BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email

info.bmjopen@bmj.com

BMJ Open

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

SCHOLARONE™
Manuscripts

BMJ

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

Paul N Deslandes [1,2,3], Hannah Blowers [3], Kath Haines[1], Karen Hodson[3], Rhian E Deslandes*[3]

1. All Wales Therapeutics and Toxicology Centre, University Hospital Llandough, Penlan Road, Llandough, UK. CF64 2XX

2. School of Care Sciences, University of South Wales, Lower Glyntaff Campus, Treforest, UK. CF37 4DB

3. Cardiff School of Pharmacy and Pharmaceutical Sciences, Cardiff University, Cardiff, UK.

Corresponding author: Dr Rhian Deslandes deslandesRE@cardiff.ac.uk

Word count main text: 3,545

ABSTRACT

Objectives

The therapeutic classes of medicines prescribed by non-medical independent prescribers (NMIPs) working in primary care in Wales has not been studied in detail. The aim of the present study was to conduct a 10 year longitudinal analysis of NMIP prescribing in Wales from April 2011 to March 2021. The study examined the BNF chapters from which medicines were prescribed by NMIPs, whether this changed over time, and whether there was variation in prescribing across the geographic regions of Wales.

Participants

Nationwide and health board monthly prescribing data for the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained from the Comparative Analysis System for Prescribing Audit (CASPA) software. Data were analysed according to BNF chapter, to identify which therapeutic areas NMIPs were prescribing, and whether this changed over the study period.

Results

The total number of items prescribed by NMIPs increased during the study period. From April 2011 to March 2021 prescribing in seven BNF chapters equated to approximately 80% of total items, with medicines from the cardiovascular system being most prescribed. In the financial year 2011-2012 the BNF chapters with the greatest proportion of items prescribed were infections (18%) and respiratory system (13%), whilst in 2020-2021, the BNF chapters with the greatest proportion of items prescribed were Cardiovascular (23%) and Nervous system (19%). The number of items prescribed in each health board in Wales varied, however, the BNF chapters contributing the largest percentages of items to the health board totals were broadly comparable.

Conclusions

The BNF chapter with the most prescribed items changed from Infection to Cardiovascular during the study period, suggesting an increase in chronic disease management by NMIPs. The impact of this on the delivery of primary care services and patient outcomes is a focus for future work.

Strengths and limitations of this study

- This study used an All Wales database, covering 10 years of non-medical independent prescribing data across the whole population in primary care.

- The data obtained allowed trends and regional variation in prescribing to be identified.
- The secondary data used did not allow causal inferences to be drawn.
- Individual patient level data were not available, therefore the appropriateness of prescribing could not be assessed.

INTRODUCTION

In the United Kingdom (UK), prescribing practice has changed significantly since the 1980s. Legislative changes in the 1990s and early 2000s granted prescribing rights to non-medical health care professionals, with appropriate experience in their relevant scope of practice who had completed an accredited course of training.[1] Non-medical independent prescribing, defined as: '*prescribing by a practitioner (e.g., doctor, dentist, nurse, pharmacist) responsible and accountable for the assessment of patients with undiagnosed or diagnosed conditions and for decisions about the clinical management required, including prescribing.*' was first introduced for pharmacists and nurses in 2006.[2] The intention was to advance and develop the healthcare system, by improving patient access to medicines, and enhancing patient care and experience, without reducing safety.[3,4] In parallel, the roles and responsibilities of non-medical health care professionals have evolved, to facilitate support for a more flexible multidisciplinary healthcare team.[1,3]

Following implementation of non-medical prescribing, the benefits have been recognised widely by both patients and practitioners themselves. Patients report satisfaction and positive experiences including increased flexibility and accessibility,[5,6] and good rapport,[7] whilst practitioners report improved autonomy and job satisfaction despite certain barriers.[8] It has also been noted that non-medical independent prescribers (NMIPs) relieve pressures on GPs.[9] However, various barriers to the uptake and implementation of non-medical independent prescribing still exist, leading to inconsistencies both across and within organisations.[10,11]

In Wales, primary care NHS services are provided through seven local health boards (LHBs). As a way to manage increasing demand for primary care services in Wales, Welsh Government implemented 64 primary care clusters in 2015.[12] Clusters are composed of groups of adjacent general practices and partner organisations, such as community pharmacies, working together to collaboratively provide services locally.[13] Implementation aimed to refocus primary care and improve patients' access to healthcare, whilst relieving pressure on NHS hospitals. In 2018, Welsh Government published a vision for health and social care, 'A Healthier Wales', which outlines the aim to move from delivering an acute service and demonstrates a shift away from providing care in hospitals to

instead providing care in the community.[14] All of these initiatives were potential drivers for greater uptake of NMIPs into primary care in Wales.[8,15]

Previous analysis of prescribing trend data for Wales has shown that the number of NMIPs prescribing in primary care increased from 2011 to 2018. The volume of items prescribed grew over the same period, with a significant increase in the prescribing rate following the implementation of primary care clusters.[15] Whilst the study of Alghamdi et al. explored the broad prescribing trend, it did not identify the specific groups of medicines prescribed, and by implication, the therapeutic areas in which NMIPs were working. The aim of the present study was to conduct a 10 year longitudinal analysis of NMIP prescribing in Wales from April 2011 to March 2021. Specifically, the study examined the BNF chapters from which medicines were prescribed by NMIPs in primary care in Wales, whether this changed over time, and whether there was variation in prescribing across the different geographic regions of Wales.

METHODS

Data source

This was a retrospective secondary data analysis of monthly prescribing data issued by NMIPs in primary care in Wales. Prescribing data were accessed from the Comparative Analysis System for Prescribing Audit (CASPA) software. CASPA software records all WP10 prescriptions (Welsh NHS prescriptions) dispensed in community pharmacies and submitted to NHS Wales Prescribing Services for financial reimbursement. Although the term 'prescribing' is used throughout this paper, the data represents prescriptions that have been issued, dispensed and forwarded for pricing.[16] As a result, dispensing may not reflect prescribing as some patients may not get their prescriptions dispensed. However, the abolition of the prescription charge in Wales in 2007 helped to reduce the number of patients who failed to have a prescription dispensed,[17] reducing the impact of this confounder. It was assumed that the difference between the number of prescriptions issued and those dispensed was not significant, and that dispensing provided an accurate representation of prescribing.

Prescribing measure

For the purpose of this study the number of prescription items was the chosen prescribing measure for prescribing volume. This measure was chosen, as it provides an indication of the extent of the prescriber's activity, as each medicine prescribed counts as an item, irrespective of the amount, or the cost. Welsh LHBs vary greatly by population size,[18] which is reflected in variation in GP prescribing data. However, as non-medical independent prescribing was a developing service, it was

felt that the amount of prescribing by NMIPs would be more dependent upon the number of practicing NMIPs in each LHB rather than the population of the LHB. Nevertheless, NMIP prescribing for the financial year 2020-2021 was correlated with the mid-year population estimate for that year (https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-lhb-age) to investigate this assumption.

Data collection

Nationwide monthly prescribing data for the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained for NMIPs in Wales. It was not possible to differentiate between healthcare professions, therefore the data represents prescribing by all NMIPs in primary care rather than a specific professional group. Data were synthesised to financial years and filtered by LHB to analyse the non-medical independent prescribing trends by geographical location. During the period of study, the structure of two LHBs changed, with part of the previous Abertawe Bro Morgannwg University Health Board (now Swansea Bay University Health Board) becoming part of Cwm Taf Morgannwg (CTM) University Health Board in April 2019. The data presented represents prescribing that occurred for these organisations as they were structured during each financial year. As a result, prescribing in Swansea Bay after March 2019 may be lower than might have been expected, and prescribing in CTM greater than what might have been expected, based upon previous trends.

Prescribing data for drugs available in CASPA is largely arranged in a way that corresponds to the chapters in the British National Formulary. As a result, prescribing was divided between 15 chapters: Gastro-intestinal system, Cardiovascular system, Respiratory system, Nervous system, Infection, Endocrine system, Genito-urinary system, Immune system and Malignant disease, Blood and Nutrition, Musculoskeletal system, Eye, Ear Nose and Throat, Skin, Vaccines and Anaesthesia.[19] However, in addition, CASPA holds details of items such as dressings, appliances and certain other preparations (e.g. substances used in medicines formulation), which are categorised beyond the BNF chapter structure. In this study, these items were grouped together, and included as "Other" items. This "Other" group also included a small number of items used in the management of poisoning. BNF chapter four (Nervous system) includes medicines for the treatment of pain, as well as those for psychological and neurological illnesses, such as depression, psychosis and Parkinson's disease. As part of the analysis of this chapter, the number of items recorded in the Analgesia section was compared with the number of items in the other sections of this chapter in order to differentiate between therapeutic areas.

Data analysis

Data were presented in graphs and figures using descriptive statistics, where appropriate. Pareto analysis was used to provide a more focused exploration of the data. Pareto charts display the total number of items prescribed within each BNF chapter in descending order of quantity and an overlaid line displays the cumulative percentage of the total prescribing. A Pareto analysis is commonly used to focus investigations on the most significant categories when the data is defined by a large variety of categories, and for this reason, was chosen for this study. A Pareto analysis of all items prescribed from April 2011 to March 2021 (the whole dataset) as well as 2011-2012 (the first year of data) and 2020-2021 (the final year of data), was used to identify the chapters which encompassed 80% of the total prescribing by NMIPs. Pearson correlation analysis was used to compare prescribing volume in 2020-2021 and health board population (analysis performed using GraphPad Prism version 5.04, GraphPad Software Inc, California, USA).

Ethical consideration

The database (CASPA) used in this study holds routinely collected, anonymised data, and did not allow the researcher to access any patient or prescriber identifiable information. As such ethical approval was not required for this study. This study was part of a wider project, which was approved by the researcher's LHB research and development department (reference number: 14/CLC/5882).

Patient and public involvement

This research was done without patient and public involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

RESULTS

Number of items prescribed by BNF chapter in Wales

The total number of items prescribed by NMIPs and dispensed in community pharmacy from April 2011 to March 2021 (referred to as the whole study period) was approximately 11.2 million. The number of items in 2011-2012 was approximately 417,000, which increased to approximately 2.2 million in 2020-2021 (an increase of 430%). The number of items prescribed during the whole study period varied according to BNF chapter, ranging from 2,184,656 items prescribed for medicines within chapter 2 (Cardiovascular system) to 15,995 items prescribed for medicines within chapter 15 (Anaesthesia). A Pareto analysis (Figure 1) identified that approximately 80% of the total number of

items prescribed during the whole study period equated to seven BNF chapters; Cardiovascular system, Nervous system, Infections, Respiratory system, Endocrine system, Gastro-intestinal system, and skin. Prescribing within three of the BNF chapters, Immune system and Malignant disease, Vaccines, and Anaesthesia was minimal.

Pareto analysis for prescribing data in 2011-2012, identified that eight BNF chapters accounted for approximately 80% of the total number of items prescribed; Infection, Respiratory system, Cardiovascular system, Nervous system, Skin, "Other", Endocrine, and Genito-urinary (Figure 2). In 2020-2021 the seven BNF chapters that accounted for approximately 80% of prescribing were Cardiovascular system, Nervous system, Endocrine system, Gastro-intestinal system, Respiratory system, Infection and Skin (Figure 3). In 2011-2012 Infection and Respiratory system were the top two chapters, and accounted for approximately 30% of prescribing overall. In 2020-2021, these chapters were ranked 6th and 5th respectively and accounted for approximately 16% of all items. In 2020-2021, Cardiovascular system and Nervous system were the top two chapters, and accounted for approximately 40% of items prescribed. This was an increase from 24% of all items in 2011-2012, where they were ranked 3rd and 4th respectively. Within the Nervous system chapter, in 2011-2012 analgesics accounted for 50% of prescribed items, whilst in 2020-2021, they accounted for 34% of prescribed items.

Prescribing trend over time

The trend in prescribing in Wales according to BNF chapter is shown in figure 4. Prescribing showed a year-on-year increase from 2011-2012 to 2019-2020 in all BNF chapters, with the exception of Vaccines, and a small fall (0.3%) in Infection in 2017-2018 compared to 2016-2017. Prescribing in five chapters (Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia) was lower in 2020-2021 than in 2019-2020, but with the exception of Vaccines, remained higher than in 2011-2012. The chapters with the largest percentage difference in prescribing between 2011-2012 and 2020-2021 were Cardiovascular (928%), Gastro-intestinal (899%), and Blood and Nutrition (894%). The greatest year-on-year increase in overall prescribing (45%) occurred between 2017-2018 and 2018-2019, whilst the smallest year-on-year increase (5%) was between 2019-2020 and 2020-2021. The largest increase in Cardiovascular system prescribing (70%) occurred between 2016-2017 and 2017-2018, and Nervous system prescribing (59%) between 2017-2018 and 2018-2019.

Number of items prescribed by LHB

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

The LHB with the largest amount of prescribing by NMIPs throughout the whole study period, and in 2011-2012 and 2020-2021 was Betsi Cadwaladr. The lowest prescribing LHB over the whole study period and in 2011-2012 was Powys, whilst the lowest prescribing in 2020-2021 was in CTM (see Table 1). Prescribing in each health board in 2020-2021 was weakly correlated with the mid-year population estimate for the health board. Prescribing in the financial years prior to and during the Covid-19 pandemic is also shown in Table 1, the largest difference in prescribing between these years was seen in Hywel Dda.

	Total n (%)	2011-2012 n (%)	2019-2020 n (%)	2020-2021 n (%)	2020 mid-year population n (%)
Wales	11,221,122 (100)	417,348 (100)	2,103,637 (100)	2,214,211 (100)	3,169,586 (100)
AB	2,080,391 (19)	57,985 (14)	406,461 (19)	492,472 (22)	598,194 (19)
BC	3,633,565 (32)	123,253 (30)	663,733 (32)	675,107 (30)	703,361 (22)
CV	1,431,904 (13)	96,398 (23)	232,040 (11)	337,484 (15)	504,497 (16)
CTM*	776,162 (7)	36,229 (9)	146,266 (7)	134,557 (6)	449,836 (14)
HD	1,634,835 (15)	53,232 (13)	393,483 (19)	254,026 (11)	389,719 (12)
Pow	663,344 (6)	4,405 (1)	134,943 (6)	168,304 (8)	133,030 (4)
SB*	1,000,921 (9)	45,846 (11)	126,711 (6)	152,261 (7)	390,949 (12)

Table 1. Total prescribing by NMIPs during the whole study period, and in 2011-2012, 2019-2020 and 2020-2021 according to LHB. Items prescribed in 2020-2021 correlated with mid-year health board population estimates (r^2=0.66, p<0.05, Pearson correlation analysis). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwn Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board.

Within each LHB, the BNF chapters contributing the largest percentage of items to the total prescribing is shown in Table 2. In 2011-2012, Infections contributed the largest percentage to the total prescribing in five of the seven LHBs, and Respiratory system and Nervous system contributed the largest percentage in Cardiff and Vale and CTM respectively. The second largest percentage was contributed by Respiratory (in three LHBs), Cardiovascular (in three LHBs), and Nervous system (in one LHB). In 2020-2021, Cardiovascular system contributed the largest percentage to the total prescribing in six LHBs, and Nervous system contributed the largest percentage in the remaining LHB (Swansea Bay). The second largest percentage in six LHBs was contributed by Nervous system, whilst Cardiovascular contributed the second largest percentage in one LHB (Swansea Bay).

	Wales		AB		BC		CV		CTM*		HD		Pow		SB*	
	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21
CVS	49,384 12%	507,641 23%	6,983 12%	132,354 27%	10,020 8%	138,249 20%	13,963 14%	84,075 25%	5,612 15%	24,448 18%	5,487 10%	53,404 21%	-	40,817 24%	7,280 16%	34,294 23%
CNS	49,104 12%	409,931 19%	7,122 12%	97,035 20%	13,434 11%	113,594 17%	10,895 11%	59,655 18%	5,872 16%	23,904 18%	6,182 12%	46,327 18%	-	33,690 20%	5,415 12%	35,726 23%
Infection	73,092 18%	174,815 8%	10,749 19%	33,538 7%	25,266 20%	70,662 10%	11,367 12%	-	5,165 14%	11,580 9%	11,673 22%	23,709 9%	1,055 24%	-	7,817 17%	8,457 6%
Respiratory	54,597 13%	178,724 8%	6,132 11%	35,485 7%	15,691 13%	56,809 8%	16,051 17%	25,117 7%	3,939 11%	15,573 12%	6,749 13%	20,671 8%	762 17%	13,385 8%	5,273 12%	11,684 8%
Endocrine	27,124 6%	198,763 9%	4,078 7%	41,112 8%	-	65,064 10%	8,229 9%	31,379 9%	2,664 7%	12,187 9%	-	20,985 8%	250 6%	14,706 9%	2,264 5%	13,330 9%
GI	-	191,470 9%	-	42,239 9%	-	57,418 9%	-	27,273 8%	2,394 7%	11,247 8%	2,880 5%	22,960 9%	-	16,992 10%	-	13,341 9%
Skin	37,858 9%	-	5,182 9%	-	11,787 10%	-	7,414 8%	-	2,705 7%	-	5,327 10%	-	722 16%	-	4,721 10%	-
Other	30,062 7%	-	4,582 8%	-	10,577 9%	-	6,684 7%	-	-	-	3,473 7%	-	529 12%	-	2,562 6%	-
Genito-urinary	-	-	-	-	8,557 7%	-	-	-	-	-	-	-	-	-	-	-
Nutrition blood	-	-	-	-	-	-	-	20,765 6%	-	-	-	-	-	9,698 6%	-	-
Total items	417,348	2,214,211	57,985	492,472	123,253	675,107	96,398	337,484	36,229	134,557	53,232	254,026	4,405	168,304	45,846	152,261

Table 2. The BNF chapters accounting for approximately 80% of prescribed items in the financial years 2011-2012 and 2020-2021 nationally in Wales, and in each of the seven LHBs. Top three chapters in each financial year highlighted (Green = first, Orange = second, Blue = third). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwn Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board. *The organisational structure of CTM and SB health boards changed in April 2019, therefore the quantity of items prescribed in the financial years shown is not necessarily comparable.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

DISCUSSION

The total number of items prescribed each year by NMIPs in Wales and dispensed in community pharmacy increased over the study period. In the financial year 2020-2021, total NMIP prescribing was 430% greater than in 2011-2012, with the largest annual increases seen after April 2016. The study identified that over the whole period from April 2011 to March 2021 prescribing in seven BNF chapters equated to approximately 80% of total items prescribed by NMIPs in Wales, with Cardiovascular system the most prescribed chapter. From 2011-2012 to 2019-2020 there was a year-on-year increase in prescribed items across the majority of BNF chapters, with the exception of Vaccines, (and from 2016-2017 to 2017-2018 Infections). From 2019-2020 to 2020-2021, prescribing fell in five chapters, but with the exception of Vaccines, remained higher than in 2011-2012. In the financial year 2011-2012 the BNF chapters with the greatest items prescribed were Infections and Respiratory system, whilst in 2020-2021, the BNF chapters with the greatest items prescribed were Cardiovascular and Nervous system. The number of items prescribed in each LHB in Wales varied, however, the BNF chapters contributing the largest percentages of items to the LHB totals was broadly comparable.

