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Article

High Antimicrobial Stewardship Engagement Among Pharmacists, Their Teams and Pharmacy Students: Evidence from the Antibiotic Guardian Campaign (2014–2025)

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Abstract

Introduction: The Antibiotic Guardian (AG) campaign uses pledges to raise awareness and promote antimicrobial stewardship behaviours among healthcare professionals (HCPs) and the public. This study aimed to assess trends in AG pledges, focusing the pharmacy workforce (including but not limited to pharmacists, pharmacy technicians and pharmacy assistants) and pharmacy students. **Methods:** Pledges made by pharmacy professionals, and pharmacy students via the main pledge page from August 2014 – December 2025 were analysed. **Results:** Pharmacy teams were the predominant HCP to make a pledge, contributing 64% (105,941/166,411) of all HCPs pledges. Similarly, among students' pledges, pharmacy undergraduates were over-represented (44% of all student pledges, 14,725/24,645). Among pharmacy team pledges pharmacy assistants (44%, 45,656/104,644) and community pharmacists (29%, 29,910/104,644) accounted for the highest number of pledges. The most frequently chosen pharmacy team pledge related to informing patients on how to take their prescribed antibiotics appropriately and how to safely dispose of any unused antibiotics (51%, 48,479/94,430), with pharmacy assistants the predominant group to select this pledge (51%, 24,534/48,479). The pledges selected by students differed from pharmacy professionals, reflecting their different abilities, responsibilities and opportunities. **Conclusion:** AG campaign engagement has increased over the years, particularly among community pharmacy workers during the COVID-19 pandemic and following the introduction of the national Pharmacy Quality Scheme (PQS).

Keywords: antibiotic guardian; antibiotic stewardship; antibiotic resistance; pharmacy; pharmacy student; pharmacist; pharmacy technician; community pharmacy

1. Introduction

Antimicrobial resistance (AMR) is becoming a major threat to global health [1]. Natural adaptation of bacteria to their environment and the overuse of antibiotics has increased drug-resistance, including the evolution of multi drug resistant (MDR) bacteria [2]. This status was foreseen by Sir Alexander Fleming in 1945, who predicted that overuse of antibiotics would lead to an evolution of antibiotic resistance [3]. After several decades, the full extent of this warning has been realised, as common infections have become increasingly difficult to treat [4]. Conventional antibiotics are losing potency and effectiveness, leading to the increased dependence on combination therapies and broad-spectrum antibiotics that are usually reserved for serious infections. Clearly, this is an unsustainable situation, and there is a significant risk that MDR bacteria will eventually become completely immune to existing therapies. The short-term solution to deal with this risk is to reduce

the use of antibiotics, as new generations of more targeted antibiotics are being developed in the longer term [5].

Over the years, there have been several national and international interventions to tackle this growing problem. In the UK, examples include raising public awareness of and education about AMR [6], improving professional education and training as part of the 5-year UK AMR strategy developed in 2013 [7] and the introduction and review of the Pharmacy Quality Scheme (PQS) as part of the Community Pharmacy Contractual Framework (CPCF) which resulted in the release of PQS Part 2 (2020) [8]. Furthermore, antimicrobial stewardship (AMS) was prioritised in the NHS Long Term Plan [9], highlighting the importance of optimising antibiotic use and reducing unnecessary exposure.

From 2014 to 2023, a 19% reduction in antibiotic prescribing was seen in primary care in England [10]. However, antibiotic consumption rates remain steady in hospitals and other community settings, such as dental clinics, suggesting additional efforts are needed in this area. One of the activities undertaken to promote AMS in the UK was the Antibiotic Guardian (AG) campaign. The ongoing AG campaign is in an online pledge system, launched in 2014, which aims to increase engagement and encourage antimicrobial stewardship actions among healthcare workers, students, and the public by encouraging individuals to become Antibiotic Guardians by pledging an action they will take to help tackle AMR. As the risks of AMR gain more attention, there has been a steady rise in the number of pledges, from health care workers as well as from the public, with the campaign meeting and exceeding its target of 10,000 pledges in its first year [11].

There have been several studies exploring the effectiveness and impact of the AG campaign since its launch. For instance, Chaintarli et al. (2016) used a questionnaire to assess self-reported behaviour and AMR knowledge amongst randomly selected pledgers prior to and five months after making their pledge [13]. The study found evidence of increased commitment and self-reported knowledge. However, the campaign was found to be more effective among those who already had prior awareness of AMR.

