3.33%
	50-59	413	21.47%	222	22.07%	0.60%
	60-69	494	25.68%	301	29.92%	4.24%
	70-79	292	15.18%	187	18.59%	3.41%
	80+	99	5.15%	43	4.27%	-0.87%
Deprivation quintile	**1 - Most deprived**	493	25.62%	63	6.26%	-19.36%
	2	440	22.87%	159	15.81%	-7.06%
	3	357	18.56%	274	27.24%	8.68%
	4	276	14.35%	319	31.71%	17.36%
	5 - Least deprived	358	18.61%	191	18.99%	0.38%
Smoking status	**Never smoked**	156	8.11%	77	7.65%	-0.45%
	Ex-smoker	208	10.81%	118	11.73%	0.92%
	Smoker	134	6.96%	66	6.56%	-0.40%
	Unknown	1426	74.12%	745	74.06%	-0.06%
Alcohol intake	**Non-drinker**	640	33.26%	379	37.67%	4.41%
	Within guidelines	590	30.67%	330	32.80%	2.14%
	Above guidelines	112	5.82%	54	5.37%	-0.45%
	Unknown	582	30.25%	243	24.16%	-6.09%
Frailty	**At least moderate**	273	14.19%	154	15.31%	1.12%
	Fit	938	48.75%	469	46.62%	-2.13%
	Mild	713	37.06%	383	38.07%	1.01%
	Moderate	231	12.01%	131	13.02%	1.02%
	Severe	42	2.18%	23	2.29%	0.10%
Charlson comorbidities	**At least one**	1505	78.22%	797	79.22%	1.00%
	1-2	419	21.78%	209	20.78%	-1.00%
	3+	937	48.70%	505	50.20%	1.50%
Comorbidities	***Cardiovascular disease (combined)**	568	29.52%	292	29.03%	-0.50%
	Cardiac arrhythmia	497	25.83%	259	25.75%	-0.09%
	CVD	106	5.51%	81	8.05%	2.54%
	Myocardial infarction	411	21.36%	190	18.89%	-2.48%
	Valvular disease	64	3.33%	30	2.98%	-0.34%
	Congestive heart disease	49	2.55%	19	1.89%	-0.66%
	Cataracts	31	1.61%	20	1.99%	0.38%
	Cancer	142	7.38%	69	6.86%	-0.52%
	Cerebrovascular disease	149	7.74%	73	7.26%	-0.49%
	Respiratory disease	108	5.61%	56	5.57%	-0.05%
	Dementia	468	24.32%	232	23.06%	-1.26%
	Diabetes (with complications)	NA	NA%	NA	NA%	NA%

	Diabetes	35	1.82%	31	3.08%	1.26%
	Metastatic tumour	179	9.30%	93	9.24%	-0.06%
	Mild liver disease	NA	NA%	NA	NA%	NA%
	Moderate liver disease	40	2.08%	12	1.19%	-0.89%
	Paraplegia	NA	NA%	NA	NA%	NA%
	Peptic ulcer	NA	NA%	NA	NA%	NA%
	Peripheral vascular disease	66	3.43%	39	3.88%	0.45%
	Renal disease	47	2.44%	23	2.29%	-0.16%
	****Dementia_**	191	9.93%	112	11.13%	1.21%
	Hypertension	511	26.56%	226	22.47%	-4.09%
	Hypothyroidism	609	31.65%	343	34.10%	2.44%
	Osteoporosis	229	11.90%	146	14.51%	2.61%
	Venous thromboembolism	143	7.43%	81	8.05%	0.62%
	Severe infection	132	6.86%	61	6.06%	-0.80%
Analgesia	**NSAIDs**	77	4.00%	41	4.08%	0.07%
	Weak opiates	576	29.94%	264	26.24%	-3.70%
	Strong opiates	807	41.94%	359	35.69%	-6.26%
Healthcare use	**GP Events**	70	3.64%	37	3.68%	0.04%
	Outpatient visits	1915	99.53%	1000	99.40%	-0.13%
	Hospital Admission	1653	85.91%	838	83.30%	-2.61%
	Emergency hospital admission	937	48.70%	481	47.81%	-0.89%
	Non-emergency hospital admission	570	29.63%	276	27.44%	-2.19%
Joint replacement	**Hip**	92	4.78%	53	5.27%	0.49%
	Knee	42	2.18%	30	2.98%	0.80%
	Other/Unspecified	NA	NA%	NA	NA%	NA%

**Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.*
***Alternative dementia coding which uses a codelist from Sarica, et al to identify patients.*

Table S13. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic and healthcare use for the Welsh population with a diagnosis of RAIRD at index date.

Category	Detail	Unadjusted			Adjusted		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate**	1.08	0.9	1.29	1.06	0.89	1.27
Charlson Comorbidities	**At least one**	1.01	0.97	1.05	1	0.96	1.04
Comorbidities	***Cardiovascular disease**	1	0.88	1.13	0.95	0.83	1.09
	Cardiac arrhythmia	1.46	1.11	1.93	1.34	1.01	1.77
	CVD	0.88	0.76	1.03	0.85	0.73	1
	Myocardial infarction	0.9	0.58	1.37	0.92	0.59	1.44
	Valvular disease	0.74	0.44	1.25	0.71	0.41	1.24
	Congestive heart disease	1.23	0.71	2.15	1.11	0.62	1.98
	Cataracts	0.93	0.7	1.23	0.84	0.64	1.11
	Cancer	0.94	0.72	1.23	0.86	0.65	1.13
	Cerebrovascular disease	0.99	0.72	1.36	0.98	0.71	1.36
	Respiratory disease	0.95	0.83	1.09	0.96	0.83	1.11
	Dementia	NA	NA	NA	NA	NA	NA
	Diabetes (with complications)	1.69	1.05	2.73	1.72	1	2.97
	Diabetes	0.99	0.78	1.26	0.96	0.74	1.24
	Metastatic tumour	NA	NA	NA	NA	NA	NA
	Mild liver disease	0.57	0.3	1.09	0.55	0.28	1.08
	Moderate liver disease	NA	NA	NA	NA	NA	NA
	Paraplegia	NA	NA	NA	NA	NA	NA
	Peptic ulcer	1.13	0.77	1.67	1.15	0.76	1.73
	Peripheral vascular disease	0.94	0.57	1.53	0.9	0.54	1.49
	Renal disease	1.12	0.9	1.4	1.13	0.91	1.42
	****Dementia_**	0.85	0.74	0.97	0.91	0.79	1.05
	Hypertension	1.08	0.97	1.2	1.05	0.95	1.18
	Hypothyroidism	1.22	1.01	1.48	1.21	0.99	1.48
	Osteoporosis	1.08	0.83	1.41	1.03	0.79	1.34
	Venous thromboembolism	0.88	0.66	1.19	0.91	0.67	1.24
	Severe infection	1.02	0.7	1.48	0.95	0.65	1.4
Analgesia	**NSAIDs**	0.88	0.77	0.99	0.95	0.83	1.08
	Weak opiates	0.85	0.77	0.94	0.89	0.8	0.99
	Strong opiates	1.01	0.68	1.49	1.02	0.68	1.54
Healthcare use	**GP Events**	1	0.99	1	1	0.99	1
	Outpatient visits	0.97	0.94	1	0.98	0.95	1.01
	Hospital Admission	0.98	0.91	1.06	0.97	0.89	1.05
	Non-emergency hospital admission	0.93	0.82	1.05	0.89	0.79	1.01
	Emergency hospital admission	0.99	0.88	1.11	0.98	0.87	1.1
Joint replacements	**Hip**	1.37	0.86	2.17	1.16	0.73	1.82
	Knee	0.96	0.59	1.55	0.89	0.53	1.5
	Other/Unspecified	1.04	0.39	2.81	1	0.33	3.02

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a codelist from Sarica, et al to identify patients.