Prior to 2015-2016, Infection was the BNF chapter with the greatest number of items prescribed. A study of nurse prescribing in England with data from 2006 to 2010, similarly identified penicillins as the most prescribed drug category by this professional group.[20] A year-on-year increase in prescribing of anti-infectives was observed across most years in the current study, consistent with an earlier study of antibiotic prescribing trends in England.[21] However, over the whole 10 year period of the present study, the greatest prescribing was seen in the Cardiovascular and Nervous system chapters. This was mainly due to large increases in prescribing in these chapters after 2015-2016. The volume of prescribing indicates that these were the predominant therapeutic areas in which NMIPs were utilising their qualification after 2015-2016, and indicates a shift in the focus of prescribing compared to the earlier years included in the study. The smaller observed increase in anti-infective prescribing (compared with Cardiovascular and Nervous system) over the study period may also reflect the role of NMIPs in promoting antimicrobial stewardship and the appropriate prescribing of these medicines.[22,23] The smaller increase in prescribing in this chapter would also align with the reducing trend in total antibacterial usage that has been observed across primary care in Wales.[16]

The observed increase in prescribing volume in Cardiovascular and Nervous system chapters, and the smaller increase in anti-infective prescribing coincided with the introduction of primary care

clusters in Wales. This change to the organisational structure of healthcare delivery in Wales has been a driver for the creation of additional pharmacist and advanced nurse practitioner posts within General Practices. In this context, the role that pharmacists have in the management of patients with complex, chronic conditions, has been noted.[12] The increase in the volume of prescribing from the Cardiovascular chapter in particular suggests that a move towards chronic disease management has been realised in practice. The increase in prescribing from the Nervous system chapter adds some further support to this. However, in addition to containing medicines for the management of chronic mental illness and neurological disorders, the Nervous system chapter also contains medicines for analgesia, which might have been prescribed for acute pain and minor illness (for example paracetamol for pyrexia). The proportion of non-analgesic prescribing as a percentage of total Nervous system chapter items increased from 50% to 66% during the study period, providing further evidence in support of an increase in primary care NMIP prescribing for long-term psychological and neurological conditions. An additional complication is the classification of certain medicines within the Nervous system chapter. Amitriptyline, gabapentin and some pregabalin prescribing is recorded in the depression and epilepsy sections of CASPA respectively. However, these medicines may have been prescribed for the management of neuropathic pain.[24] Adjusting the categorisation of these medicines to analgesics from 2015-2016 onwards (when the greatest increases in prescribing were seen) results in prescribing for long-term psychological and neurological conditions accounting for 50% of items in 2015-2016, increasing to 57% in 2020-2021. Whilst lower than the unadjusted percentages, there still appears to be an increase in prescribing for these long-term conditions. It might also be argued that management of neuropathic pain is indicative of chronic disease management, and that re-categorisation of these medicines is unnecessary. Consistent with the findings of our study, a survey of pharmacy services in UK General practice conducted in 2018/2019, identified that over 80% of pharmacist respondents provided clinical services including chronic disease management,[25] albeit based upon a relatively small sample. A change in prescribing from items for acute to chronic illness was also observed in a study of nurse practitioners prescribing in Ontario (Canada) from 2000 to 2010.[26] However, a study examining more recent non-medical prescribing trends in New Zealand identified antibiotics and analgesics as the most commonly prescribed items.[27]

Over the whole study period, the total number of items prescribed by NMIPs in each of the seven LHBs in Wales varied significantly, with the lowest prescribing in Powys, and the highest in Betsi Cadwaladr. Although the number of items varied, the chapters contributing the greatest number of prescribed items were relatively consistent across the LHBs. Infection accounted for the most items

in five of the seven LHBs in 2011-2012, whilst Cardiovascular and Nervous system were the two most prescribed chapters across all seven LHBs in 2020-2021. Although NMIP prescribing might have been expected to be more dependent upon the number of NMIPs practicing in each LHB, rather than the population size of the LHB, there was nevertheless a relatively weak correlation between items prescribed and population. This reflected the previous observation that LHBs with larger populations employed greater numbers of NMIPs.[15] The Covid-19 pandemic appeared to have a variable impact across the LHBs based upon the difference in NMIP prescribing between 2019-2020 and 2020-2021. Overall, NMIP prescribing was 5% higher in Wales in 2020-2021 compared with the previous year, although this was a much smaller increase than the 16% seen from 2018-2019 to 2019-2020. Across Wales as a whole, NMIP prescribing from Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia chapters was lower in 2020-2021 than in the previous year. In the individual LHBs, prescribing in two (Hywel Dda and CTM) was lower, prescribing in one (Betsi Cadwaladr) remained relatively constant, and prescribing in the other four LHBs was higher than the previous year. Prescribing of antibiotics decreased in LHBs compared with 2019-2020, consistent with other studies examining primary care usage of these drugs during the Covid-19 pandemic.[28,29] Other chapters in which there was a reduction in items prescribed across all LHBs were Vaccines, and Ear Nose and Throat. Nevertheless, the data indicate that NMIPs were still actively prescribing as part of their roles during the pandemic.

This study has some limitations. As a result of the retrospective secondary data design, confounding factors that may have influenced prescribing trends could not be identified and explored.[30] For example, whilst the introduction of primary care clusters may have been a driver for the apparent change towards more chronic disease management in Wales (as well as the overall increase in prescribing), a causal association could not be determined. CASPA does not provide patient level data, nor data relating to indication. The study was therefore unable to investigate the appropriateness of NMIP prescribing. It also limits other conclusions that can be drawn. Whilst the increase in prescribing from the Cardiovascular chapter suggested an increase in chronic disease management, it was not possible to determine whether NMIPs were prescribing ongoing items for the same patient on a long-term basis, or whether they were prescribing occasional items for multiple patients. Similarly, as noted above, indications for the gabapentinoids and amitriptyline could not be determined. The prescribing measure chosen for this study was items, as it was felt that this best reflects a single prescribing interaction. However, it should be noted that the quantity supplied on each prescription may vary. If a prescription were issued with a three month supply, the number of items would be smaller. In particular, this may have influenced the number of oral

contraceptive items prescribed as part of the Genito-urinary chapter, as these are typically provided as a longer supply.

In summary, the BNF chapter with the most prescribed items changed from Infection to Cardiovascular during the study period, suggesting an increase in chronic disease management by NMIPs over time. There was little regional variation in the therapeutic areas most commonly prescribed, indicating a similar approach to NMIP implementation across the LHBs in Wales. The Covid-19 pandemic had variable impact on prescribing both in terms of therapeutic area, and regional variation. However, prescribing by NMIPs continued to increase, and the impact of this on the delivery of primary care services is a focus for future work.

REFERENCES

1. Cope LC, Abuzour AS, Tully MP. 2016. Nonmedical prescribing: where are we now? Ther Adv Drug Saf. 7(4):165-172.

2. Graham-Clarke E, Rushton A, Noblet T, Marriott J. 2019. Non-medical prescribing in the United Kingdom National Health Service: A systematic policy review. PLOS One. 14(7): e0214630. doi: 10.1371/journal.pone.0214630

3. Department of Health, 1999. Review of prescribing, supply & administration of medicines. Final report .

4. Department of Health, 2000. The NHS plan: a plan for investment. A plan for reform. Available at: https://webarchive.nationalarchives.gov.uk/20130124064356/http://www.dh.gov.uk/prod_cons um_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_118522.pdf [Accessed: 16 October 2020]

5. Stewart D, MacLure K, Bond CM, Cunningham S, Diack L, George J, McCaig DJ. 2011. Pharmacist prescribing in primary care: the views of patients across Great Britain who had experienced the service. Int J Pharm Pract. 19(5):328-332

6. Deslandes RE, John DN, Deslandes PN. 2015. An exploratory study of the patient experience of pharmacist supplementary prescribing in a secondary care mental health setting. Pharm. Pract. 13(2):553 doi: 10.18549/pharmpract.2015.02.553.

7. Tinelli M, Blenkinsopp A, Latter S, Smith A, Chapman S. 2015. Survey of patients' experiences and perceptions of care provided by nurse and pharmacist independent prescribers in primary care. Health Expectations 18:1241-1255

8. Mills T, Patel N, Ryan K. 2021. Pharmacist non-medical prescribing in primary care. A systematic review of views, opinions, and attitudes. Int J Clin Pract. 75(3): e13827 Doi:10.1111/ijcp.13827

9. Hindi AMK, Seston EM, Bell D, Steinke D, Willis S, Schafheutle EI. 2019. Independent prescribing in primary care: A survey of patients', prescribers' and colleagues' perceptions and experiences. Health and Social Care in the Community, 27:e459-e470

10. Courtenay M, Khanfer R, Harries-Huntly G, Deslandes R, Gillespie D, Hodson K, Morris G, Pritchard A, Williams E. 2017a. Overview of the uptake and implementation of non-medical prescribing in Wales: a national survey. BMJ Open 7(9): e015313.doi:10.1136/bmjopen-2016-105313

11. Stewart D, Jebara T, Cunningham S, Awaisu A, Pallivalapila A, MacLure K. 2017. Future perspectives on nonmedical prescribing. Ther Adv Drug Saf. 8(6):183-197

12. National Assembly for Wales, Health, Social Care and Sport Committee, 2017. Inquiry into Primary Care: Clusters. Availabe at: https://senedd.wales/laid%20documents/cr-ld11226/cr-ld11226-e.pdf Accessed October 2021

13. Welsh Government. 2014. Our plan for a primary care service for Wales up to March 2018. Available at: http://www.wales.nhs.uk/sitesplus/documents/986/our%20plan%20for%20primary%20care%20in%20wales%20up%20to%20march%202018.pdf [Accessed: 20 November 2020]

14. Welsh Government. 2018. A Healthier Wales: our plan for health and social care. Available at: https://gov.wales/sites/default/files/publications/2019-10/a-healthier-wales-action-plan.pdf Accessed October 2021

15. Alghamdi SSA, Hodson K, Deslandes P, Gillespie D, Haines K, Hulme E, Courtenay M, Deslandes R. 2020. Prescribing trends over time by non-medical independent prescribers in primary care settings across Wales (2011–2018): a secondary database analysis. BMJ Open 2020;10:e036379. doi: 10.1136/bmjopen-2019-036379.

16. All Wales Therapeutics and Toxicology Centre. 2021. National Prescribing Indicators 2020–2021 Analysis of Prescribing Data to March 2021. Available at: https://awmsg.nhs.wales/files/national-prescribing-indicators/national-prescribing-indicators-2020-2021-analysis-of-prescribing-data-to-march-2021-pdf/ [Accessed October 2021].

17. Groves S, Cohen D, Alam MF, Dunstan FDJ, Routledge PA, Hughes DA, Myles S. 2010. Abolition of prescription charges in Wales: the impact on medicines use in those who used to pay. Int J Pharmacy Pract. 18:332-340

18. Welsh Government 2020. Population estimates by local health boards and year. Available at: https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-welshhealthboard-year [Accessed: October 2021]

19. Joint Formulary Committee, 2021. British National Formulary. BMJ Group and Pharmaceutical Press.

20. Drennan VM, Grant RL, Harris R. 2014. Trends over time in prescribing by English primary care nurses: a secondary analysis of a national prescription database. BMC Health Services Research 14:54

21. Courtenay M, Gillespie D, Lim R. 2017b. Patterns of dispensed non-medical prescriber prescriptions for antibiotics in primary care across England: a retrospective analysis. Antimicrob Chemother 72: 2915–2920

22. Courtenay M, Rowbotham S, Lim R. Deslandes R, Hodson K, MacLure K, Peters S, Stewart D. 2017c. Antibiotics for acute respiratory tract infections: a mixed-methods study of patient experiences of non-medical prescriber management. BMJ Open 7:e013515.doi:10.1136/bmjopen-2016-013515

23. Hodson K, Deslandes R, Courtenay M. 2017. Pharmacist independent prescribers can make a significant contribution to antimicrobial stewardship. Pharm. J. 298(7901): DOI:10.1211/PJ.2017.20202780

24. National Institute for Health and Care Excellence. 2013. Neuropathic pain in adults: pharmacological management in non-specialist settings CG173. Available at: https://www.nice.org.uk/guidance/cg173 [Accessed October 2021]

25. Savickas V, Foreman E, Ladva A, Bhamra SK, Sharma R, Corlett SA. 2021. Pharmacy services and role development in UK general practice: a cross-sectional survey. Int J Pharm Pract 29:37-44

26. Tranmer JE, Colley L, Edge DS, Sears K, VanDenKerkhof E, Levesque L. 2015. Trends in nurse practitioners' prescribing to older adults in Ontario, 2000–2010: a retrospective cohort study. CMAJ Open 3(3):e299-e304 DOI: https://doi.org/10.9778/cmajo.20150029

27. Raghunandan R, Marra CA, Tordoff J, Smith A. 2021. Examining non-medical prescribing trends in New Zealand: 2016–2020. BMC Health Services Res. 21:418 https://doi.org/10.1186/s12913-021-06435-y

28. Hussain AZ, Paudyal V, Habdi MA. 2021. Impact of the COVID-19 pandemic on the prescribing patterns of first-line antibiotics in English primary care: A longitudinal analysis of national prescribing dataset. Antibiotics 10(5): 591 doi: 10.3390/antibiotics10050591

29. Zhu N, Aylin P, Eawson T, Gichrist M, Majeed A, Holmes A. 2021. Investigating the impact of COVID-19 on primary care antibiotic prescribing in North West London across two epidemic waves. Clin Microbiol Infect 27(5):762-768

30. Cheng HG, Phillips MR. 2014. Secondary analysis of existing data: opportunities and implementation. Shanghai Archives Psychiatry. 26(6):371-375

Figure legends

Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.
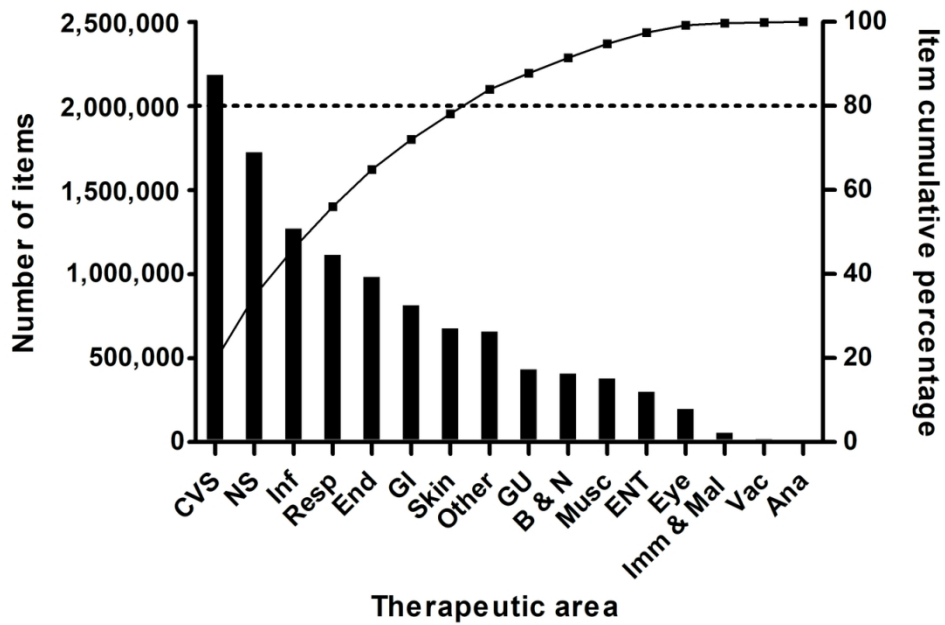
Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
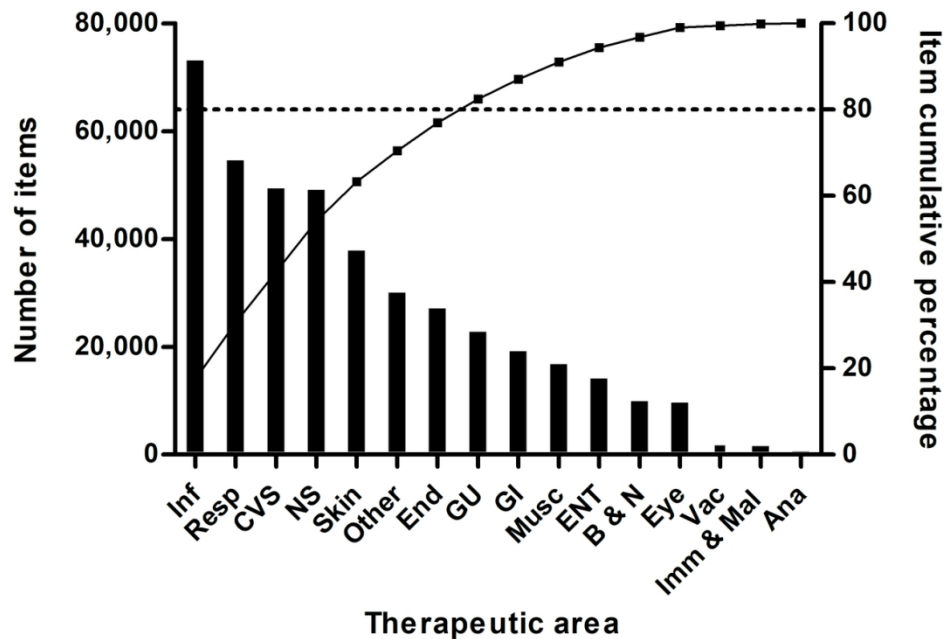
121x82mm (300 x 300 DPI)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
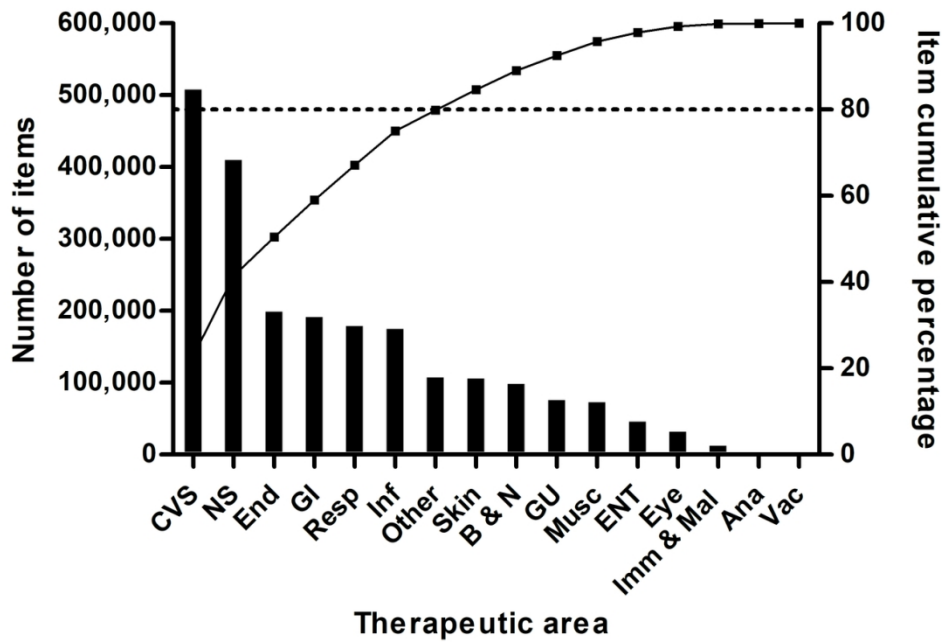
117x82mm (300 x 300 DPI)

Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
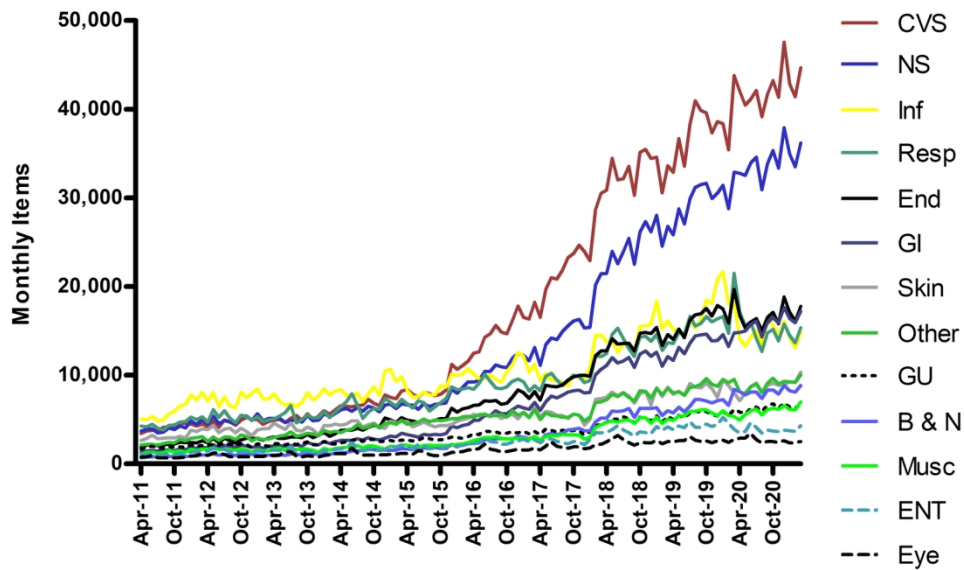
117x82mm (300 x 300 DPI)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.

152x93mm (300 x 300 DPI)

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found		RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included.	Title, Abstract, Methods
				RECORD 1.2: If applicable the geographic region and timeframe within which the study took place should be reported in the title or abstract.	Title, Abstract, Methods
				RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	N/A
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported			
Objectives	3	State specific objectives, including any prespecified hypotheses			
Methods					
Study Design	4	Present key elements of study design early in the paper			
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure,follow-up, and data collection			
Participants	6	(a) Cohort study - Give the eligibility criteria, and the sources and methods of selection		RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects)	N/A

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.		RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	N/A
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group			
Bias	9	Describe any efforts to address potential sources of bias			
Study size	10	Explain how the study size was arrived at			
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why			

Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses			
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	Method, Discussion

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	N/A
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	N/A
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram		RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	N/A
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)			
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or			

Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period			
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses			
Discussion					
Key results	18	Summarise key results with reference to study objectives			
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias		RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results			

Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based			
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	N/A

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

*Checklist is protected under Creative Commons Attribution (CC BY) license.

BMJ Open

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

SCHOLARONE™
Manuscripts

BMJ

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

Paul N Deslandes [1,2,3], Hannah Blowers [3], Kath Haines[1], Karen Hodson[3], Rhian E Deslandes*[3]

1. All Wales Therapeutics and Toxicology Centre, University Hospital Llandough, Penlan Road, Llandough, UK. CF64 2XX

2. School of Care Sciences, University of South Wales, Lower Glyntaff Campus, Treforest, UK. CF37 4DB

3. Cardiff School of Pharmacy and Pharmaceutical Sciences, Cardiff University, Cardiff, UK.

Corresponding author: Dr Rhian Deslandes deslandesRE@cardiff.ac.uk

Word count main text: 3,876

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work

available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such

Open Access shall be governed by a Creative Commons licence – details of these licences and

which Creative Commons licence will apply to this Work are set out in our licence referred to above.

ABSTRACT

Objectives

The therapeutic classes of medicines prescribed by non-medical independent prescribers (NMIPs)

working in primary care in Wales has not been studied in detail. The aim of the present study was to

conduct a 10 year longitudinal analysis of NMIP prescribing in Wales from April 2011 to March 2021.

The study examined the British National Formulary (BNF) chapters from which medicines were

prescribed by NMIPs, whether this changed over time, and whether there was variation in

prescribing across the geographic regions of Wales.

Design

Retrospective secondary data analysis of primary care prescribing data. Monthly prescribing data for

the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained from the

Comparative Analysis System for Prescribing Audit (CASPA) software. Data were analysed according

to BNF chapter, to identify in which therapeutic areas NMIPs were prescribing, and whether this

changed over the study period.

Results

The number of items prescribed by NMIPs increased during the study period. From April 2011 to

March 2021 prescribing in seven BNF Chapters equated to approximately 80% of total items, with

cardiovascular system medicines most prescribed. In the financial year 2011-2012 the BNF Chapters

with the greatest proportion of items prescribed were Infections (18%) and Respiratory system

(13%), whilst in 2020-2021, these had changed to Cardiovascular (23%) and Nervous system (19%).

The number of items prescribed in each health board in Wales varied, however, the BNF Chapters

contributing the largest percentages of items to the health board totals were broadly comparable.

Conclusions

The BNF Chapter with the most prescribed items changed from Infection to Cardiovascular during

the study period, suggesting an increase in chronic disease management by NMIPs. The impact of

this on the delivery of primary care services and patient outcomes is a focus for future work.

Strengths and limitations of this study

- This study used an All Wales database, covering 10 years of non-medical independent prescribing data across the whole population in primary care.

- The data obtained allowed trends and regional variation in prescribing to be identified.

- The secondary data used did not allow the reasons for any observed changes in prescribing to be investigated..

- Patient level data were not available, therefore it was not possible to determine prescribing patterns for individual patients.

INTRODUCTION

In the United Kingdom (UK), prescribing practice has changed significantly since the 1980s. Legislative changes in the 1990s and early 2000s granted prescribing rights to non-medical health care professionals, with appropriate experience in their relevant scope of practice who had completed an accredited course of training.[1] Non-medical independent prescribing, defined as: *'prescribing by a practitioner (e.g., doctor, dentist, nurse, pharmacist) responsible and accountable for the assessment of patients with undiagnosed or diagnosed conditions and for decisions about the clinical management required, including prescribing.'* was first introduced for pharmacists and nurses in 2006.[2] The intention was to advance and develop the healthcare system, by improving patient access to medicines, and enhancing patient care and experience, without reducing safety.[3,4] In parallel, the roles and responsibilities of non-medical health care professionals have evolved, to facilitate support for a more flexible multidisciplinary healthcare team.[1,3]

Following implementation of non-medical prescribing, the benefits have been recognised widely by both patients and prescribers themselves. Patients report satisfaction and positive experiences including increased flexibility and accessibility,[5,6] and good rapport,[7] whilst practitioners report improved autonomy and job satisfaction despite certain barriers.[8] It has also been noted that non-medical independent prescribers (NMIPs) relieve pressures on GPs.[9] However, various barriers to the uptake and implementation of non-medical independent prescribing still exist, such as lack of support and confidence, leading to inconsistencies both across and within organisations.[10,11]

In Wales, primary care NHS services are provided through seven local health boards (LHBs). As a way to manage increasing demand for primary care services in Wales, Welsh Government implemented 64 primary care clusters in 2015.[12] Clusters are composed of groups of adjacent general practices and partner organisations, such as community pharmacies, working together to collaboratively provide services locally.[13] Implementation aimed to refocus primary care and improve patients'

access to healthcare, whilst relieving pressure on NHS hospitals. In 2018, Welsh Government
published a vision for health and social care, 'A Healthier Wales', which outlines the aim to move
away from providing care in hospitals to instead providing care in the community.[14] All of these
initiatives were potential drivers for greater uptake of NMIPs into primary care in Wales.[8,15]

Previous analysis of prescribing trend data for Wales has shown that the number of NMIPs
prescribing in primary care increased from 2011 to 2018. The total volume of items prescribed as
well as the volume prescribed by NMIPs grew over the same period, with a significant increase in the
prescribing rate for NMIPs following the implementation of primary care clusters.[15] Whilst the study
of Alghamdi et al. explored the broad prescribing trend, it did not identify the specific groups of
medicines prescribed, and by implication, the therapeutic areas in which NMIPs were working. The
aim of the present study was to conduct a 10 year longitudinal analysis of NMIP prescribing in Wales
from April 2011 to March 2021. Specifically, the study examined the BNF chapters from which
medicines were prescribed by NMIPs in primary care in Wales, whether this changed over time, and
whether there was variation in prescribing across the different geographic regions of Wales.

METHODS

Data source

This was a retrospective secondary data analysis of monthly prescribing data issued by NMIPs in
primary care in Wales. Prescribing data were accessed from the Comparative Analysis System for
Prescribing Audit (CASPA) software. CASPA software records all WP10 prescriptions (Welsh NHS
prescriptions) dispensed in community pharmacies and submitted to NHS Wales Prescribing Services
for financial reimbursement. Although the term 'prescribing' is used throughout this paper, the data
represents prescriptions that have been issued, dispensed and forwarded for pricing.[16] As a result,
dispensing may not reflect prescribing as some patients may not get their prescriptions dispensed.
However, the abolition of the prescription charge in Wales in 2007 helped to reduce the percentage
of patients who failed to have a prescription dispensed from an estimated 8.9% to an estimated
5.5%,[17] reducing the impact of this confounder.

Prescribing measure

For the purpose of this study the number of prescription items was the chosen prescribing measure
for prescribing volume. This measure was chosen, as it provides an indication of the extent of the
prescriber's activity, as each medicine prescribed counts as an item, irrespective of the amount, or
the cost. Welsh LHBs vary greatly by population size,[18] which is reflected in variation in GP

prescribing data. However, as non-medical independent prescribing was a developing service, it was felt that the amount of prescribing by NMIPs would be more dependent upon the number of practising NMIPs in each LHB, which might or might not have been related to the population of the LHB. For example, the number of items prescribed in an LHB with a small population but a large number of NMIPs would likely be greater than that in an LHB with a large population but a small number of NMIPs. NMIP prescribing in each LHB for the financial year 2020-2021 was correlated with the mid-year population estimate for the LHB (using population data for that year available at https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-lhb-age) to investigate this assumption.

Data collection

Nationwide monthly prescribing data for the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained for NMIPs in Wales. It was not possible to differentiate between healthcare professions, therefore the data represents prescribing by all NMIPs in primary care rather than a specific professional group. Data were synthesised to financial years and filtered by LHB to analyse the non-medical independent prescribing trends by geographical location. During the period of study, the structure of two LHBs changed, with part of the previous Abertawe Bro Morgannwg University Health Board (now Swansea Bay University Health Board) becoming part of Cwm Taf Morgannwg University Health Board in April 2019. The data presented represents prescribing that occurred for these organisations as they were structured during each financial year. As a result, prescribing in Swansea Bay after March 2019 may be lower than might have been expected, and prescribing in Cwm Taf Morgannwg greater than might have been expected, based upon previous trends.

Prescribing data for drugs available in CASPA are largely arranged in a way that corresponds to the chapters in the British National Formulary. As a result, prescribing was divided between 15 Chapters: Gastro-intestinal system, Cardiovascular system, Respiratory system, Nervous system, Infection, Endocrine system, Genito-urinary system, Immune system and Malignant disease, Blood and Nutrition, Musculoskeletal system, Eye, Ear Nose and Throat, Skin, Vaccines and Anaesthesia.[19] However, in addition, CASPA holds details of items such as dressings, appliances and certain other preparations (e.g. substances used in medicines formulation), which are categorised beyond the BNF chapter structure. In this study, these items were grouped together, and included as "Other" items. This "Other" group also included a small number of items used in the management of poisoning. BNF Chapter four (Nervous system) includes medicines for the treatment of pain, as well as those for

psychological and neurological illnesses, such as depression, psychosis and Parkinson's Disease. As part of the analysis of this Chapter, the number of items recorded in the Analgesia section was compared with the number of items in the other sections of this Chapter in order to differentiate between therapeutic areas.

Data analysis

Data were presented in graphs and figures using descriptive statistics, where appropriate. Pareto analysis was used to provide a more focused exploration of the data. Pareto charts display the total number of items prescribed within each BNF chapter in descending order of quantity and an overlaid line displays the cumulative percentage of the total prescribing. A Pareto analysis is commonly used to focus investigations on the most significant categories when the data is defined by a large variety of categories, and for this reason, was chosen for this study. A Pareto analysis of all items prescribed from April 2011 to March 2021 (the whole dataset) as well as 2011-2012 (the first year of data) and 2020-2021 (the final year of data), was used to identify the chapters which encompassed 80% of the total prescribing by NMIPs. Pearson correlation analysis was used to compare prescribing volume in 2020-2021 and health board population (analysis performed using GraphPad Prism version 5.04, GraphPad Software Inc, California, USA).

Ethical consideration

The database (CASPA) used in this study holds routinely collected, anonymised prescription data, and did not allow the researcher to access any patient or prescriber identifiable information. As such ethical approval was not required for this study. This study was part of a wider project, which was approved by the researcher's LHB research and development department (reference number: 14/CLC/5882).

Patient and public involvement

This research was done without patient and public involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

RESULTS

Number of items prescribed by BNF chapter in Wales

The total number of items prescribed by NMIPs and dispensed in community pharmacy from April 2011 to March 2021 (referred to as the whole study period) was approximately 11.2 million. The number of items in 2011-2012 was approximately 417,000, which increased to approximately 2.2 million in 2020-2021 (an increase of 430%). The number of items prescribed during the whole study period varied according to BNF chapter, ranging from 2,184,656 items prescribed for medicines within Chapter 2 (Cardiovascular system) to 15,995 items prescribed for medicines within Chapter 15 (Anaesthesia). A Pareto analysis (Figure 1) identified that approximately 80% of the total number of items prescribed during the whole study period equated to seven BNF Chapters; Cardiovascular system, Nervous system, Infections, Respiratory system, Endocrine system, Gastro-intestinal system, and Skin. Prescribing within three of the BNF Chapters, Immune system and Malignant disease, Vaccines, and Anaesthesia was minimal.

Pareto analysis for prescribing data in 2011-2012, identified that eight BNF Chapters accounted for approximately 80% of the total number of items prescribed; Infection, Respiratory system, Cardiovascular system, Nervous system, Skin, "Other", Endocrine, and Genito-urinary (Figure 2). In 2020-2021 the seven BNF Chapters that accounted for approximately 80% of prescribing were Cardiovascular system, Nervous system, Endocrine system, Gastro-intestinal system, Respiratory system, Infection and Skin (Figure 3). In 2011-2012 Infection and Respiratory system were the top two Chapters, and accounted for approximately 18% and 13% of prescribing respectively. In 2020-2021, these Chapters were ranked 6th and 5th respectively and each accounted for approximately 8% of all items (16% for the two chapters combined). Prior to the Covid pandemic in both 2018–2019 and 2019–2020 Infection accounted for 10% of prescribed items, and was the 3rd ranked Chapter. In 2020-2021, Cardiovascular system and Nervous system were the top two Chapters, and accounted for approximately 40% of items prescribed. This was an increase from 24% of all items in 2011-2012, where they were ranked 3rd and 4th respectively. Within the Nervous system Chapter, in 2011-2012 analgesics accounted for 50% of prescribed items, whilst in 2020-2021, they accounted for 34% of prescribed items.