Kesten et al. (2017), conducted a qualitative evaluation using telephone interviews [14]. Pledgers representing both HCP and members of public were asked about their experiences of the campaign, such as motives for joining and initial impressions. The study found that while most Antibiotic Guardians believed they complied with their pledge, they also felt that the pledges only reinforced pre-existing behaviours, and more needed to be done to promote the campaign to those who had no awareness of AMR.

The pharmacy workforce including pharmacy professionals such as pharmacists, registered/regulated pharmacy technicians and individuals working within pharmacy teams, for example, pharmacy assistants are critical to tackling overprescription of antibiotics, as they interact with patients, the prescriber, and other healthcare workers [12]. This puts them in a strong position to reduce inappropriate antibiotic prescribing via clinical intervention. They are therefore a key target group for the AG campaign, meaning their pledge activity warrants further investigation.

This paper aims to improve understanding of pharmacy professionals', other pharmacy workers, and students' engagement in AMS, using pledges made via the AG website as a proxy measure, by analysing data from the main AG webpage since its launch, focusing on trends in participation levels and the types of pledges selected by pharmacy professionals, other pharmacy workers and students.

2. Materials and Methods

2.1. Materials

The AG website (AntibioticGuardian.com) is a multi-format media campaign and acts as the access point for visitors to make a pledge towards addressing AMR.

The AG website consists of a main page which was originally launched in 2014. As the AG campaign expanded in the following years, the website was rebranded in September 2017 under the

Keep Antibiotics Working brand to align with other AMR activities by Public Health England (PHE) [15]. Continent (Africa) and country specific (South Africa, Australia,) webpages were also developed and translated into 11 languages, namely Mandarin, Romanian, Polish, Punjabi, Urdu, Dutch, French, German, Russian, Turkish and Welsh, as of December 2025 [16].

Once visitors access the AG website, a short video outlines the importance of AMS, the impact of AMR on global health and introduces key messages on appropriate antibiotics use and a call to action. Resources and links to other related public campaigns and organisations are also given. Upon scrolling down the page, visitors see three categories under which they can select a pledge from pre-populated tailored options: (i) health or social care professional or leader, or (ii) member of the public, or (iii) student, educator or scientist (Figure 1). Note the student part of category (iii) was implemented in 2015 however prior to this, individuals were able to select students as an option within the (i) category.

**BECOME AN ANTIBIOTIC GUARDIAN
CHOOSE YOUR PLEDGE NOW!**

I AM A

HEALTH OR SOCIAL CARE PROFESSIONAL OR LEADER
Pharmacy Teams

MEMBER OF THE PUBLIC
- Select from the list -

STUDENT, EDUCATOR OR SCIENTIST
- Select from the list -

SELECT YOUR PHARMACY GROUP
- Select from the list -

SELECT A PLEDGE MESSAGE
Messages will display below

Pharmacy choices

- I will review antibiotic prescriptions, assessing for adherence to local guidance. For those that do not I will contact the prescriber to discuss the rationale for the antibiotic choice.
- Every time a person/patient presents with a potentially self-limiting infection I will use the patient information leaflet to explain the potential duration of illness and how to treat their symptoms available at: <https://learning.rcgp.org.uk/mod/book/view.php?id=42647>
- When handing out a prescription that includes antibiotics, I will inform the patients of dose and duration, to take their antibiotics exactly as prescribed and how to safely dispose of antibiotics in the context of preventing antimicrobial resistance.
- When people pick up an antibiotic prescription, I will encourage them to visit the Antibiotic Guardian website in order for them to choose their own pledge to become Antibiotic Guardians.
- To help address patient expectations for antibiotics in self-limiting conditions, I will promote nationally or locally agreed key messages, to raise awareness of antimicrobial resistance.
- When I undertake Structured Medication Reviews, I will review any antibiotics prescribed either on repeat, or regularly on acute
- I will advocate for the switch from intravenous antibiotics to oral antibiotics at the earliest possible opportunity.

Or
 I want to create my own pledge

Name
First Last

Email

Age
- Select your age group -

Ethnicity
- Select your ethnicity -

Country
- Select your country -

Postcode
For healthcare professionals and students, please provide your work or university postcode.
0 of 9 max characters.