Table S14. Clinical characteristics of urban and rural RAIRD populations in Wales at 4-5 years from index date.

Category	Detail	Urban		Rural		Difference
		N	%	N	%	%
Frailty	**At least moderate frailty**	545	28.68%	283	28.61%	-0.07%
	Fit	482	25.37%	239	24.17%	-1.20%
	Mild	873	45.95%	467	47.22%	1.27%
	Moderate	423	22.26%	203	20.53%	-1.74%
	Severe	122	6.42%	80	8.09%	1.67%
Charlson comorbidities	**At least one Charlson comorbidity**	1698	89.37%	901	91.10%	1.73%
	0	202	10.63%	88	8.90%	-1.73%
	1-2	780	41.05%	421	42.57%	1.52%
	3+	918	48.32%	480	48.53%	0.22%
Comorbidities	***Cardiovascular disease**	767	40.37%	395	39.94%	-0.43%
	Cardiac arrhythmia	167	8.79%	119	12.03%	3.24%
	CVD	644	33.89%	311	31.45%	-2.45%
	Myocardial infarction	90	4.74%	40	4.04%	-0.69%
	Valvular disease	85	4.47%	37	3.74%	-0.73%
	Congestive heart disease	63	3.32%	35	3.54%	0.22%
	Cataracts	298	15.68%	138	13.95%	-1.73%
	Cancer	232	12.21%	121	12.23%	0.02%
	Cerebrovascular disease	146	7.68%	80	8.09%	0.40%
	Respiratory disease	520	27.37%	253	25.58%	-1.79%
	Dementia	20	1.05%	16	1.62%	0.57%
	Diabetes (with complications)	60	3.16%	43	4.35%	1.19%
	Diabetes	274	14.42%	150	15.17%	0.75%
	Metastatic tumour	NA	NA%	NA	NA%	NA%
	Mild liver disease	47	2.47%	15	1.52%	-0.96%
	Moderate liver disease	11	0.58%	6	0.61%	0.03%
	Paraplegia	NA	NA%	NA	NA%	NA%
	Peptic ulcer	74	3.89%	42	4.25%	0.35%
	Peripheral vascular disease	71	3.74%	33	3.34%	-0.40%
	Renal disease	372	19.58%	214	21.64%	2.06%
	****Dementia_**	616	32.42%	288	29.12%	-3.30%
	Hypertension	758	39.89%	432	43.68%	3.79%
	Hypothyroidism	257	13.53%	161	16.28%	2.75%
	Osteoporosis	248	13.05%	128	12.94%	-0.11%
	Venous thromboembolism	198	10.42%	92	9.30%	-1.12%
	Severe infection	57	3.00%	31	3.13%	0.13%
Analgesia	**NSAIDs**	244	12.84%	105	10.62%	-2.23%
	Weak opiates	519	27.32%	231	23.36%	-3.96%
	Strong opiates	126	6.63%	51	5.16%	-1.47%
Healthcare use	**GP Events**	1553	81.74%	802	81.09%	-0.64%
	Outpatient visits	1510	79.47%	747	75.53%	-3.94%
	Hospital Admission	631	33.21%	316	31.95%	-1.26%
	Non-emergency hospital admission	443	23.32%	228	23.05%	-0.26%

	Emergency hospital admission	311	16.37%	144	14.56%	-1.81%
Mortality	**Deaths**	24	1.25%	17	1.69%	0.44%
Joint replacement	**Hip**	24	1.26%	6	0.61%	-0.66%
	Knee	30	1.58%	11	1.11%	-0.47%
	Other/Unspecified	NA	NA%	NA	NA%	NA%

*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.
**Alternative dementia coding which uses a codelist from Sarica, et al to identify patients.

Table S15. Relationship between living in a rural area and presence of frailty, co-morbidities, frailty, analgesic and healthcare use for the Welsh population with a diagnosis of RAIRD at 4-5 years from index date.