Prescribing trend over time

The trend in prescribing in Wales according to BNF chapter is shown in Figure 4, with Figures 5 and 6 highlighting the prescribing trend from the middle and lower Chapters respectively. Prescribing showed a year-on-year increase from 2011-2012 to 2019-2020 in all BNF chapters, with the exception of Vaccines, and a small fall (0.3%) in Infection in 2017-2018 compared to 2016-2017. Prescribing in five Chapters (Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia)

was lower in 2020-2021 than in 2019-2020, but with the exception of Vaccines, remained higher than in 2011-2012. The Chapters with the largest percentage difference in prescribing between 2011-2012 and 2020-2021 were Cardiovascular (928%), Gastro-intestinal (899%), and Blood and Nutrition (894%). The greatest year-on-year increase in overall prescribing (45%) occurred between 2017-2018 and 2018-2019, whilst the smallest year-on-year increase (5%) was between 2019-2020 and 2020-2021. The largest increase in Cardiovascular system prescribing (70%) occurred between 2016-2017 and 2017-2018, and Nervous system prescribing (59%) between 2017-2018 and 2018-2019.

Number of items prescribed by LHB

The LHB with the largest amount of prescribing by NMIPs throughout the whole study period, and in 2011-2012 and 2020-2021 was Betsi Cadwaladr. The lowest prescribing LHB over the whole study period and in 2011-2012 was Powys, whilst the lowest prescribing in 2020-2021 was in Cwm Taf Morgannwg (see Table 1). Prescribing in each health board in 2020-2021 was weakly correlated with the mid-year population estimate for the health board (Pearson r^2 = 0.66, p<0.05). Prescribing in the financial years prior to and during the Covid-19 pandemic is also shown in Table 1. For Wales, the percentage difference between 2011–2012 was 404%, and from 2011–2012 to 2020–2021 was 430%. The largest reduction in prescribing between 2019–2020 and 2020–2021 was seen in Hywel Dda (-35%), whilst the largest increase was seen in Cardiff and Vale (45%).

	Total n (%)	2011-2012 n (%)	2019-2020 n (%)	2020-2021 n (%)	2020 mid-year population n (%)
Wales	11,221,122 (100)	417,348 (100)	2,103,637 (100)	2,214,211 (100)	3,169,586 (100)
AB	2,080,391 (19)	57,985 (14)	406,461 (19)	492,472 (22)	598,194 (19)
BC	3,633,565 (32)	123,253 (30)	663,733 (32)	675,107 (30)	703,361 (22)
CV	1,431,904 (13)	96,398 (23)	232,040 (11)	337,484 (15)	504,497 (16)
CTM*	776,162 (7)	36,229 (9)	146,266 (7)	134,557 (6)	449,836 (14)
HD	1,634,835 (15)	53,232 (13)	393,483 (19)	254,026 (11)	389,719 (12)
Pow	663,344 (6)	4,405 (1)	134,943 (6)	168,304 (8)	133,030 (4)
SB*	1,000,921 (9)	45,846 (11)	126,711 (6)	152,261 (7)	390,949 (12)

Table 1. Total prescribing by NMIPs during the whole study period, and in 2011-2012, 2019-2020 and 2020-2021 according to LHB. Items prescribed in 2020-2021 correlated with mid-year health board population estimates (r^2=0.66, p<0.05, Pearson correlation analysis). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwm Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board.

Within each LHB, the BNF Chapters contributing the largest percentage of items to the total prescribing is shown in Table 2. In 2011-2012, Infections contributed the largest percentage to the

total prescribing in five of the seven LHBs, and Respiratory system and Nervous system contributed the largest percentage in Cardiff and Vale and Cwm Taf Morgannwg respectively. The second largest percentage was contributed by Respiratory (in three LHBs), Cardiovascular (in three LHBs), and Nervous system (in one LHB). In 2020-2021, Cardiovascular system contributed the largest percentage to the total prescribing in six LHBs, and Nervous system contributed the largest percentage in the remaining LHB (Swansea Bay). The second largest percentage in six LHBs was contributed by Nervous system, whilst Cardiovascular contributed the second largest percentage in one LHB (Swansea Bay). This pattern was consistent with data prior to the Covid pandemic in 2018–2019 and 2020–2021.

	Wales		AB		BC		CV		CTM*		HD		Pow		SB*	
	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21
CVS	49,384 12%	507,641 23%	6,983 12%	132,354 27%	10,020 8%	138,249 20%	13,963 14%	84,075 25%	5,612 15%	24,448 18%	5,487 10%	53,404 21%	-	40,817 24%	7,280 16%	34,294 23%
CNS	49,104 12%	409,931 19%	7,122 12%	97,035 20%	13,434 11%	113,594 17%	10,895 11%	59,655 18%	5,872 16%	23,904 18%	6,182 12%	46,327 18%	-	33,690 20%	5,415 12%	35,726 23%
Infection	73,092 18%	174,815 8%	10,749 19%	33,538 7%	25,266 20%	70,662 10%	11,367 12%	-	5,165 14%	11,580 9%	11,673 22%	23,709 9%	1,055 24%	-	7,817 17%	8,457 6%
Respiratory	54,597 13%	178,724 8%	6,132 11%	35,485 7%	15,691 13%	56,809 8%	16,051 17%	25,117 7%	3,939 11%	15,573 12%	6,749 13%	20,671 8%	762 17%	13,385 8%	5,273 12%	11,684 8%
Endocrine	27,124 6%	198,763 9%	4,078 7%	41,112 8%	-	65,064 10%	8,229 9%	31,379 9%	2,664 7%	12,187 9%	-	20,985 8%	250 6%	14,706 9%	2,264 5%	13,330 9%
GI	-	191,470 9%	-	42,239 9%	-	57,418 9%	-	27,273 8%	2,394 7%	11,247 8%	2,880 5%	22,960 9%	-	16,992 10%	-	13,341 9%
Skin	37,858 9%	-	5,182 9%	-	11,787 10%	-	7,414 8%	-	2,705 7%	-	5,327 10%	-	722 16%	-	4,721 10%	-
Other	30,062 7%	-	4,582 8%	-	10,577 9%	-	6,684 7%	-	-	-	3,473 7%	-	529 12%	-	2,562 6%	-
Genito-urinary	-	-	-	-	8,557 7%	-	-	-	-	-	-	-	-	-	-	-
Nutrition blood	-	-	-	-	-	-	-	20,765 6%	-	-	-	-	-	9,698 6%	-	-
Total items	417,348	2,214,211	57,985	492,472	123,253	675,107	96,398	337,484	36,229	134,557	53,232	254,026	4,405	168,304	45,846	152,261

Table 2. The BNF Chapters accounting for approximately 80% of prescribed items in the financial years 2011-2012 and 2020-2021 nationally in Wales, and in each of the seven LHBs. Top three Chapters in each financial year highlighted (Green = first, Orange = second, Blue = third). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwn Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board. *The organisational structure of CTM and SB health boards changed in April 2019, therefore the quantity of items prescribed in the financial years shown is not necessarily comparable.

DISCUSSION

The total number of items prescribed each year by NMIPs in Wales and dispensed in community pharmacy increased over the study period. In the financial year 2020-2021, total NMIP prescribing was 430% greater than in 2011-2012, with the largest annual increases seen after April 2016. The study identified that over the whole period from April 2011 to March 2021 prescribing in seven BNF Chapters equated to approximately 80% of total items prescribed by NMIPs in Wales, with Cardiovascular system the most prescribed Chapter. From 2011-2012 to 2019-2020 there was a year-on-year increase in prescribed items across the majority of BNF Chapters, with the exception of Vaccines, (and from 2016-2017 to 2017-2018 Infections). From 2019-2020 to 2020-2021, prescribing fell in five Chapters, but with the exception of Vaccines, remained higher than in 2011-2012. In the financial year 2011-2012 the BNF Chapters with the greatest items prescribed were Infections and Respiratory system, whilst in 2020-2021, the BNF Chapters with the greatest items prescribed were Cardiovascular and Nervous system. The number of items prescribed in each LHB in Wales varied, however, the BNF chapters contributing the largest percentages of items to the LHB totals were broadly comparable.

Prior to 2015-2016, Infection was the BNF Chapter with the greatest number of items prescribed. A study of nurse prescribing in England with data from 2006 to 2010, similarly identified penicillins as the most prescribed drug category by this professional group.[20] A year-on-year increase in prescribing of anti-infectives was observed across most years in the current study, consistent with an earlier study of antibiotic prescribing trends in England.[21] However, over the whole 10 year period of the present study, the greatest prescribing was seen in the Cardiovascular and Nervous system Chapters. This was mainly due to large increases in prescribing in these Chapters after 2015-2016. The volume of prescribing indicates that these were the predominant therapeutic areas in which NMIPs were utilising their qualification after 2015-2016, and indicates a shift in the focus of prescribing compared to the earlier years included in the study. The smaller observed increase in anti-infective prescribing (compared with Cardiovascular and Nervous system) over the study period may also reflect the role of NMIPs in promoting antimicrobial stewardship and the appropriate prescribing of these medicines.[22,23]

The observed increase in prescribing volume in Cardiovascular and Nervous system Chapters, and the smaller increase in anti-infective prescribing coincided with the introduction of primary care clusters in Wales. This change to the organisational structure of healthcare delivery in Wales has been a driver for the creation of additional pharmacist and advanced nurse practitioner posts within

General Practices. Funding has been made available in Wales to provide prescribing training for these healthcare professionals[13], and the number of NMIPs working in primary care increased over the period from 2011 to 2018[15]. In this context, the role that pharmacists have in the management of patients with complex, chronic conditions, has been noted.[12] The increase in the volume of prescribing from the Cardiovascular Chapter in particular, (along with somewhat smaller increases in prescribing from other Chapters associated with of long-term illness such as the Endocrine Chapter), suggests that a move towards chronic disease management has been realised in practice. The increase in prescribing from the Nervous system Chapter adds some further support to this. However, in addition to containing medicines for the management of chronic mental illness and neurological disorders, the Nervous system Chapter also contains medicines for analgesia, which might have been prescribed for acute pain and minor illness (for example paracetamol for pyrexia). The proportion of non-analgesic prescribing as a percentage of total Nervous system Chapter items increased from 50% to 66% during the study period, providing further evidence in support of an increase in primary care NMIP prescribing for long-term psychological and neurological conditions. An additional complication is the classification of certain medicines within the Nervous system Chapter. Amitriptyline and the gabapentinoids (gabapentin and pregabalin) are used in the management of depression, and epilepsy respectively, and some of this prescribing is recorded in those sections of CAPSA. However, these medicines may also be prescribed for the management of neuropathic pain,[24] and some formulations of each medicine are recorded in the analgesia section of CAPSA, despite the indication not necessarily being specific to the formulation. Adjusting the categorisation of these medicines to analgesics from 2015-2016 onwards (when the greatest increases in prescribing were seen) results in prescribing for long-term (non-analgesic) psychological and neurological conditions accounting for 50% of items in 2015-2016, increasing to 57% in 2020-2021. Whilst lower than the unadjusted percentages, there still appears to be an increase in prescribing for these long-term conditions. Consistent with the findings of our study, a survey of pharmacy professionals working in UK General Practice conducted in 2018/2019, identified that over 80% of pharmacist respondents provided clinical services including chronic disease management.[25] It should be noted that the sample size was relatively small, with 81 pharmacists, of whom, approximately 75% were prescribers. A change in prescribing from items for acute to chronic illness was also observed in a study of nurse practitioners prescribing in Ontario (Canada) from 2000 to 2010.[26] In contrast, a study examining more recent non-medical prescribing trends in New Zealand identified antibiotics and analgesics as the most commonly prescribed items.[27] However, it should be noted that this study included practitioners able to prescribe from a limited formulary, in addition to NMIPs, which may have influenced the findings. These changes suggest that those responsible for

delivering NMIP education should ensure that chronic disease management forms part of the program of learning.

Over the whole study period, the total number of items prescribed by NMIPs in each of the seven LHBs in Wales varied significantly, with the lowest prescribing in Powys, and the highest in Betsi Cadwaladr. Although the number of items varied, the Chapters contributing the greatest number of prescribed items were relatively consistent across the LHBs. Infection accounted for the most items in five of the seven LHBs in 2011-2012, whilst Cardiovascular and Nervous system were the two most prescribed Chapters across all seven LHBs in 2020-2021. There was a relatively weak correlation between items prescribed and population, which reflected the previous observation that LHBs with larger populations employed greater numbers of NMIPs.[15] The Covid-19 pandemic appeared to have a variable impact across the LHBs based upon the difference in NMIP prescribing between 2019-2020 and 2020-2021. Overall, NMIP prescribing was 5% higher in Wales in 2020-2021 compared with the previous year, although this was a much smaller increase than the 16% seen from 2018-2019 to 2019-2020. Across Wales as a whole, NMIP prescribing from Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia Chapters was lower in 2020-2021 than in the previous year. In the individual LHBs, prescribing in two (Hywel Dda and Cwm Taf Morgannwg) was lower, prescribing in one (Betsi Cadwaladr) remained relatively constant, and prescribing in the other four LHBs was higher than the previous year. Prescribing of antibiotics decreased in LHBs compared with 2019-2020, consistent with other studies examining primary care usage of these drugs during the Covid-19 pandemic.[28,29] This Covid related effect contributed to Infection being the 6th ranked BNF Chapter in 2020–2021, compared with the 3rd ranked Chapter in 2019–2020. However, the percentage contribution of the Infection Chapter to total NMIP prescribing was similar in both years (8% and 10% respectively). Other Chapters in which there was a reduction in items prescribed across all LHBs were Vaccines, and Ear Nose and Throat. Nevertheless, the data indicate that NMIPs were still actively prescribing as part of their roles during the pandemic.

This study has some limitations. As a result of the retrospective secondary data design, confounding factors that may have influenced prescribing trends could not be identified and explored.[30] For example, whilst the introduction of primary care clusters may have been a driver for the apparent change towards more chronic disease management in Wales (as well as the overall increase in prescribing), a causal association could not be determined. CASPA does not provide patient level data, nor data relating to indication, which limits conclusions that can be drawn. Whilst the increase in prescribing from the Cardiovascular Chapter suggested an increase in chronic disease

management, it was not possible to determine whether NMIPs were prescribing ongoing items for the same patient on a long-term basis, or whether they were prescribing occasional items for multiple patients. Similarly, as noted above, indications for the gabapentinoids and amitriptyline could not be determined. The prescribing measure chosen for this study was items, as it was felt that this best reflects a single prescribing interaction. However, it should be noted that the quantity supplied on each prescription may vary. If a prescription were issued with a three month supply, the number of items would be smaller. In particular, this may have influenced the number of oral contraceptive items prescribed as part of the Genito-urinary Chapter, as these are typically provided as a longer supply.

In summary, the BNF Chapter with the most prescribed items changed from Infection to Cardiovascular during the study period. This, along with increases in prescribing from other chapters associated with long-term illness, suggested an increase in chronic disease management by NMIPs over time. There was little regional variation in the therapeutic areas most commonly prescribed, indicating a similar approach to NMIP implementation across the LHBs in Wales. The Covid-19 pandemic had variable impact on prescribing both in terms of therapeutic area, and regional variation. However, prescribing by NMIPs continued to increase, and the impact of this on the delivery of primary care services is a focus for future work.

REFERENCES

1. Cope LC, Abuzour AS, Tully MP. 2016. Nonmedical prescribing: where are we now? Ther Adv Drug Saf. 7(4):165-172. doi: 10.1177/2042098616646726.

2. Graham-Clarke E, Rushton A, Noblet T, Marriott J. 2019. Non-medical prescribing in the United Kingdom National Health Service: A systematic policy review. PLOS One. 14(7): e0214630. doi: 10.1371/journal.pone.0214630.

3. Department of Health, 1999. Review of prescribing, supply & administration of medicines. Final report. Available at:
https://www.publichealth.hscni.net/sites/default/files/directorates/files/Review%20of%20prescribing,%20supply%20and%20administration%20of%20medicines.pdf
[Accessed 4 January 2022].

4. Department of Health, 2000. The NHS plan: a plan for investment. A plan for reform. Available at:
https://webarchive.nationalarchives.gov.uk/20130124064356/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_118522.pdf
[Accessed: 16 October 2020].

5. Stewart D, MacLure K, Bond CM, Cunningham S, Diack L, George J, McCaig DJ. 2011. Pharmacist prescribing in primary care: the views of patients across Great Britain who had experienced the service. Int J Pharm Pract. 19(5):328-332. doi: 10.1111/j.2042-7174.2011.00130.x.

6. Deslandes RE, John DN, Deslandes PN. 2015. An exploratory study of the patient experience of pharmacist supplementary prescribing in a secondary care mental health setting. Pharm. Pract. 13(2):553. doi: 10.18549/pharmpract.2015.02.553.

7. Tinelli M, Blenkinsopp A, Latter S, Smith A, Chapman S. 2015. Survey of patients' experiences and perceptions of care provided by nurse and pharmacist independent prescribers in primary care. Health Expectations 18(5):1241-1255. doi: 10.1111/hex.12099.

8. Mills T, Patel N, Ryan K. 2021. Pharmacist non-medical prescribing in primary care. A systematic review of views, opinions, and attitudes. Int J Clin Pract. 75(3): e13827 doi:10.1111/ijcp.13827.

9. Hindi AMK, Seston EM, Bell D, Steinke D, Willis S, Schafheutle EI. 2019. Independent prescribing in primary care: A survey of patients', prescribers' and colleagues' perceptions and experiences. Health and Social Care in the Community, 27(4):e459-e470. doi.org/10.1111/hsc.12746.

10. Courtenay M, Khanfer R, Harries-Huntly G, Deslandes R, Gillespie D, Hodson K, Morris G, Pritchard A, Williams E. 2017a. Overview of the uptake and implementation of non-medical prescribing in Wales: a national survey. BMJ Open 7(9): e015313. doi:10.1136/bmjopen-2016-105313.

11. Stewart D, Jebara T, Cunningham S, Awaisu A, Pallivalapila A, MacLure K. 2017. Future perspectives on nonmedical prescribing. Ther Adv Drug Saf. 8(6):183-197. doi: 10.1177/2042098617693354.

12. National Assembly for Wales, Health, Social Care and Sport Committee, 2017. Inquiry into Primary Care: Clusters. Available at: https://senedd.wales/laid%20documents/cr-ld11226/cr-ld11226-e.pdf [Accessed October 2021].