HOW DID YOU HEAR ABOUT US?
- Select option -

Permission to follow up

May we contact you in the future about your antibiotic pledge?
 Yes
 No

May we contact you in the future about relevant events/activities and add you to our newsletter list?
 Yes
 No

Please ensure that ALL the required fields marked by a * are completed before submitting
Your Email and Postcode will never be published publicly on the website

Figure 1. shows the pledge section of the main Antibiotic Guardian webpage for pharmacy teams.

Under each of these three categories, there are further sub-categories. For example, under the health or social care professional or leader, the sub-categories include dentists, farm advisor, pharmacy teams (note: in this situation, 'teams' refers to pharmacy HCP and excludes any student who might be working in a pharmacy), midwives, nurses, etc. Once a visitor selects a sub-category, a list of pledges that are appropriate to that sub-category become visible, and the visitor can select one of them or create their own pledge (Figure 1). The available pledges focus on improving attitudes towards antibiotics or encouraging behavioural changes around antibiotic use.

All visitors selecting the 'Pharmacy Teams' sub-category can select a further sub-category, which includes Primary care pharmacist, Secondary care pharmacist, Academic pharmacist, Pharmacy technicians, Pharmacy assistants and Community pharmacist. However, they were all shown the same pledges.

Visitor demographics, including name, email, postcode, country of origin, source of AG awareness, and consent for contact, were also collected. In April 2023, the pledge form was updated, broadening the demographic information collected to include age and ethnicity. Individuals can visit the website multiple times to make multiple pledges.

In addition to changes made to demographic information, an update to the AG pledges was also conducted between February and March 2023. A survey collected a total of 74 responses from stakeholders working across a range of organisations on the appropriateness of the AG pledges and the professional groups. The survey and subsequent stakeholder workshop led to 81 of the 132 pledges being updated, 16 pledges being removed and the addition of 12 new pledges to reflect changes in the field of AMR, medical practice and information dissemination in recent years [10].

2.2. Methods

In this work, data from the inception of the campaign (1st August 2014) to 31st December 2025 was collected from the AG website, collated into a spreadsheet by the AG working group and anonymised prior to analysis. The collected data included the date, nature of the pledge(s) made and the categories and sub-categories of pledge-makers. Only pledges made via the main webpage (which was in English) were included in the analysis; country- and continent-specific and translated webpages were excluded. As this paper aims to assess pharmacy teams' and pharmacy students' engagement with the campaign, paper, only data from the Pharmacy Teams subcategory and the Student, Educator or Scientist category were further analysed. In addition, the demographics of pledgers and their location was explored to establish the reach of the campaign and the most common sources of campaign awareness and identify ways to increase the number of pledgers.

Pearson's chi-squared test (χ^2) was used to determine whether there was an association between the type of pharmacy professional and the nature of the selected pledges. Analysis of student data provided an understanding of the numbers involved, the types of their pledges and how this group responded to the campaign. When analysing self-created pledges, where the participant had not selected the theme of their pledge, the authors used the text from the pledge to identify the most appropriate theme from those on the website. R version 4.3.1 and Microsoft Excel were used to conduct the analyses. Statistical significance was accepted at $p \leq 0.05$.

3. Results

Number of pledges made by HCPs and students, and contributions from the Pharmacy sector

A total of 167,333 pledges were made between August 2014 and December 2025, by HCPs ($n=144,180$) and students ($n=24,645$). The contribution of different types of HCPs pledges, as well as the total number of student pledges are shown in Table 1. In addition to this the campaign has received 19,070 pledges from the public.

Table 1. Total number of AG pledges received from healthcare professionals and students between August 2014 and Dec 2025.

	Number of pledges	%
Antimicrobial/IPC Specialists	2658	2%
Dentists	1920	1%
Executives/Management	2956	2%
Farm Advisors	34	0.02%
Local Authorities	600	0.36%
Midwives	306	0.18%
Non-medical prescribers	253	0.15%
Nurses	11,377	7%
Other HCPs	5569	3%
Pharmacy Teams	105,984	64%
Primary Care Prescribers	6473	4%
Secondary Care Prescribers	3926	2%
UK & International Organisations	313	0.19%
Veterinary	1811	1%
Students	24,645	15%
Total	167,333	100%

Among the pledges made by HCPs, Pharmacy Teams contributed the greatest number (64%, 105,984/167,333). Of those who selected a sub-category within the Pharmacy Teams option, the most commonly selected role was pharmacy assistant (43%, 45,665/104,867), followed by community pharmacist (28%, 29,923/104,867), pharmacy technician (11%, 11,741/104,867), primary care pharmacist (11%, 11,406/104,867), secondary care pharmacist (5%, 5292/104,867) and academic pharmacist (1%, 660/104,867).