Category	Detail	Unadjusted			Adjusted for age, sex and WIMD quintile		
		Risk Ratio	95% Lower CI	95% Upper CI	Risk Ratio	95% Lower CI	95% Upper CI
Frailty	**At least moderate frailty**	1	0.88	1.13	0.97	0.86	1.09
Charlson comobidities	**At least one Charlson comorbidity**	1.02	0.99	1.05	1.01	0.98	1.04
Comorbidities	***Cardiovascular disease**	0.99	0.9	1.09	0.97	0.88	1.07
	Cardiac arrhythmia	1.37	1.1	1.71	1.25	1	1.56
	CVD	0.93	0.83	1.04	0.92	0.82	1.03
	Myocardial infarction	0.85	0.59	1.23	0.9	0.62	1.32
	Valvular disease	0.84	0.57	1.22	0.81	0.54	1.22
	Congestive heart disease	1.07	0.71	1.6	1.03	0.67	1.57
	Cataracts	0.89	0.74	1.07	0.76	0.63	0.91
	Cancer	1	0.82	1.23	0.93	0.75	1.15
	Cerebrovascular disease	1.05	0.81	1.37	1.06	0.81	1.4
	Respiratory disease	0.93	0.82	1.06	0.95	0.83	1.09
	Dementia	1.54	0.8	2.95	1.41	0.71	2.83
	Diabetes (with complications)	1.38	0.94	2.02	1.33	0.87	2.03
	Diabetes	1.05	0.88	1.26	1	0.83	1.21
	Metastatic tumour	NA	NA	NA	NA	NA	NA
	Mild liver disease	0.61	0.34	1.09	0.61	0.32	1.13
	Moderate liver disease	1.05	0.39	2.83	0.78	0.25	2.38
	Paraplegia	NA	NA	NA	NA	NA	NA
	Peptic ulcer	1.09	0.75	1.58	1.1	0.74	1.63
	Peripheral vascular disease	0.89	0.6	1.34	0.94	0.62	1.43
	Renal disease	1.11	0.95	1.28	1.08	0.93	1.26
	****Dementia_**	0.9	0.8	1.01	0.95	0.84	1.07
	Hypertension	1.09	1	1.2	1.06	0.97	1.16
	Hypothyroidism	1.2	1	1.44	1.19	0.99	1.43
	Osteoporosis	0.99	0.81	1.21	0.89	0.73	1.09
	Venous thromboembolism	0.89	0.71	1.13	0.89	0.69	1.14
	Severe infection	1.04	0.68	1.61	1.11	0.7	1.76
Analgesia	**NSAIDs**	0.83	0.67	1.03	0.89	0.71	1.11
	Weak opiates	0.86	0.75	0.98	0.92	0.8	1.06
	Strong opiates	0.78	0.57	1.07	0.83	0.6	1.17
Healthcare use	**GP Events**	0.99	0.96	1.03	1	0.96	1.04
	Outpatient visits	0.95	0.91	0.99	0.96	0.92	1
	Hospital Admission	0.96	0.86	1.08	1	0.89	1.12
	Non-emergency hospital admission	0.99	0.86	1.14	1	0.86	1.16
	Emergency hospital admission	0.89	0.74	1.07	0.93	0.76	1.12
Joint replacement	**Hip**	0.48	0.2	1.17	0.58	0.22	1.47
	Knee	0.7	0.35	1.4	0.88	0.42	1.84
	Other/Unspecified	NA	NA	NA	NA	NA	NA