13. Welsh Government. 2014. Our plan for a primary care service for Wales up to March 2018. Available at: http://www.wales.nhs.uk/sitesplus/documents/986/our%20plan%20for%20primary%20care%20in%20wales%20up%20to%20march%202018.pdf [Accessed: 20 November 2020].

14. Welsh Government. 2018. A Healthier Wales: our plan for health and social care. Available at: https://gov.wales/sites/default/files/publications/2019-10/a-healthier-wales-action-plan.pdf [Accessed October 2021].

15. Alghamdi SSA, Hodson K, Deslandes P, Gillespie D, Haines K, Hulme E, Courtenay M, Deslandes R. 2020. Prescribing trends over time by non-medical independent prescribers in primary care settings across Wales (2011–2018): a secondary database analysis. BMJ Open 2020;10:e036379. doi: 10.1136/bmjopen-2019-036379.

16. All Wales Therapeutics and Toxicology Centre. 2021. National Prescribing Indicators 2020–2021 Analysis of Prescribing Data to March 2021. Available at: https://awmsg.nhs.wales/files/national-prescribing-indicators/national-prescribing-indicators-2020-2021-analysis-of-prescribing-data-to-march-2021-pdf/ [Accessed October 2021].

17. Groves S, Cohen D, Alam MF, Dunstan FDJ, Routledge PA, Hughes DA, Myles S. 2010. Abolition of prescription charges in Wales: the impact on medicines use in those who used to pay. Int J Pharmacy Pract. 18(6):332-340. doi-org.abc.cardiff.ac.uk/10.1111/j.2042-7174.2010.00063.x.

18. Welsh Government 2020. Population estimates by local health boards and year. Available at: https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-welshhealthboard-year [Accessed: October 2021].

19. Joint Formulary Committee, 2021. British National Formulary. BMJ Group and Pharmaceutical Press.

20. Drennan VM, Grant RL, Harris R. 2014. Trends over time in prescribing by English primary care nurses: a secondary analysis of a national prescription database. BMC Health Services Research 14:54. doi: 10.1186/1472-6963-14-54.

21. Courtenay M, Gillespie D, Lim R. 2017b. Patterns of dispensed non-medical prescriber prescriptions for antibiotics in primary care across England: a retrospective analysis. Antimicrob Chemother 72: 2915–2920. doi:10.1093/jac/dkx230.

22. Courtenay M, Rowbotham S, Lim R. Deslandes R, Hodson K, MacLure K, Peters S, Stewart D. 2017c. Antibiotics for acute respiratory tract infections: a mixed-methods study of patient experiences of non-medical prescriber management. BMJ Open 7:e013515. Doi:10.1136/bmjopen-2016-013515.

23. Hodson K, Deslandes R, Courtenay M. 2017. Pharmacist independent prescribers can make a significant contribution to antimicrobial stewardship. Pharm. J. 298(7901): doi:10.1211/PJ.2017.20202780.

24. National Institute for Health and Care Excellence. 2013. Neuropathic pain in adults: pharmacological management in non-specialist settings CG173. Available at: https://www.nice.org.uk/guidance/cg173 [Accessed October 2021].

25. Savickas V, Foreman E, Ladva A, Bhamra SK, Sharma R, Corlett SA. 2021. Pharmacy services and role development in UK general practice: a cross-sectional survey. Int J Pharm Pract 29:37-44. Doi:10.1111/ijpp.12653.

26. Tranmer JE, Colley L, Edge DS, Sears K, VanDenKerkhof E, Levesque L. 2015. Trends in nurse practitioners' prescribing to older adults in Ontario, 2000–2010: a retrospective cohort study. CMAJ Open 3(3):e299-e304. doi: https://doi.org/10.9778/cmajo.20150029.

27. Raghunandan R, Marra CA, Tordoff J, Smith A. 2021. Examining non-medical prescribing trends in New Zealand: 2016–2020. BMC Health Services Res. 21:418. doi.org/10.1186/s12913-021-06435-y.

28. Hussain AZ, Paudyal V, Habdi MA. 2021. Impact of the COVID-19 pandemic on the prescribing patterns of first-line antibiotics in English primary care: A longitudinal analysis of national prescribing dataset. Antibiotics 10(5): 591. doi: 10.3390/antibiotics10050591.

29. Zhu N, Aylin P, Eawson T, Gichrist M, Majeed A, Holmes A. 2021. Investigating the impact of COVID-19 on primary care antibiotic prescribing in North West London across two epidemic waves. Clin Microbiol Infect 27(5):762-768. doi: 10.1016/j.cmi.2021.02.007.

30. Cheng HG, Phillips MR. 2014. Secondary analysis of existing data: opportunities and implementation. Shanghai Archives Psychiatry. 26(6):371-375. doi:10.11919/j.issn.1002-0829.214171.

Figure legends

Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three Chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.

Figure 5. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Respiratory system (Resp), Infection (Inf), Endocrine system (End).

Figure 6. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye (Eye), Ear Nose and Throat (ENT), Skin (Skin).
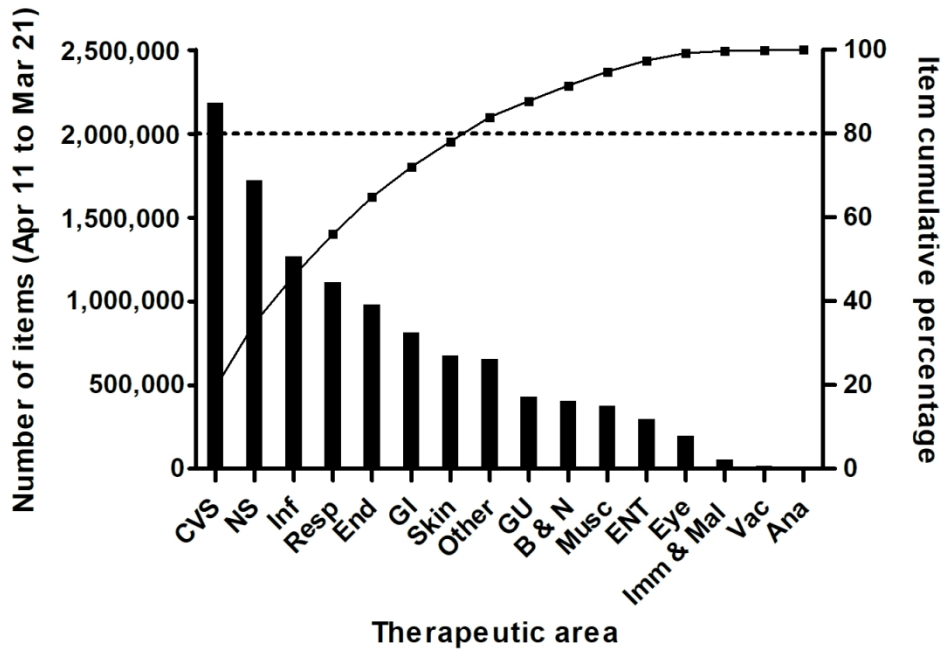
Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
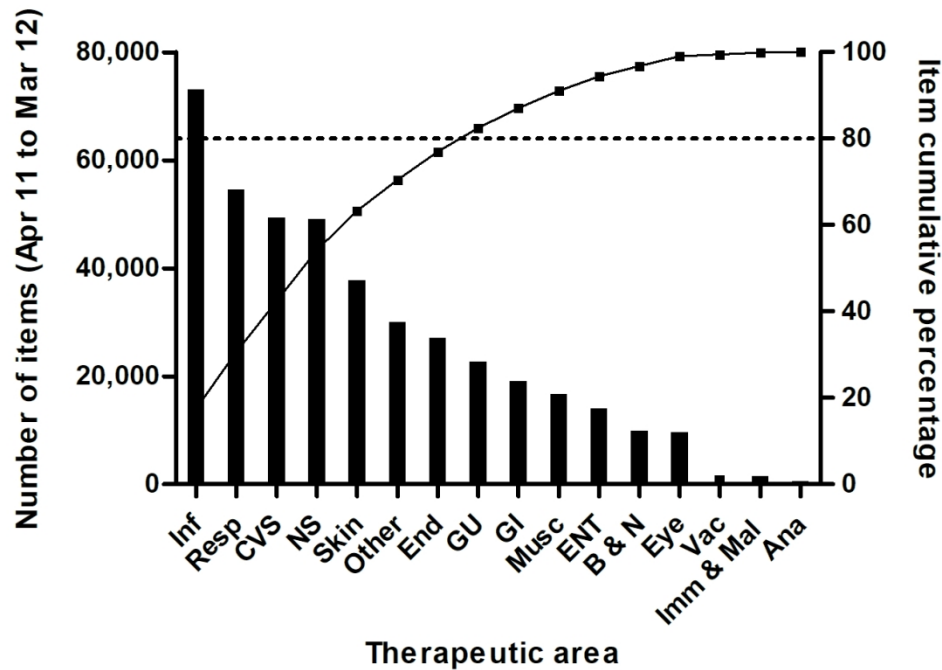
121x85mm (300 x 300 DPI)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
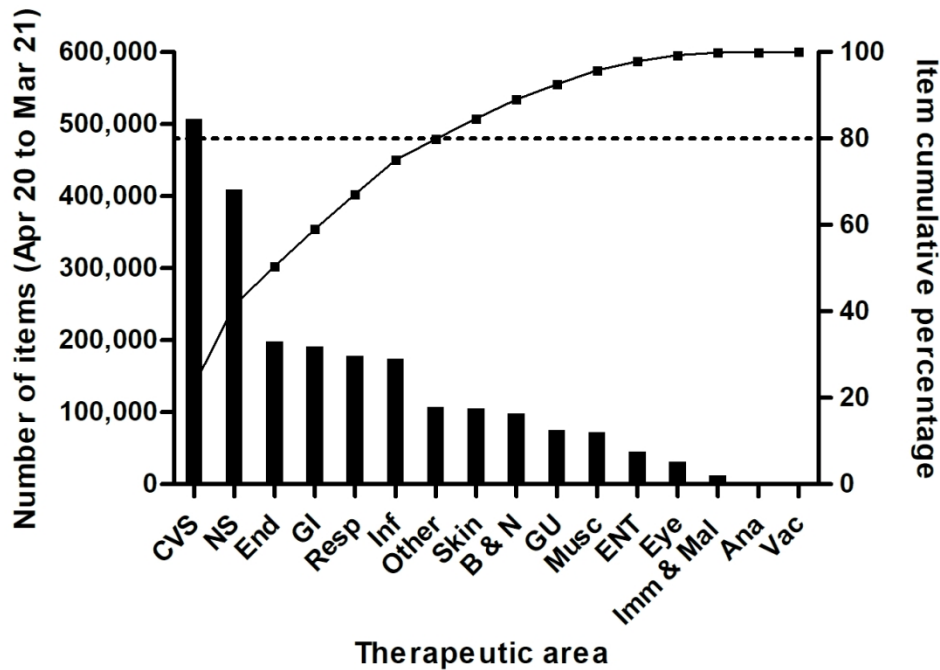
117x85mm (300 x 300 DPI)

Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
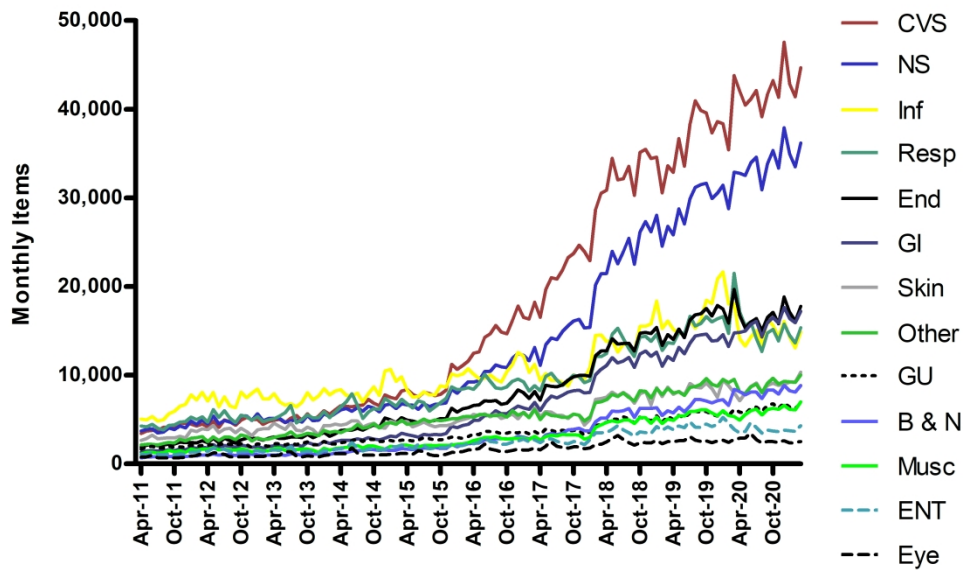
117x85mm (300 x 300 DPI)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.
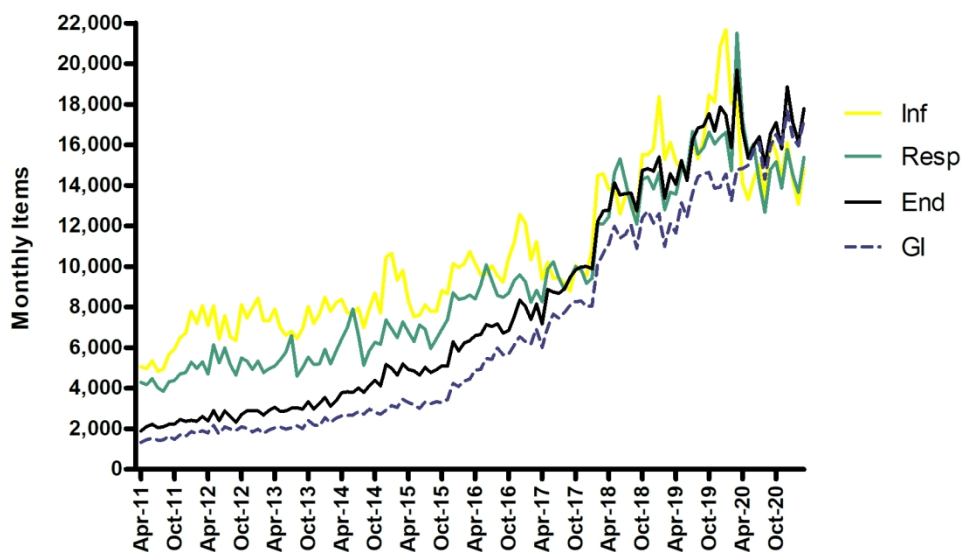
152x93mm (600 x 600 DPI)

Figure 5. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Respiratory system (Resp), Infection (Inf), Endocrine system (End).
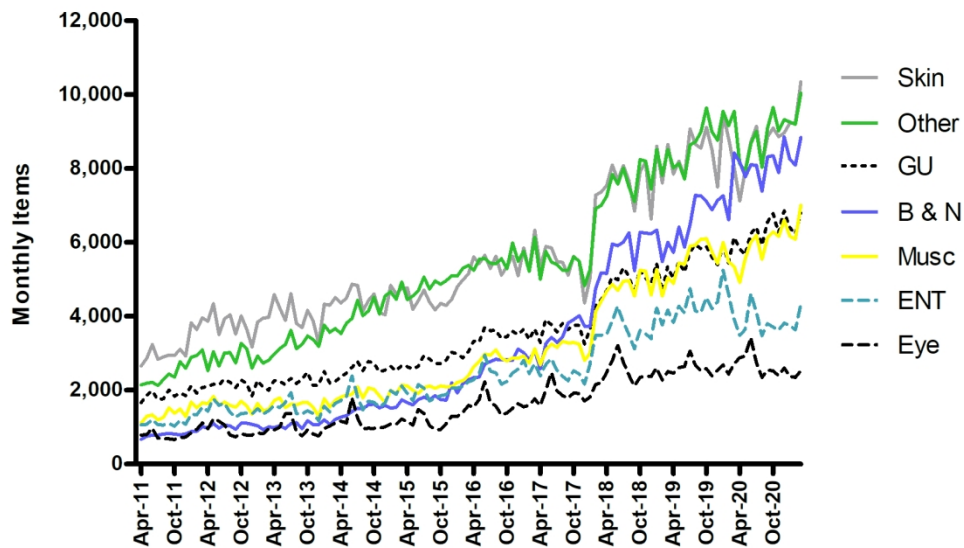
151x90mm (300 x 300 DPI)

Figure 6. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye (Eye), Ear Nose and Throat (ENT), Skin (Skin).

152x90mm (300 x 300 DPI)

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found		RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included.	Title Abstract "Design" section page 3
				RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract.	Title Abstract "Objectives" section Abstract "Design" section page 3
				RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	N/A there was no linkage of databases in this study
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Abstract "Objectives" section page 3 Introduction final paragraph page 5		
Objectives	3	State specific objectives, including any prespecified hypotheses	Abstract "Objectives" section page 3 Introduction final paragraph page 5		
Methods					

Study Design	4	Present key elements of study design early in the paper	Methods Data source section page 5		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure,follow-up, and data collection	Methods Data collection section page 6		
Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants	N/A this was not a cohort study	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.	N/A subjects were not recruited to this study N/A subjects were not recruited to this study
		(b) Cohort study - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	N/A this was not a cohort study	RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	N/A there was no linkage of databases in this study
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	N/A this was not a study involving participants	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	N/A no coding was used to collect data for this study

Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Data were collected using the Comparative Analysis System for Prescribing Audit (CASPA), which records WP10 prescriptions dispensed by community pharmacies and forwarded for pricing. Methods data source page 5.		
Bias	9	Describe any efforts to address potential sources of bias	N/A this study reported national prescribing volume as determined by a prescription dispensing database. Speculation regarding factors influencing prescribing could be made, but could not be addressed.		
Study size	10	Explain how the study size was arrived at	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.		