Among the pledges made by students, pharmacy students contributed the greatest number (60%, 14,731/24,653). The remaining pledges were made by students reading medicine (10%, 2362/24,653), non-healthcare related degrees (11%, 2640/24,653), nursing (10%, 2533/24,653), veterinary (2%, 387/24,653), dental (1%, 216/24,653) or other healthcare degrees (7%, 1784/24,653).

3.1. Trend Analysis

Figure 2 shows the number of pledges made by pharmacy teams and pharmacy students since the launch of Antibiotic Guardian on 1st August 2014 until 31st December 2025. The number of pledges made by pharmacy teams remained stable from 2014 to 2019, followed by a sharp increase in 2020 (by 1188%). Subsequently, there was a small reduction in 2021 (by 4%) and then a much larger reduction (by 64%) in 2022, and by 2025, the annual pledge counts had returned to pre-pandemic levels, after a small increase in 2023.

The trend in numbers of student pledges mirrored those of pharmacy teams to a large extent, except for a peak in 2016 and a faster return to the baseline level by 2021.

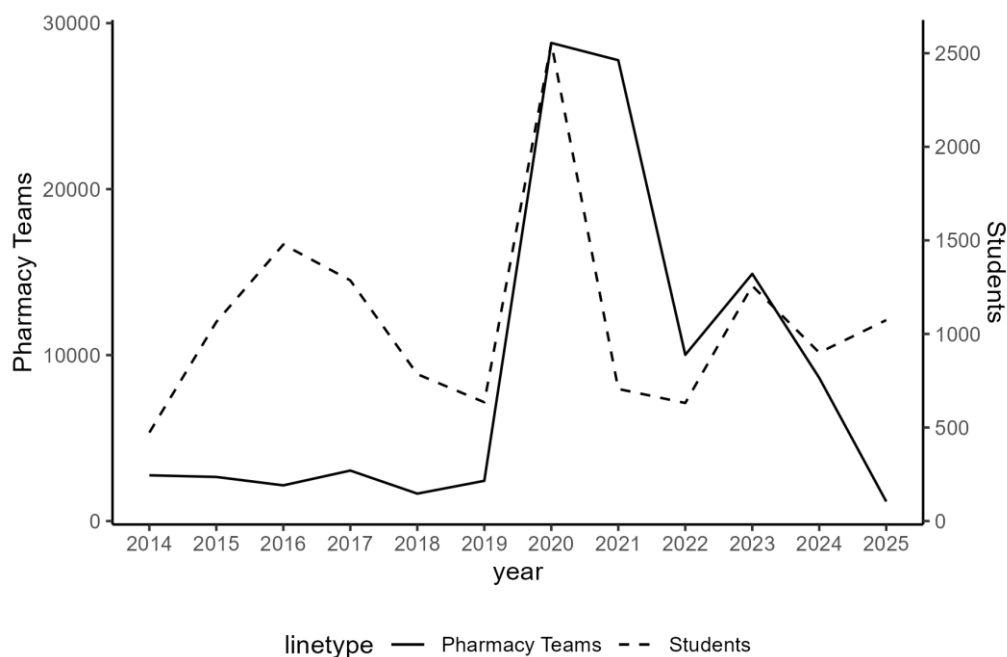


Figure 2. Number of Antibiotic Guardian pledges made annually by pharmacy teams and pharmacy students from 1 August 2014 to 31 December 2025. Data is presented by calendar year.

3.2. Geographical Location of Pharmacy Team Pledgers

The AG campaign main webpage received pledges from pharmacy professionals and students based in diverse countries around the world as shown in Table 2. Most pledgers were from the UK (87% of pledges; 109,666/126,699), although significant numbers of pledges were made on the Asian and African continents. A number of pledgers (3%; 3251/126,699) did not specify their country. It can be seen from Table 2 that in general, pharmacy teams made more pledges than students, except in Asia where 67% of the pledges were from students.

Table 2. Total number of 'Pharmacy Teams' (i.e., pharmacists, pharmacy technicians and pharmacy assistants) and pharmacy student pledges by location. The two countries where the most pledges originated within each continent are specified. Data is from 1 August 2014 to 31 December 2025.