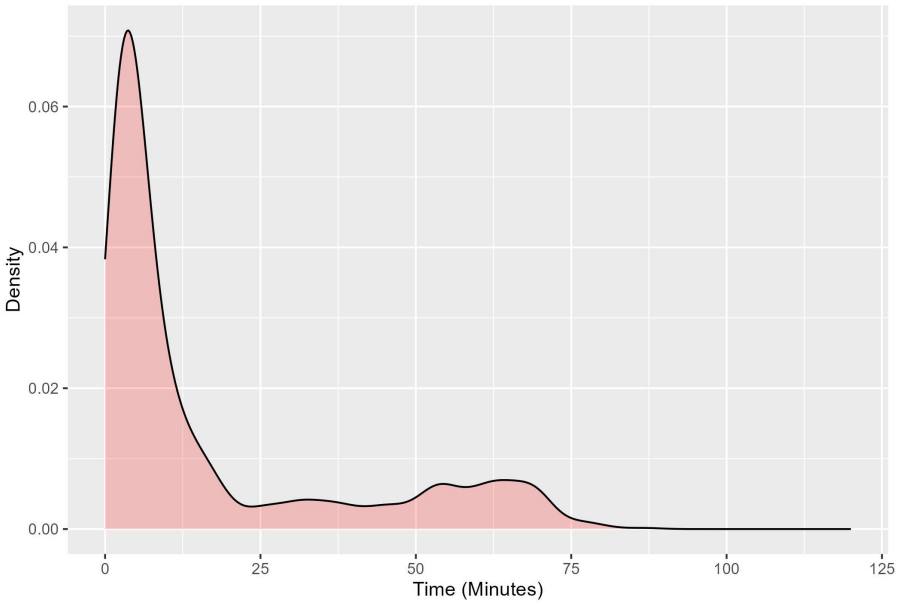
*Multiple cardiac-related Charlson comorbidities combined to include arrhythmias, MI, valvular disease & CHD.

**Alternative dementia coding which uses a codelist from Sarica, et al to identify patients.

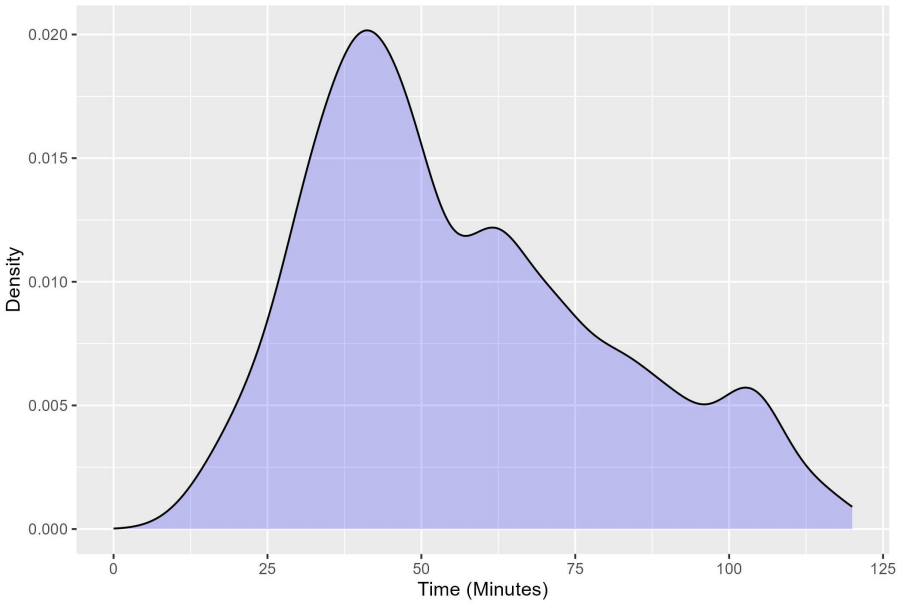
Appendix 6: Travel times by car and bus for people with RAIRDs to their nearest specialist rheumatology service

Figure S1. Travel time by (a) car and (b) bus to nearest specialist rheumatology services for people with RAIRD (relevant READ codes plus two or more prescriptions for at least one relevant conventional DMARD) in Wales.

(a) Car travel time to Rheumatology services



(b) Bus travel time to Rheumatology services (no access = not accessible by bus or bus travel time > 2 hours).



Appendix 7: Documents reviewed in place-based policy review

Click on the image below to open a spreadsheet of documents reviewed as part of the place-based policy review.