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Data were grouped according to BNF chapter, and LHB geographical area. These were chosen as they were readily available from the database used.		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	This study presented a descriptive analysis of prescribing data using Pareto analysis to identify the most commonly prescribed BNF chapters. Pearson's correlation co-efficient was used to compare prescribing volume and 2020 LHB mid year population estimate. No other statistical comparisons between groups were made.		
		(b) Describe any methods used to examine subgroups and interactions	Pearson's correlation co-efficient was used to compare prescribing volume and LHB mid year population estimate 2020.		
		(c) Explain how missing data were addressed	N/A there were no missing data		
		(d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how	N/A this study reported prescribing volume as determined by a prescription dispensing database.		

| | | matching of cases and controls was addressed
Cross-sectional study - If applicable, describe analytical methods taking account of sampling strategy
(e) Describe any sensitivity analyses | A comparison between prescribing pre (2018–2019 and 2019–2020) and during (2020–2021) the Covid pandemic is included in the Results section pages 8 to 9 | | |
| Data access and cleaning methods | | .. | | RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.included | Method, data source section page 5

Method, data collection section page 6 |

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	N/A no data cleaning took place as this was not necessary
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	N/A there was no linkage of databases in this study
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.		
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a		

			prescription dispensing database.		
		category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A data are presented as number of items and percentages		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Subgroup analyses based upon BNF chapters and LHBs are presented in the results section pages 7 to 9		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Key results are summarised in the Discussion page 11 paragraph 1		

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	The limitations of the database used are discussed in the discussion page 13 paragraph 2	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	The limitations of the database used are discussed in the discussion page 13 paragraph 2
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	A summary paragraph is included as the finals paragraph of the discussion on page 14		
		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion, limitations paragraph, page 13		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No funding was received. Title page		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data or programming code.	No supplemental information, study protocol or programming code was included. Primary care prescribing data for Wales were obtained from the Comparative Analysis System for Prescribing Audit (CASPA), which

For peer review only

					records WP10 prescriptions dispensed by community pharmacies and forwarded for pricing. Methods Data source page 5

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

*Checklist is protected under Creative Commons Attribution (CC BY) license.

BMJ Open

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-059204.R2
Article Type:	Original research
Date Submitted by the Author:	01-Feb-2022
Complete List of Authors:	Deslandes, Paul; University Hospital Llandough, All Wales Therapeutics and Toxicology Centre, Academic Centre; University of South Wales - Trefforest Campus, School of Care Sciences Blowers, Hannah; Cardiff University Haines, kath; University Hospital Llandough, All Wales Therapeutics and Toxicology Centre, Academic Centre Hodson, Karen; Cardiff University, Redwood Building Deslandes, Rhian; Cardiff University
Primary Subject Heading:	Health policy
Secondary Subject Heading:	Health services research, General practice / Family practice
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PRIMARY CARE

SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

BMJ

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Medicines prescribed by non-medical independent prescribers in primary care in Wales: A 10 year longitudinal study April 2011 to March 2021

Paul N Deslandes [1,2,3], Hannah Blowers [3], Kath Haines[1], Karen Hodson[3], Rhian E Deslandes*[3]

1. All Wales Therapeutics and Toxicology Centre, University Hospital Llandough, Penlan Road, Llandough, UK. CF64 2XX

2. School of Care Sciences, University of South Wales, Lower Glyntaff Campus, Treforest, UK. CF37 4DB

3. Cardiff School of Pharmacy and Pharmaceutical Sciences, Cardiff University, Cardiff, UK.

Corresponding author: Dr Rhian Deslandes deslandesRE@cardiff.ac.uk

Word count main text: 3,876

charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work

available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such

Open Access shall be governed by a Creative Commons licence – details of these licences and

which Creative Commons licence will apply to this Work are set out in our licence referred to above.

ABSTRACT

Objectives

The therapeutic classes of medicines prescribed by non-medical independent prescribers (NMIPs)

working in primary care in Wales has not been studied in detail. The aim of the present study was to

conduct a 10 year longitudinal analysis of NMIP prescribing in Wales from April 2011 to March 2021.

The study examined the British National Formulary (BNF) chapters from which medicines were

prescribed by NMIPs, whether this changed over time, and whether there was variation in

prescribing across the geographic regions of Wales.

Design

Retrospective secondary data analysis of primary care prescribing data. Monthly prescribing data for

the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained from the

Comparative Analysis System for Prescribing Audit (CASPA) software. Data were analysed according

to BNF chapter, to identify in which therapeutic areas NMIPs were prescribing, and whether this

changed over the study period.

Results

The number of items prescribed by NMIPs increased during the study period. From April 2011 to

March 2021 prescribing in seven BNF chapters equated to approximately 80% of total items, with

cardiovascular system medicines most prescribed. In the financial year 2011-2012 the BNF chapters

with the greatest proportion of items prescribed were Infection (18%) and Respiratory system (13%),

whilst in 2020-2021, these had changed to Cardiovascular (23%) and Nervous system (19%). The

number of items prescribed in each health board in Wales varied, however, the BNF chapters

contributing the largest percentages of items to the health board totals were broadly comparable.

Conclusions

The BNF chapter with the most prescribed items changed from Infection to Cardiovascular during

the study period, suggesting an increase in chronic disease management by NMIPs. The impact of

this on the delivery of primary care services and patient outcomes is a focus for future work.

Strengths and limitations of this study

- This study used an All Wales database, covering 10 years of non-medical independent prescribing data across the whole population in primary care.
- The data obtained allowed trends and regional variation in prescribing to be identified.
- The secondary data used did not allow the reasons for any observed changes in prescribing to be investigated.
- Patient level data were not available, therefore it was not possible to determine prescribing patterns for individual patients.

INTRODUCTION

In the United Kingdom (UK), prescribing practice has changed significantly since the 1980s. Legislative changes in the 1990s and early 2000s granted prescribing rights to non-medical health care professionals, with appropriate experience in their relevant scope of practice who had completed an accredited course of training.[1] Non-medical independent prescribing, defined as: '*prescribing by a practitioner (e.g., doctor, dentist, nurse, pharmacist) responsible and accountable for the assessment of patients with undiagnosed or diagnosed conditions and for decisions about the clinical management required, including prescribing.*' was first introduced for pharmacists and nurses in 2006.[2] The intention was to advance and develop the healthcare system, by improving patient access to medicines, and enhancing patient care and experience, without reducing safety.[3,4] In parallel, the roles and responsibilities of non-medical health care professionals have evolved, to facilitate support for a more flexible multidisciplinary healthcare team.[1,3]

Following implementation of non-medical prescribing, the benefits have been recognised widely by both patients and prescribers themselves. Patients report satisfaction and positive experiences including increased flexibility and accessibility,[5,6] and good rapport,[7] whilst practitioners report improved autonomy and job satisfaction despite certain barriers.[8] It has also been noted that non-medical independent prescribers (NMIPs) relieve pressures on GPs.[9] However, various barriers to the uptake and implementation of non-medical independent prescribing still exist, such as lack of support and confidence, leading to inconsistencies both across and within organisations.[10,11]

In Wales, primary care NHS services are provided through seven local health boards (LHBs). As a way to manage increasing demand for primary care services in Wales, Welsh Government implemented 64 primary care clusters in 2015.[12] Clusters are composed of groups of adjacent general practices and partner organisations, such as community pharmacies, working together to collaboratively provide services locally.[13] Implementation aimed to refocus primary care and improve patients'

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

access to healthcare, whilst relieving pressure on NHS hospitals. In 2018, Welsh Government

published a vision for health and social care, 'A Healthier Wales', which outlines the aim to move

away from providing care in hospitals to instead providing care in the community.[14] All of these

initiatives were potential drivers for greater uptake of NMIPs into primary care in Wales.[8,15]

Previous analysis of prescribing trend data for Wales has shown that the number of NMIPs

prescribing in primary care increased from 2011 to 2018. The total volume of items prescribed as

well as the volume prescribed by NMIPs grew over the same period, with a significant increase in the

prescribing rate for NMIPs following the implementation of primary care clusters.[15] Whilst the study

of Alghamdi et al. explored the broad prescribing trend, it did not identify the specific groups of

medicines prescribed, and by implication, the therapeutic areas in which NMIPs were working. The

aim of the present study was to conduct a 10 year longitudinal analysis of NMIP prescribing in Wales

from April 2011 to March 2021. Specifically, the study examined the BNF chapters from which

medicines were prescribed by NMIPs in primary care in Wales, whether this changed over time, and

whether there was variation in prescribing across the different geographic regions of Wales.

METHODS

Data source

This was a retrospective secondary data analysis of monthly prescribing data issued by NMIPs in

primary care in Wales. Prescribing data were accessed from the Comparative Analysis System for

Prescribing Audit (CASPA) software. CASPA software records all WP10 prescriptions (Welsh NHS

prescriptions) dispensed in community pharmacies and submitted to NHS Wales Prescribing Services

for financial reimbursement. Although the term 'prescribing' is used throughout this paper, the data

represents prescriptions that have been issued, dispensed and forwarded for pricing.[16] As a result,

dispensing may not reflect prescribing as some patients may not get their prescriptions dispensed.

However, the abolition of the prescription charge in Wales in 2007 helped to reduce the percentage

of patients who failed to have a prescription dispensed from an estimated 8.9% to an estimated

5.5%,[17] reducing the impact of this confounder.

Prescribing measure

For the purpose of this study the number of prescription items was the chosen prescribing measure

for prescribing volume. This measure was chosen, as it provides an indication of the extent of the

prescriber's activity, as each medicine prescribed counts as an item, irrespective of the amount, or

the cost. Welsh LHBs vary greatly by population size,[18] which is reflected in variation in GP

prescribing data. However, as non-medical independent prescribing was a developing service, it was felt that the amount of prescribing by NMIPs would be more dependent upon the number of practising NMIPs in each LHB, which might or might not have been related to the population of the LHB. For example, the number of items prescribed in an LHB with a small population but a large number of NMIPs would likely be greater than that in an LHB with a large population but a small number of NMIPs. NMIP prescribing in each LHB for the financial year 2020-2021 was correlated with the mid-year population estimate for the LHB (using population data for that year available at https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-lhb-age) to investigate this assumption.

Data collection

Nationwide monthly prescribing data for the 10 NHS financial years (April to March) from April 2011 to March 2021 were obtained for NMIPs in Wales. It was not possible to differentiate between healthcare professions, therefore the data represents prescribing by all NMIPs in primary care rather than a specific professional group. Data were synthesised to financial years and filtered by LHB to analyse the non-medical independent prescribing trends by geographical location. During the period of study, the structure of two LHBs changed, with part of the previous Abertawe Bro Morgannwg University Health Board (now Swansea Bay University Health Board) becoming part of Cwm Taf Morgannwg University Health Board in April 2019. The data presented represents prescribing that occurred for these organisations as they were structured during each financial year. As a result, prescribing in Swansea Bay after March 2019 may be lower than might have been expected, and prescribing in Cwm Taf Morgannwg greater than might have been expected, based upon previous trends.

Prescribing data for drugs available in CASPA are largely arranged in a way that corresponds to the chapters in the British National Formulary. As a result, prescribing was divided between 15 chapters: Gastro-intestinal system, Cardiovascular system, Respiratory system, Nervous system, Infection, Endocrine system, Genito-urinary system, Immune system and Malignant disease, Blood and Nutrition, Musculoskeletal system, Eye, Ear Nose and Throat, Skin, Vaccines and Anaesthesia.[19] However, in addition, CASPA holds details of items such as dressings, appliances and certain other preparations (e.g. substances used in medicines formulation), which are categorised beyond the BNF chapter structure. In this study, these items were grouped together, and included as "Other" items. This "Other" group also included a small number of items used in the management of poisoning. BNF Chapter 4 (Nervous system) includes medicines for the treatment of pain, as well as those for

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

psychological and neurological illnesses, such as depression, psychosis and Parkinson's Disease. As part of the analysis of this chapter, the number of items recorded in the Analgesia section was compared with the number of items in the other sections of this chapter in order to differentiate between therapeutic areas.

Data analysis

Data were presented in graphs and figures using descriptive statistics, where appropriate. Pareto analysis was used to provide a more focused exploration of the data. Pareto charts display the total number of items prescribed within each BNF chapter in descending order of quantity and an overlaid line displays the cumulative percentage of the total prescribing. A Pareto analysis is commonly used to focus investigations on the most significant categories when the data is defined by a large variety of categories, and for this reason, was chosen for this study. A Pareto analysis of all items prescribed from April 2011 to March 2021 (the whole dataset) as well as 2011-2012 (the first year of data) and 2020-2021 (the final year of data), was used to identify the chapters which encompassed 80% of the total prescribing by NMIPs. Pearson correlation analysis was used to compare prescribing volume in 2020-2021 and health board population (analysis performed using GraphPad Prism version 5.04, GraphPad Software Inc, California, USA).

Ethical consideration

The database (CASPA) used in this study holds routinely collected, anonymised prescription data, and did not allow the researcher to access any patient or prescriber identifiable information. As such ethical approval was not required for this study. This study was part of a wider project, which was approved by the researcher's LHB research and development department (reference number: 14/CLC/5882).

Patient and public involvement

This research was done without patient and public involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

RESULTS

Number of items prescribed by BNF chapter in Wales

The total number of items prescribed by NMIPs and dispensed in community pharmacy from April 2011 to March 2021 (referred to as the whole study period) was approximately 11.2 million. The number of items in 2011-2012 was approximately 417,000, which increased to approximately 2.2 million in 2020-2021 (an increase of 430%). The number of items prescribed during the whole study period varied according to BNF chapter, ranging from 2,184,656 items prescribed for medicines within Chapter 2 (Cardiovascular system) to 15,995 items prescribed for medicines within Chapter 15 (Anaesthesia). A Pareto analysis (Figure 1) identified that approximately 80% of the total number of items prescribed during the whole study period equated to seven BNF chapters; Cardiovascular system, Nervous system, Infection, Respiratory system, Endocrine system, Gastro-intestinal system, and Skin. Prescribing within three of the BNF chapters, Immune system and Malignant disease, Vaccines, and Anaesthesia was minimal.

Pareto analysis for prescribing data in 2011-2012, identified that eight BNF chapters accounted for approximately 80% of the total number of items prescribed; Infection, Respiratory system, Cardiovascular system, Nervous system, Skin, "Other", Endocrine, and Genito-urinary (Figure 2). In 2020-2021 the seven BNF chapters that accounted for approximately 80% of prescribing were Cardiovascular system, Nervous system, Endocrine system, Gastro-intestinal system, Respiratory system, Infection and Skin (Figure 3). In 2011-2012 Infection and Respiratory system were the top two chapters, and accounted for approximately 18% and 13% of prescribing respectively. In 2020-2021, these chapters were ranked 6th and 5th respectively and each accounted for approximately 8% of all items (16% for the two chapters combined). Prior to the Covid pandemic in both 2018–2019 and 2019–2020 Infection accounted for 10% of prescribed items, and was the 3rd ranked chapter. In 2020-2021, Cardiovascular system and Nervous system were the top two chapters, and accounted for approximately 40% of items prescribed. This was an increase from 24% of all items in 2011-2012, where they were ranked 3rd and 4th respectively. Within the Nervous system chapter, in 2011-2012 analgesics accounted for 50% of prescribed items, whilst in 2020-2021, they accounted for 34% of prescribed items.

Prescribing trend over time

The trend in prescribing in Wales according to BNF chapter is shown in Figure 4, with Figures 5 and 6 highlighting the prescribing trend from the middle and lower chapters respectively. Prescribing showed a year-on-year increase from 2011-2012 to 2019-2020 in all BNF chapters, with the exception of Vaccines, and a small fall (0.3%) in Infection in 2017-2018 compared to 2016-2017. Prescribing in five chapters (Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia)

was lower in 2020-2021 than in 2019-2020, but with the exception of Vaccines, remained higher than in 2011-2012. The chapters with the largest percentage difference in prescribing between 2011-2012 and 2020-2021 were Cardiovascular (928%), Gastro-intestinal (899%), and Blood and Nutrition (894%). The greatest year-on-year increase in overall prescribing (45%) occurred between 2017-2018 and 2018-2019, whilst the smallest year-on-year increase (5%) was between 2019-2020 and 2020-2021. The largest increase in Cardiovascular system prescribing (70%) occurred between 2016-2017 and 2017-2018, and Nervous system prescribing (59%) between 2017-2018 and 2018-2019.

Number of items prescribed by LHB

The LHB with the largest amount of prescribing by NMIPs throughout the whole study period, and in 2011-2012 and 2020-2021 was Betsi Cadwaladr. The lowest prescribing LHB over the whole study period and in 2011-2012 was Powys, whilst the lowest prescribing in 2020-2021 was in Cwm Taf Morgannwg (see Table 1). Prescribing in each health board in 2020-2021 was weakly correlated with the mid-year population estimate for the health board (Pearson r^2 = 0.66, p<0.05). Prescribing in the financial years prior to and during the Covid-19 pandemic is also shown in Table 1. For Wales, the percentage difference between 2011–2012 was 404%, and from 2011–2012 to 2020–2021 was 430%. The largest reduction in prescribing between 2019–2020 and 2020–2021 was seen in Hywel Dda (-35%), whilst the largest increase was seen in Cardiff and Vale (45%).

	Total n (%)	2011-2012 n (%)	2019-2020 n (%)	2020-2021 n (%)	2020 mid-year population n (%)
Wales	11,221,122 (100)	417,348 (100)	2,103,637 (100)	2,214,211 (100)	3,169,586 (100)
AB	2,080,391 (19)	57,985 (14)	406,461 (19)	492,472 (22)	598,194 (19)
BC	3,633,565 (32)	123,253 (30)	663,733 (32)	675,107 (30)	703,361 (22)
CV	1,431,904 (13)	96,398 (23)	232,040 (11)	337,484 (15)	504,497 (16)
CTM*	776,162 (7)	36,229 (9)	146,266 (7)	134,557 (6)	449,836 (14)
HD	1,634,835 (15)	53,232 (13)	393,483 (19)	254,026 (11)	389,719 (12)
Pow	663,344 (6)	4,405 (1)	134,943 (6)	168,304 (8)	133,030 (4)
SB*	1,000,921 (9)	45,846 (11)	126,711 (6)	152,261 (7)	390,949 (12)

Table 1. Total prescribing by NMIPs during the whole study period, and in 2011-2012, 2019-2020 and 2020-2021 according to LHB. Items prescribed in 2020-2021 correlated with mid-year health board population estimates (r^2=0.66, p<0.05, Pearson correlation analysis). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwn Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board.