Location	Pharmacy Teams	Students	Total
UK	100,892	8774	109,666
Europe (excluding UK; Spain = 33; Ireland = 70)	270	126	8191
Africa (Nigeria = 245; Kenya = 86)	650	269	1180
Asia (India = 2409; Pakistan = 426)	760	2689	4027
Americas (United States = 55; Canada = 23)	129	37	319
Oceania (Australia = 16; New Zealand = 18)	44	2	64
Antarctica	1	0	1
Not Specified	3237	5	3251
Total	105,983	11,902	126,699

3.3. Source of Awareness of AG Campaign

The source of awareness of the AG campaign varied among pledge groups. Overall, the most common source for the 'Pharmacy Teams' subgroup was 'community pharmacies' (50%; 53,659/107,210), followed by 'hearing from colleagues' (20%; 21,343/107,210). Awareness through social media for 'Pharmacy Teams' peaked in 2014 and 2016 (8%, 212/2757; 8%, 163/2152 respectively); it has declined in subsequent years accounting for <1% since 2020 and an all-time low of 0.12%

(10/8628) in 2024. Students had most frequently heard about the campaign through universities (44%; 5507/12,541). The least frequently cited method of awareness were scouts/guides, and primary and secondary schools (<1%).

3.4. Age and Ethnicity of Pharmacy Teams Pledgers

Analysis of additional demographic data incorporated in April 2023, is provided in Table 3. Over half of pharmacy teams selected White ethnicity (55%, 9045/16,502); while among pharmacy students, Asian or Asian British was the most common ethnicity (50%, 1149/2291). Pledges from pharmacy teams were more frequent in the 35-64 year age group (45%, 7349/16,459) and pharmacy students pledges were more frequent in the 18-34 year age group (83%, 1909/2291).

Table 3. Frequency of age and ethnicity of pharmacy teams and pharmacy student pledgers.

	Pharmacy Teams		Pharmacy Students	
	n	%	n	%
Ethnicity				
Asian or Asian British	3573	2	1149	50
Black, African, Caribbean or Black British	702	4	182	8
Mixed ethnic groups	241	1	44	2
Other (e.g., Arab)	419	3	222	10
Prefer not to say	800	5	76	3
White	9045	55	423	18
(blank)	1722	10	195	9
Age				
18-34	6693	41	1909	83
35-64	7367	45	154	7
Over 65	296	2	4	0.18
Prefer not to say	222	1	10	0.44
Under 18	202	1	19	1
(blank)	1722	10	195	9

3.5. Analysis of Pledges

3.5.1. Pharmacy Teams

The different pledges that could be selected by those working within pharmacy teams are shown in Table 4, along with the numbers of these pledges made by the different pharmacy team groups. A significant relationship was found between pharmacy group and the type of pledge chosen (X^2 (df 40, n = 101,169) = 8844, $p < 0.001$).

Table 4. Frequency of each pledge from each pharmacy group (August 2014 – Dec 2025), (N = 94,430). Excludes pledgers who did not identify their belonging to any particular pharmacy group.

Pledge Option	Pharmacy Option													
	Academic Pharmacist		Community Pharmacist		Pharmacy Assistant		Pharmacy Technician		Primary Care Pharmacist		Secondary Care Pharmacist		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Every time a person/patient presents with a potentially self-limiting infection I will use the patient information leaflet to explain the potential duration of illness and how to treat their symptoms available at:	42	1	1890	35	2378	44	497	9	485	9	153	3	5445	6

https://elearning.rcgp.org.uk/mod/book/view.php?id=12647														
I will advocate for the switch from intravenous antibiotics to oral antibiotics at the earliest possible opportunity.	6	1	241	24	428	42	152	15	65	6	132	13	1024	1
I will review antibiotic prescriptions, assessing for adherence to local guidance. For those that do not I will contact the prescriber to discuss the rationale for the antibiotic choice	138	1	5876	30	6088	31	2194	11	2080	11	3281	17	1965	21
To help address patient expectations for antibiotics in self-limiting conditions, I will promote nationally or locally agreed key messages, to raise awareness of antimicrobial resistance.	61	1	1335	27	2446	50	587	12	349	7	155	3	4933	5
When handing out a prescription that includes antibiotics, I will inform the patients of dose and duration, to take their antibiotics exactly as prescribed and how to safely dispose of antibiotics in the context of preventing antimicrobial resistance.	207	0	14401	30	24541	51	5985	12	2498	5	862	2	4849	51
When I undertake Structured Medication Reviews, I will review any antibiotics prescribed either on repeat, or regularly on acute	3	1	59	19	66	21	42	14	117	38	21	7	308	0
When people pick up an antibiotic prescription, I will encourage them to visit the Antibiotic Guardian website in order for them to choose their own pledge to become Antibiotic Guardians	66	1	1156	21	2845	51	604	11	542	10	312	6	5525	6
Other pledges*	44	1	2610	32	3470	43	988	12	607	8	350	4	8069	9
Created own pledge	43	4	245	24	358	35	104	10	167	16	101	10	1018	1