Date	Title	Author	Link
2009	Rural Health Plan- Improving integrated service delivery across Wales	Welsh Government	https://ruralhealthandcare.wales/wp-content/uploads/2017/07/WGRuralHealthPlan2009.pdf
2010	Setting the Direction, Primary and Community Services Strategic Delivery Programme	Welsh Government	https://phw.nhs.wales/services-and-teams/observatory/data-and-analysis/publication-documents/gp-clusters-2013/setting-the-direction-pdf/
2011	National Dementia Vision for Wales	Welsh Government	https://socialcare.wales/cms-assets/documents/National-dementia-vision-for-Wales.pdf
2012	Written Statement- Rural Health Implementation Plan Progress	Minister for Health and Social Services	https://www.gov.wales/written-statement-rural-health-implementation-plan-progress
2012	Together for Health, A Five Year Vision for the NHS in Wales	Welsh Government	https://studylib.net/doc/14085340/together-for-health-a-five-year-vision-for-the-nhs-in-wales
2013	Together for Health- Delivering End of Life Care, A Delivery Plan up to 2016 for NHS Wales and its	Welsh Government	https://static1.squarespace.com/static/58d8d0ffe4fcb5ad94cde63e/t/5b4365b28a922d4f1de5e39b/1531143603651/Wales+-+Delivering+EoL+Care.pdf
2013	A framework for Delivering Integrated Health and Social Care for Older People with Complex Needs	Welsh Government	https://www.rctcbc.gov.uk/EN/Council/PerformanceBudgetsandSpending/Councilperformance/RelatedDocuments/WGIntegration.pdf
2014	Mid Wales Healthcare Study Report- AKA the Longley Report.	Welsh Institute for Health and Social Care	https://pure.southwales.ac.uk/ws/portalfiles/portal/1440809/MWHS_Report_WIHSC_for_Welsh_Government.pdf
2018	The Welsh Language Standards Regulations 2018	Welsh Government	https://www.legislation.gov.uk/wsi/2018/441/made
2018	Dementia Action Plan	Welsh Government	https://www.gov.wales/sites/default/files/publications/2019-04/dementia-action-plan-for-wales.pdf
2018	Rural Health and Care Services in Wales	The Welsh NHS Confederation	https://www.nhsconfed.org/system/files/media/Rural-Health-and-Care-Services-in-Wales_0.pdf
2018	A healthier Wales: long term plan for health and social care	Welsh Government	https://www.gov.wales/sites/default/files/publications/2021-09/a-healthier-wales-our-plan-for-health-and-social-care.pdf
2021	A healthier Mid and West Wales: Our future generations living well	Welsh Government	https://hduhb.nhs.wales/about-us/healthier-mid-and-west-wales/healthier-mid-and-west-wales-folder/documents/a-healthier-mid-and-west-wales-strategy/
2023	Building capacity through Community Care- Further Faster	Welsh Government	https://www.gov.wales/sites/default/files/publications/2023-06/building-capacity-through-community-care-further-faster.pdf
			Aneurin Bevan University Health Board
2020	Cancer Strategy: Delivering a Vision		https://abuhb.nhs.wales/files/key-documents/annual-plan-2021-2022/appendix-3-cancer-strategy-final-draft-v-2019-11-27-002-pdf/
2019	Digital Strategy: Transformation through digital	To ensure that "in our area, people are looking after their own health and wellbeing and that of their families. When they need help, this is readily available at home, in their communities and it supported through innovative technology.	https://abuhb.nhs.wales/files/key-documents/digital-strategy/
			Betsi Cdwaladr University Health Board
2023	Annual Plan 2023	Annual plan for 23/24, set in the conext of longer term direction of travel for health and healthcare in North Wales.	https://bcuhb.nhs.wales/files/bcuhb-annual-plan-2023-compressed-1-pdf/
	Dementia: A shared Journey	A new guide to explain more about the support and services available for people diagnosed with dementia, their families and carers.	https://bcuhb.nhs.wales/files/dementia-pathways-community-final-en-pdf/
			Cwm Taf Morgannwg University Health Board

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