Within each LHB, the BNF chapters contributing the largest percentage of items to the total prescribing are shown in Table 2. In 2011-2012, Infection contributed the largest percentage to the

total prescribing in five of the seven LHBs, and Respiratory system and Nervous system contributed the largest percentage in Cardiff and Vale and Cwm Taf Morgannwg respectively. The second largest percentage was contributed by Respiratory (in three LHBs), Cardiovascular (in three LHBs), and Nervous system (in one LHB). In 2020-2021, Cardiovascular system contributed the largest percentage to the total prescribing in six LHBs, and Nervous system contributed the largest percentage in the remaining LHB (Swansea Bay). The second largest percentage in six LHBs was contributed by Nervous system, whilst Cardiovascular contributed the second largest percentage in one LHB (Swansea Bay). This pattern was consistent with data prior to the Covid pandemic in 2018–2019 and 2020–2021.

	Wales		AB		BC		CV		CTM*		HD		Pow		SB*	
	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21	11-12	20-21
CVS	49,384 12%	507,641 23%	6,983 12%	132,354 27%	10,020 8%	138,249 20%	13,963 14%	84,075 25%	5,612 15%	24,448 18%	5,487 10%	53,404 21%	-	40,817 24%	7,280 16%	34,294 23%
CNS	49,104 12%	409,931 19%	7,122 12%	97,035 20%	13,434 11%	113,594 17%	10,895 11%	59,655 18%	5,872 16%	23,904 18%	6,182 12%	46,327 18%	-	33,690 20%	5,415 12%	35,726 23%
Infection	73,092 18%	174,815 8%	10,749 19%	33,538 7%	25,266 20%	70,662 10%	11,367 12%	-	5,165 14%	11,580 9%	11,673 22%	23,709 9%	1,055 24%	-	7,817 17%	8,457 6%
Respiratory	54,597 13%	178,724 8%	6,132 11%	35,485 7%	15,691 13%	56,809 8%	16,051 17%	25,117 7%	3,939 11%	15,573 12%	6,749 13%	20,671 8%	762 17%	13,385 8%	5,273 12%	11,684 8%
Endocrine	27,124 6%	198,763 9%	4,078 7%	41,112 8%	-	65,064 10%	8,229 9%	31,379 9%	2,664 7%	12,187 9%	-	20,985 8%	250 6%	14,706 9%	2,264 5%	13,330 9%
GI	-	191,470 9%	-	42,239 9%	-	57,418 9%	-	27,273 8%	2,394 7%	11,247 8%	2,880 5%	22,960 9%	-	16,992 10%	-	13,341 9%
Skin	37,858 9%	-	5,182 9%	-	11,787 10%	-	7,414 8%	-	2,705 7%	-	5,327 10%	-	722 16%	-	4,721 10%	-
Other	30,062 7%	-	4,582 8%	-	10,577 9%	-	6,684 7%	-	-	-	3,473 7%	-	529 12%	-	2,562 6%	-
Genito-urinary	-	-	-	-	8,557 7%	-	-	-	-	-	-	-	-	-	-	-
Nutrition blood	-	-	-	-	-	-	-	20,765 6%	-	-	-	-	-	9,698 6%	-	-
Total items	417,348	2,214,211	57,985	492,472	123,253	675,107	96,398	337,484	36,229	134,557	53,232	254,026	4,405	168,304	45,846	152,261

Table 2. The BNF chapters accounting for approximately 80% of prescribed items in the financial years 2011-2012 and 2020-2021 nationally in Wales, and in each of the seven LHBs. Top three chapters in each financial year highlighted (Green = first, Orange = second, Blue = third). AB – Aneurin Bevan University Health Board, BC – Betsi Cadwaladr University Health Board, CV – Cardiff and Vale University Health Board, CTM – Cwn Taf Morgannwg University Health Board, HD – Hywel Dda University Health Board, Pow – Powys Teaching Health Board, SB – Swansea Bay University Health Board. *The organisational structure of CTM and SB health boards changed in April 2019, therefore the quantity of items prescribed in the financial years shown is not necessarily comparable.

DISCUSSION

The total number of items prescribed each year by NMIPs in Wales and dispensed in community pharmacy increased over the study period. In the financial year 2020-2021, total NMIP prescribing was 430% greater than in 2011-2012, with the largest annual increases seen after April 2016. The study identified that over the whole period from April 2011 to March 2021 prescribing in seven BNF chapters equated to approximately 80% of total items prescribed by NMIPs in Wales, with Cardiovascular system the most prescribed chapter. From 2011-2012 to 2019-2020 there was a year-on-year increase in prescribed items across the majority of BNF chapters, with the exception of Vaccines, (and from 2016-2017 to 2017-2018 Infection). From 2019-2020 to 2020-2021, prescribing fell in five chapters, but with the exception of Vaccines, remained higher than in 2011-2012. In the financial year 2011-2012 the BNF chapters with the greatest items prescribed were Infection and Respiratory system, whilst in 2020-2021, the BNF chapters with the greatest items prescribed were Cardiovascular and Nervous system. The number of items prescribed in each LHB in Wales varied, however, the BNF chapters contributing the largest percentages of items to the LHB totals were broadly comparable.

Prior to 2015-2016, Infection was the BNF chapter with the greatest number of items prescribed. A study of nurse prescribing in England with data from 2006 to 2010, similarly identified penicillins as the most prescribed drug category by this professional group.[20] A year-on-year increase in prescribing of anti-infectives was observed across most years in the current study, consistent with an earlier study of antibiotic prescribing trends in England.[21] However, over the whole 10 year period of the present study, the greatest prescribing was seen in the Cardiovascular and Nervous system chapters. This was mainly due to large increases in prescribing in these chapters after 2015-2016. The volume of prescribing indicates that these were the predominant therapeutic areas in which NMIPs were utilising their qualification after 2015-2016, and indicates a shift in the focus of prescribing compared to the earlier years included in the study. The smaller observed increase in anti-infective prescribing (compared with Cardiovascular and Nervous system) over the study period may also reflect the role of NMIPs in promoting antimicrobial stewardship and the appropriate prescribing of these medicines.[22,23]

The observed increase in prescribing volume in Cardiovascular and Nervous system chapters, and the smaller increase in anti-infective prescribing coincided with the introduction of primary care clusters in Wales. This change to the organisational structure of healthcare delivery in Wales has been a driver for the creation of additional pharmacist and advanced nurse practitioner posts within

General Practices. Funding has been made available in Wales to provide prescribing training for these healthcare professionals[13], and the number of NMIPs working in primary care increased over the period from 2011 to 2018[15]. In this context, the role that pharmacists have in the management of patients with complex, chronic conditions, has been noted.[12] The increase in the volume of prescribing from the Cardiovascular chapter in particular, (along with somewhat smaller increases in prescribing from other chapters associated with of long-term illness such as the Endocrine chapter), suggests that a move towards chronic disease management has been realised in practice. The increase in prescribing from the Nervous system chapter adds some further support to this. However, in addition to containing medicines for the management of chronic mental illness and neurological disorders, the Nervous system chapter also contains medicines for analgesia, which might have been prescribed for acute pain and minor illness (for example paracetamol for pyrexia). The proportion of non-analgesic prescribing as a percentage of total Nervous system chapter items increased from 50% to 66% during the study period, providing further evidence in support of an increase in primary care NMIP prescribing for long-term psychological and neurological conditions. An additional complication is the classification of certain medicines within the Nervous system chapter. Amitriptyline and the gabapentinoids (gabapentin and pregabalin) are used in the management of depression, and epilepsy respectively, and some of this prescribing is recorded in those sections of CAPSA. However, these medicines may also be prescribed for the management of neuropathic pain,[24] and some formulations of each medicine are recorded in the analgesia section of CAPSA, despite the indication not necessarily being specific to the formulation. Adjusting the categorisation of these medicines to analgesics from 2015-2016 onwards (when the greatest increases in prescribing were seen) results in prescribing for long-term (non-analgesic) psychological and neurological conditions accounting for 50% of items in 2015-2016, increasing to 57% in 2020-2021. Whilst lower than the unadjusted percentages, there still appears to be an increase in prescribing for these long-term conditions. Consistent with the findings of our study, a survey of pharmacy professionals working in UK General Practice conducted in 2018/2019, identified that over 80% of pharmacist respondents provided clinical services including chronic disease management.[25] It should be noted that the sample size was relatively small, with 81 pharmacists, of whom, approximately 75% were prescribers. A change in prescribing from items for acute to chronic illness was also observed in a study of nurse practitioners prescribing in Ontario (Canada) from 2000 to 2010.[26] In contrast, a study examining more recent non-medical prescribing trends in New Zealand identified antibiotics and analgesics as the most commonly prescribed items.[27] However, it should be noted that this study included practitioners able to prescribe from a limited formulary, in addition to NMIPs, which may have influenced the findings. These changes suggest that those responsible for

delivering NMIP education should ensure that chronic disease management forms part of the program of learning.

Over the whole study period, the total number of items prescribed by NMIPs in each of the seven LHBs in Wales varied significantly, with the lowest prescribing in Powys, and the highest in Betsi Cadwaladr. Although the number of items varied, the chapters contributing the greatest number of prescribed items were relatively consistent across the LHBs. Infection accounted for the most items in five of the seven LHBs in 2011-2012, whilst Cardiovascular and Nervous system were the two most prescribed chapters across all seven LHBs in 2020-2021. There was a relatively weak correlation between items prescribed and population, which reflected the previous observation that LHBs with larger populations employed greater numbers of NMIPs.[15] The Covid-19 pandemic appeared to have a variable impact across the LHBs based upon the difference in NMIP prescribing between 2019-2020 and 2020-2021. Overall, NMIP prescribing was 5% higher in Wales in 2020-2021 compared with the previous year, although this was a much smaller increase than the 16% seen from 2018-2019 to 2019-2020. Across Wales as a whole, NMIP prescribing from Respiratory, Infection, Ear Nose and Throat, Vaccines, and Anaesthesia chapters was lower in 2020-2021 than in the previous year. In the individual LHBs, prescribing in two (Hywel Dda and Cwm Taf Morgannwg) was lower, prescribing in one (Betsi Cadwaladr) remained relatively constant, and prescribing in the other four LHBs was higher than the previous year. Prescribing of antibiotics decreased in LHBs compared with 2019-2020, consistent with other studies examining primary care usage of these drugs during the Covid-19 pandemic.[28,29] This Covid related effect contributed to Infection being the 6th ranked BNF chapter in 2020–2021, compared with the 3rd ranked chapter in 2019–2020. However, the percentage contribution of the Infection chapter to total NMIP prescribing was similar in both years (8% and 10% respectively). Other chapters in which there was a reduction in items prescribed across all LHBs were Vaccines, and Ear Nose and Throat. Nevertheless, the data indicate that NMIPs were still actively prescribing as part of their roles during the pandemic.

This study has some limitations. As a result of the retrospective secondary data design, confounding factors that may have influenced prescribing trends could not be identified and explored.[30] For example, whilst the introduction of primary care clusters may have been a driver for the apparent change towards more chronic disease management in Wales (as well as the overall increase in prescribing), a causal association could not be determined. CASPA does not provide patient level data, nor data relating to indication, which limits conclusions that can be drawn. Whilst the increase in prescribing from the Cardiovascular chapter suggested an increase in chronic disease

management, it was not possible to determine whether NMIPs were prescribing ongoing items for the same patient on a long-term basis, or whether they were prescribing occasional items for multiple patients. Similarly, as noted above, indications for the gabapentinoids and amitriptyline could not be determined. The prescribing measure chosen for this study was items, as it was felt that this best reflects a single prescribing interaction. However, it should be noted that the quantity supplied on each prescription may vary. If a prescription were issued with a three month supply, the number of items would be smaller. In particular, this may have influenced the number of oral contraceptive items prescribed as part of the Genito-urinary chapter, as these are typically provided as a longer supply.

In summary, the BNF chapter with the most prescribed items changed from Infection to Cardiovascular during the study period. This, along with increases in prescribing from other chapters associated with long-term illness, suggested an increase in chronic disease management by NMIPs over time. There was little regional variation in the therapeutic areas most commonly prescribed, indicating a similar approach to NMIP implementation across the LHBs in Wales. The Covid-19 pandemic had variable impact on prescribing both in terms of therapeutic area, and regional variation. However, prescribing by NMIPs continued to increase, and the impact of this on the delivery of primary care services is a focus for future work.

REFERENCES

1. Cope LC, Abuzour AS, Tully MP. 2016. Nonmedical prescribing: where are we now? Ther Adv Drug Saf. 7(4):165-172. doi: 10.1177/2042098616646726.

2. Graham-Clarke E, Rushton A, Noblet T, Marriott J. 2019. Non-medical prescribing in the United Kingdom National Health Service: A systematic policy review. PLOS One. 14(7): e0214630. doi: 10.1371/journal.pone.0214630.

3. Department of Health, 1999. Review of prescribing, supply & administration of medicines. Final report. Available at: https://www.publichealth.hscni.net/sites/default/files/directorates/files/Review%20of%20prescribing,%20supply%20and%20administration%20of%20medicines.pdf [Accessed 4 January 2022].

4. Department of Health, 2000. The NHS plan: a plan for investment. A plan for reform. Available at: https://webarchive.nationalarchives.gov.uk/20130124064356/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_118522.pdf [Accessed: 16 October 2020].

5. Stewart D, MacLure K, Bond CM, Cunningham S, Diack L, George J, McCaig DJ. 2011. Pharmacist prescribing in primary care: the views of patients across Great Britain who had experienced the service. Int J Pharm Pract. 19(5):328-332. doi: 10.1111/j.2042-7174.2011.00130.x.

6. Deslandes RE, John DN, Deslandes PN. 2015. An exploratory study of the patient experience of pharmacist supplementary prescribing in a secondary care mental health setting. Pharm. Pract. 13(2):553. doi: 10.18549/pharmpract.2015.02.553.

7. Tinelli M, Blenkinsopp A, Latter S, Smith A, Chapman S. 2015. Survey of patients' experiences and perceptions of care provided by nurse and pharmacist independent prescribers in primary care. Health Expectations 18(5):1241-1255. doi: 10.1111/hex.12099.

8. Mills T, Patel N, Ryan K. 2021. Pharmacist non-medical prescribing in primary care. A systematic review of views, opinions, and attitudes. Int J Clin Pract. 75(3): e13827 doi:10.1111/ijcp.13827.

9. Hindi AMK, Seston EM, Bell D, Steinke D, Willis S, Schafheutle EI. 2019. Independent prescribing in primary care: A survey of patients', prescribers' and colleagues' perceptions and experiences. Health and Social Care in the Community, 27(4):e459-e470. doi.org/10.1111/hsc.12746.

10. Courtenay M, Khanfer R, Harries-Huntly G, Deslandes R, Gillespie D, Hodson K, Morris G, Pritchard A, Williams E. 2017a. Overview of the uptake and implementation of non-medical prescribing in Wales: a national survey. BMJ Open 7(9): e015313. doi:10.1136/bmjopen-2016-105313.

11. Stewart D, Jebara T, Cunningham S, Awaisu A, Pallivalapila A, MacLure K. 2017. Future perspectives on nonmedical prescribing. Ther Adv Drug Saf. 8(6):183-197. doi: 10.1177/ 204209861769354.

12. National Assembly for Wales, Health, Social Care and Sport Committee, 2017. Inquiry into Primary Care: Clusters. Available at: https://senedd.wales/laid%20documents/cr-ld11226/cr-ld11226-e.pdf [Accessed October 2021].

13. Welsh Government. 2014. Our plan for a primary care service for Wales up to March 2018. Available at: http://www.wales.nhs.uk/sitesplus/documents/986/our%20plan%20for%20primary%20care%20in%20wales%20up%20to%20march%202018.pdf [Accessed: 20 November 2020].

14. Welsh Government. 2018. A Healthier Wales: our plan for health and social care. Available at: https://gov.wales/sites/default/files/publications/2019-10/a-healthier-wales-action-plan.pdf [Accessed October 2021].

15. Alghamdi SSA, Hodson K, Deslandes P, Gillespie D, Haines K, Hulme E, Courtenay M, Deslandes R. 2020. Prescribing trends over time by non-medical independent prescribers in primary care settings across Wales (2011–2018): a secondary database analysis. BMJ Open 2020;10:e036379. doi: 10.1136/bmjopen-2019-036379.

16. All Wales Therapeutics and Toxicology Centre. 2021. National Prescribing Indicators 2020–2021 Analysis of Prescribing Data to March 2021. Available at: https://awmsg.nhs.wales/files/national-prescribing-indicators/national-prescribing-indicators-2020-2021-analysis-of-prescribing-data-to-march-2021-pdf/ [Accessed October 2021].

17. Groves S, Cohen D, Alam MF, Dunstan FDJ, Routledge PA, Hughes DA, Myles S. 2010. Abolition of prescription charges in Wales: the impact on medicines use in those who used to pay. Int J Pharmacy Pract. 18(6):332-340. doi-org.abc.cardiff.ac.uk/10.1111/j.2042-7174.2010.00063.x.

18. Welsh Government 2020. Population estimates by local health boards and year. Available at: https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Health-Boards/populationestimates-by-welshhealthboard-year [Accessed: October 2021].

19. Joint Formulary Committee, 2021. British National Formulary. BMJ Group and Pharmaceutical Press.

20. Drennan VM, Grant RL, Harris R. 2014. Trends over time in prescribing by English primary care nurses: a secondary analysis of a national prescription database. BMC Health Services Research 14:54. doi: 10.1186/1472-6963-14-54.

21. Courtenay M, Gillespie D, Lim R. 2017b. Patterns of dispensed non-medical prescriber prescriptions for antibiotics in primary care across England: a retrospective analysis. Antimicrob Chemother 72: 2915–2920. doi:10.1093/jac/dkx230.

22. Courtenay M, Rowbotham S, Lim R. Deslandes R, Hodson K, MacLure K, Peters S, Stewart D. 2017c. Antibiotics for acute respiratory tract infections: a mixed-methods study of patient experiences of non-medical prescriber management. BMJ Open 7:e013515. Doi:10.1136/bmjopen-2016-013515.