*These include pledges selected by only a few individuals and have therefore been grouped.

The most commonly chosen pledge was 'When handing out a prescription that includes antibiotics, I will inform the patients of dose and duration, to take their antibiotics exactly as prescribed and how to safely dispose of antibiotics in the context of preventing antimicrobial resistance' (51%, 48,494/94,440). Pharmacy assistants were the predominant group to select this pledge (51%, 24,541/48,494).

A small number of pledgers created their own pledge, shown in Table 5. Among pharmacy team members who did this (n=1018), the most common theme was 'preventing or controlling infections' (270/1018, 27%). Pharmacy assistants were the greatest contributors to this theme (130/270, 48%), followed by community pharmacists (88/270, 33%). Another common theme was 'Community/public engagement' (199/1018, 20%) which was most often used by pharmacy assistants (94/199, 47%), followed by community pharmacists (69/199, 35%).

Table 5. Themes associated with self-created pledges made by those working within pharmacy teams (n=1016*).

Theme	Academic pharmacist		Community pharmacist		Pharmacy assistant		Pharmacy technicians		Primary care pharmacists		Secondary care pharmacist		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Community/public engagement (leading/organising activities to promote antibiotic awareness or infection prevention messages to patients/public/community/schools)	5	3	69	35	94	47	22	11	44	22	9	5	199	20
Example pledge: "Ensure understanding and adherence of antibiotics for both patients and family/friends"														
Diagnostics	1	1	30	36	39	47	8	10	11	13	5	6	83	8

“The next time I see an antibiotic prescribed, I will ask the prescriber about the indication and duration, to understand if this is in accordance to local and national guidelines”.

Table 6. Frequency of pledges made by pharmacy students (August 2014 – Dec 2025),.

Pledge Option	Number of Pledges	%
For infections that my body can fight off on its own, like coughs, colds, sore throats and flu, I pledge to talk to my pharmacist about how to treat my symptoms first rather than going to the GP	1541	14
I will ask my tutors to discuss in class the challenges of responsible use of antibiotics in various animal sectors, including companion animals	234	2
I will familiarise myself with PROTECT, the British Veterinary Society’s 7-point plan or similar guidance materials and resources regarding prudent use of antimicrobials within the animal sector and discuss them in my classes	143	1
I will use the e-Bug young adult peer education materials on drug-resistant infections, antibiotic use and vaccinations to educate and inform my peers. Available at: https://www.e-bug.eu	315	3
I will wash my hands after sneezing or coughing to reduce transmission of infection and antibiotic resistance	1366	13
If I’m prescribed antibiotics, I will take them exactly as prescribed and never share them with others	2347	22
The next time I see an antibiotic prescribed, I will ask the prescriber about the indication and duration, to understand if this is in accordance to local and national guidelines	2766	26
The next time I see that a recommended infection prevention practice is not being adhered to (e.g., hand hygiene, on-farm biosecurity), I will respectfully challenge my peers and healthcare workers/veterinarians	802	7
To help address patient expectations for antibiotics in self-limiting conditions, I will promote nationally or locally agreed key messages, to raise awareness of antimicrobial resistance.	581	5
Other pledges*	360	3
Created own pledge	270	3
TOTAL	10725	100

*These include pledges selected by only a few individuals and have therefore been grouped.

When pharmacy students created their own pledge, the most common themes were ‘Community/public engagement’ (30%, 81/270), ‘Preventing or controlling infections’ (22.9%, 75/270) and ‘Diagnostics’ (27%, 73/270). Examples of pledges from these themes are shown in Table 7.

Table 7. Themes and examples of pledges associated with self-created pharmacy student pledges (n=263). As pledgers can select more than one pledge theme for self-created pledges, the percentage column adds up to more than 100.