23. Hodson K, Deslandes R, Courtenay M. 2017. Pharmacist independent prescribers can make a significant contribution to antimicrobial stewardship. Pharm. J. 298(7901): doi:10.1211/PJ.2017.20202780.

24. National Institute for Health and Care Excellence. 2013. Neuropathic pain in adults: pharmacological management in non-specialist settings CG173. Available at: https://www.nice.org.uk/guidance/cg173 [Accessed October 2021].

25. Savickas V, Foreman E, Ladva A, Bhamra SK, Sharma R, Corlett SA. 2021. Pharmacy services and role development in UK general practice: a cross-sectional survey. Int J Pharm Pract 29:37-44. Doi:10.1111/ijpp.12653.

26. Tranmer JE, Colley L, Edge DS, Sears K, VanDenKerkhof E, Levesque L. 2015. Trends in nurse practitioners' prescribing to older adults in Ontario, 2000–2010: a retrospective cohort study. CMAJ Open 3(3):e299-e304. doi: https://doi.org/10.9778/cmajo.20150029.

27. Raghunandan R, Marra CA, Tordoff J, Smith A. 2021. Examining non-medical prescribing trends in New Zealand: 2016–2020. BMC Health Services Res. 21:418. doi.org/10.1186/s12913-021-06435-y.

28. Hussain AZ, Paudyal V, Habdi MA. 2021. Impact of the COVID-19 pandemic on the prescribing patterns of first-line antibiotics in English primary care: A longitudinal analysis of national prescribing dataset. Antibiotics 10(5): 591. doi: 10.3390/antibiotics10050591.

29. Zhu N, Aylin P, Eawson T, Gichrist M, Majeed A, Holmes A. 2021. Investigating the impact of COVID-19 on primary care antibiotic prescribing in North West London across two epidemic waves. Clin Microbiol Infect 27(5):762-768. doi: 10.1016/j.cmi.2021.02.007.

30. Cheng HG, Phillips MR. 2014. Secondary analysis of existing data: opportunities and implementation. Shanghai Archives Psychiatry. 26(6):371-375. doi:10.11919/j.issn.1002-0829.214171.

Figure legends

Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
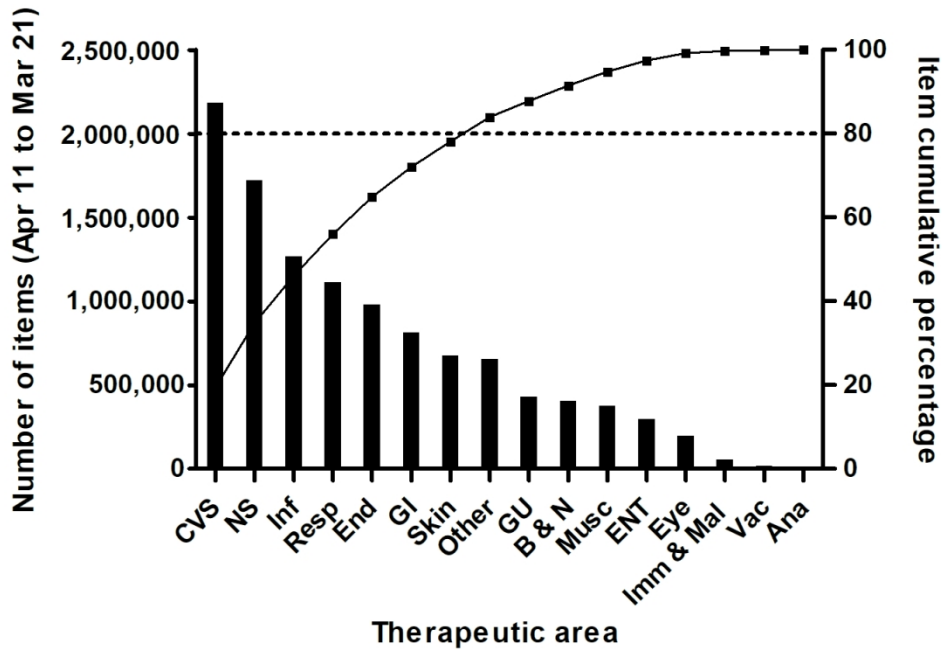
Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.

The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.

Figure 5. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Respiratory system (Resp), Infection (Inf), Endocrine system (End).

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure 6. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye (Eye), Ear Nose and Throat (ENT), Skin (Skin).

Figure 1. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Oropharynx (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
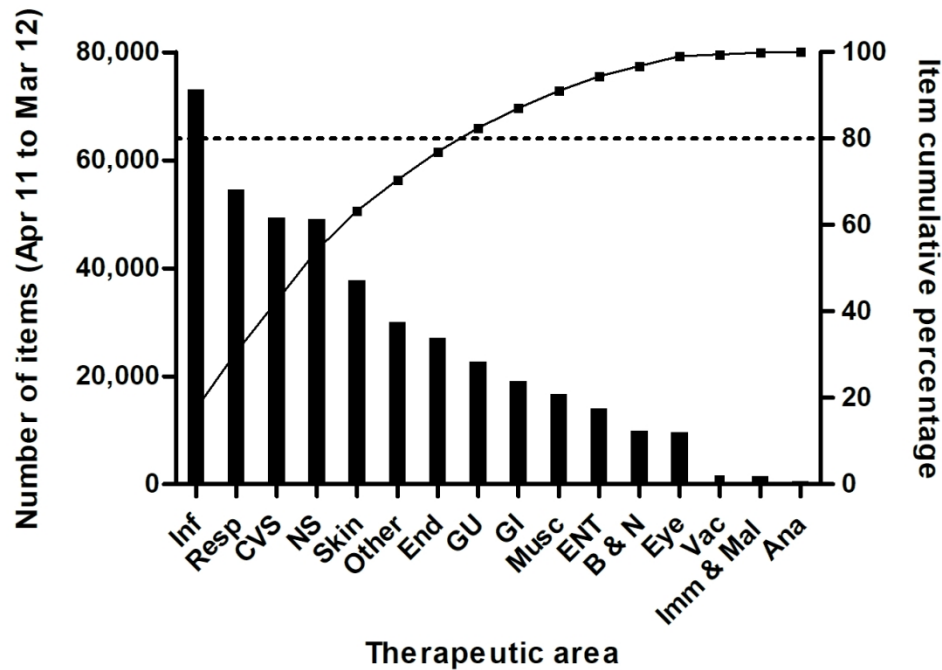
121x85mm (300 x 300 DPI)

Figure 2. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2011 to March 2012 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
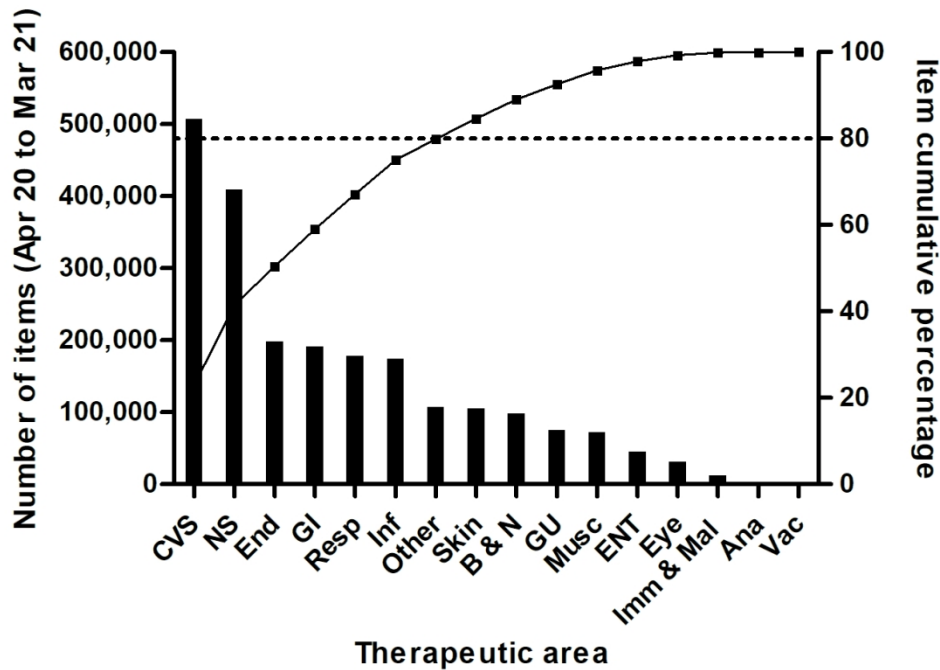
117x85mm (300 x 300 DPI)

Figure 3. Pareto analysis of the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy from April 2020 to March 2021 by BNF chapter. The columns on the left axis represent items per BNF chapter. The line on the right axis shows a cumulative percentage of the number of items prescribed.
The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Immune system and Malignant disease (Imm & Mal), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin), Vaccines (Vac), and Anaesthesia (Ana)
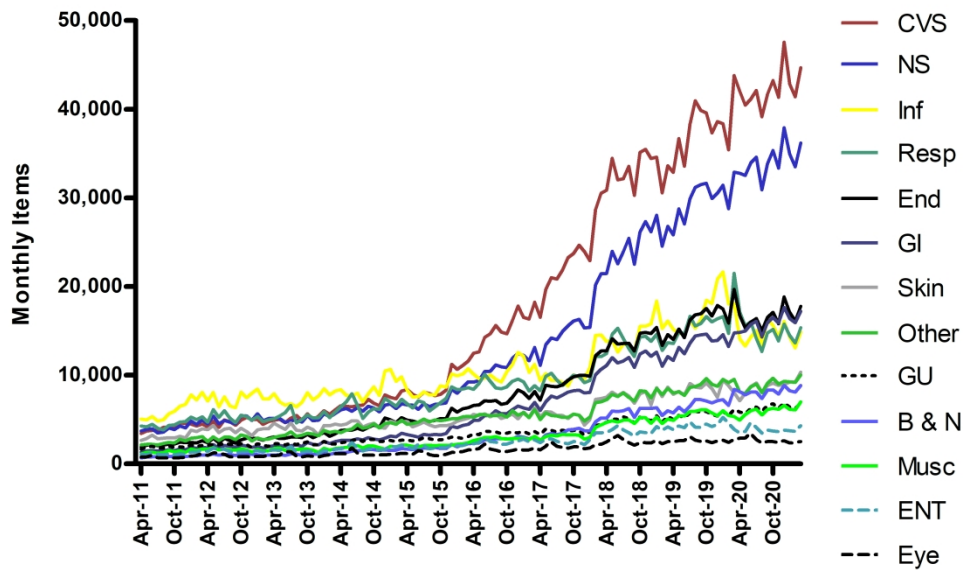
117x85mm (300 x 300 DPI)

Figure 4. Trend in the total number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF chapters are abbreviated as: Gastro-intestinal system (GI), Cardiovascular system (CVS), Respiratory system (Resp), Nervous system (NS), Infection (Inf), Endocrine system (End), Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye, Ear Nose and Throat (ENT), Skin (Skin). The three chapters with the smallest usage (Immune system and Malignant disease, Anaesthesia, and Vaccines), have been removed to aid clarity.
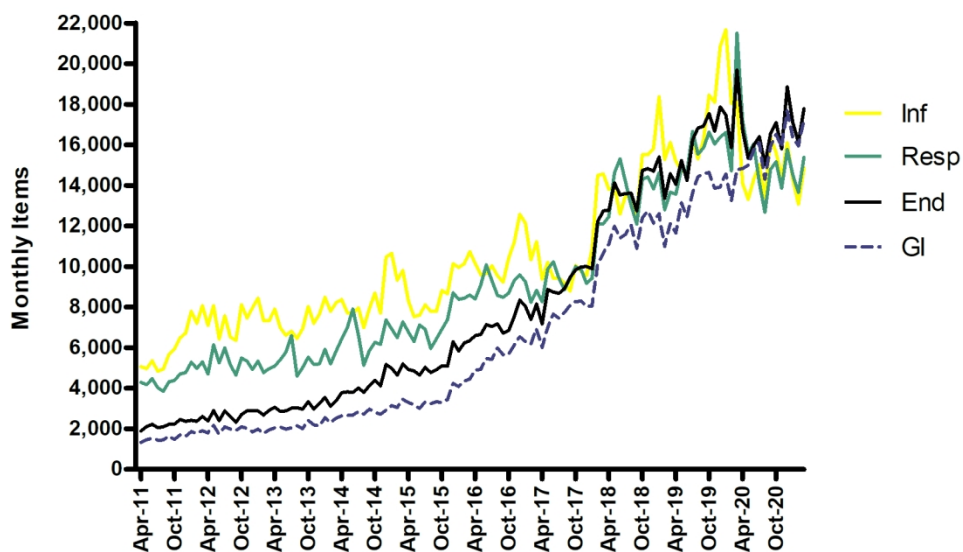
152x93mm (600 x 600 DPI)

Figure 5. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Gastro-intestinal system (GI), Respiratory system (Resp), Infection (Inf), Endocrine system (End).
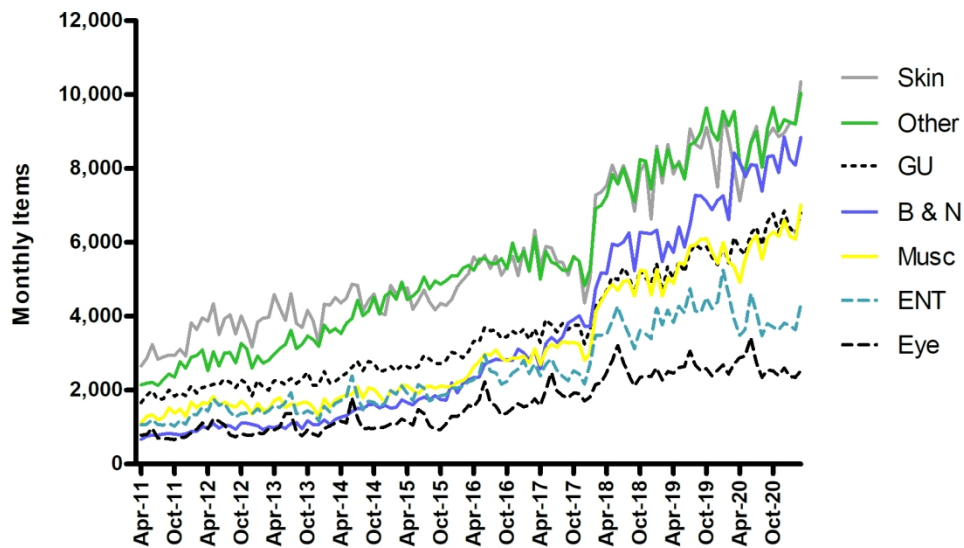
151x90mm (300 x 300 DPI)

Figure 6. Trend in the number of items prescribed by an NMIP in Wales and dispensed in a community pharmacy by BNF category. The BNF Chapters are abbreviated as: Genito-urinary system (GU), Blood and Nutrition (B & N), Musculoskeletal system (Musc), Eye (Eye), Ear Nose and Throat (ENT), Skin (Skin).

152x90mm (300 x 300 DPI)

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found		RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included.	Title Abstract "Design" section page 3
				RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract.	Title Abstract "Objectives" section Abstract "Design" section page 3
				RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	N/A there was no linkage of databases in this study
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Abstract "Objectives" section page 3 Introduction final paragraph page 5		
Objectives	3	State specific objectives, including any prespecified hypotheses	Abstract "Objectives" section page 3 Introduction final paragraph page 5		
Methods					

Study Design	4	Present key elements of study design early in the paper	Methods Data source section page 5		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure,follow-up, and data collection	Methods Data collection section page 6		

Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	N/A this was not a cohort study N/A this was not a cohort study	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	N/A subjects were not recruited to this study N/A subjects were not recruited to this study N/A there was no linkage of databases in this study
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	N/A this was not a study involving participants	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	N/A no coding was used to collect data for this study

Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Data were collected using the Comparative Analysis System for Prescribing Audit (CASPA), which records WP10 prescriptions dispensed by community pharmacies and forwarded for pricing. Methods data source page 5.		
Bias	9	Describe any efforts to address potential sources of bias	N/A this study reported national prescribing volume as determined by a prescription dispensing database. Speculation regarding factors influencing prescribing could be made, but could not be addressed.		
Study size	10	Explain how the study size was arrived at	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.		

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Data were grouped according to BNF chapter, and LHB geographical area. These were chosen as they were readily available from the database used.			
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	This study presented a descriptive analysis of prescribing data using Pareto analysis to identify the most commonly prescribed BNF chapters. Pearson's correlation co-efficient was used to compare prescribing volume and 2020 LHB mid year population estimate. No other statistical comparisons between groups were made.			
		(b) Describe any methods used to examine subgroups and interactions	Pearson's correlation co-efficient was used to compare prescribing volume and LHB mid year population estimate 2020.			
		(c) Explain how missing data were addressed	N/A there were no missing data			
		(d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how	N/A this study reported prescribing volume as determined by a prescription dispensing database.			

		matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	A comparison between prescribing pre (2018–2019 and 2019–2020) and during (2020–2021) the Covid pandemic is included in the Results section pages 8 to 9		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.included	Method, data source section page 5 Method, data collection section page 6

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	N/A no data cleaning took place as this was not necessary
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	N/A there was no linkage of databases in this study
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a prescription dispensing database.		
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure	N/A this was not a study involving participants. This study reported national prescribing volume as determined by a		

			prescription dispensing database.		
		category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A data are presented as number of items and percentages		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Subgroup analyses based upon BNF chapters and LHBs are presented in the results section pages 7 to 9		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Key results are summarised in the Discussion page 11 paragraph 1		

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	The limitations of the database used are discussed in the discussion page 13 paragraph 2	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	The limitations of the database used are discussed in the discussion page 13 paragraph 2
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	A summary paragraph is included as the finals paragraph of the discussion on page 14		
		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion, limitations paragraph, page 13		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No funding was received. Title page		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	No supplemental information, study protocol or programming code was included. Primary care prescribing data for Wales were obtained from the Comparative Analysis System for Prescribing Audit (CASPA), which

				records WP10 prescriptions dispensed by community pharmacies and forwarded for pricing. Methods Data source page 5

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

*Checklist is protected under Creative Commons Attribution (CC BY) license.