Theme	n	%
Preventing or controlling infections (e.g., vaccination/immunisation; hand washing; good hygiene) Example pledge: “I pledge to incorporate antimicrobial resistance awareness into every healthcare business proposal or pitch I prepare, ensuring that public health is prioritized alongside profitability”	75	28
Use of data/surveillance data (e.g., using published national data sources or reports such as PHE Fingertips/ESPAUR report and equivalent; or using data from within your organisation such as those from audits to develop action plans)	33	12

Example pledge:		
Diagnostics		
Example pledge: <i>"I would like to understand more the warning signs and symptoms where antibiotics should be prescribed to understand the fine difference on when antibiotics should be prescribed or when other means could be used."</i>	73	27
Education and Training (e.g., organising or attending education/training events for health workers or the public)		
Example pledge: <i>"I pledge to educate the public on the correct usage of antibiotics and its effects after being overused"</i>	65	24
Community/public engagement (leading/organising activities to promote antibiotic awareness or infection prevention messages to patients/public/community/schools)		
Example pledge: <i>"I will engage in community awareness campaigns and encourage proper hygiene practices to reduce the spread of infections"</i>	81	30
Research on antimicrobial resistance, prescribing or stewardship		
Example pledge: <i>"I will create a research project centred around the rise of antimicrobial resistance as well as spreading awareness around this topic."</i>	53	20
Other		
Example pledge: <i>"As an aspiring pharmacist, I promise to ask the prescriber about the indication and duration, to understand if this is in accordance too local and national guidelines"</i>	27	10

4. Discussion

The high levels of engagement with the AG campaign in the UK (compared to other countries) reflects the fact the AG website was first launched and promoted mainly in the UK by UKHSA (previously Public Health England). Translation of the AG website in 2016 into French, Russian, Dutch, German, and Turkish languages through collaboration with WHO-Europe, Belgian Antibiotic Policy Coordination Committee (BAPCOC) and the Turkish Government, to raise awareness of AMR and to expand the campaign across Europe led to 492 unique visitors to the Russian webpage, 1124 to the Dutch and 152 to the French ones, equating to adjusted conversion rates (the proportion of individuals who visited the webpage who then went on to make a pledge) of 10.2, 27.3 and 6.7%, respectively [16]. Collaboration with Africa Centres for Disease Control and Prevention (CDC) has also taken place to develop pledges aimed at African countries. Furthermore, in 2025 the website was translated into the five most commonly spoken languages in the UK, namely, Polish, Romanian, Punjabi, Urdu and Mandarin. While the analysis of pledges from international pledge pages was beyond the scope of this paper, analyses of pledges from the collaboration with WHO Europe and BAPCOC have previously been reported by Newitt et al. [16], and more recently by Sanusi et al. who investigated the pledges from the Africa pages [17].

In the UK, pharmacy healthcare workers, were the predominant pledgers out of all the AG website visitors [18]. Within the pharmacy workforce, pharmacy assistants contributed the greatest number of pledges (n=45,665). Among pharmacists, community pharmacists contributed the greatest number of pledges (n=29,923) reflecting the fact that they make up 40% of pharmacists in the UK, as shown by a General Medical Council survey of registered pharmacy professionals in 2019 [19].

The sharp increase in the number of pledges from those working within pharmacy teams in 2020 (Figure 2) may have been due to the release of the national policy PQS Part 2 [13]. This scheme was developed to 'incentivise quality improvement in areas that support the COVID-19 response by including criteria that improve patient safety and outcomes.' Included in the Infection Prevention and Control section was the statement 'all patient facing staff that provide health advice, should also become Antibiotic Guardians.' Pharmacies are assessed annually to determine whether they meet quality criteria for their clinical effectiveness, patient safety and patient experience [20]. This proved to be successful, as seen by the rapid increase in pledges among community pharmacy workers after

2020 [21]. Since 2020, an AMS domain has been included in the PQS, making it mandatory for patient-facing pharmacy staff to make an AG pledge.

The decline in pledges seen in 2022 suggests that the COVID-19 pandemic itself also likely influenced pledges being made, with HCPs and the public being more aware of and attentive to health campaigns. The potential impact of the COVID-19 pandemic on engagement with the AG campaign was demonstrated in a service evaluation to investigate the impact of the AG Campaign on pharmacy workers and their motivations for pledging [22]. Seaton *et al.* found that the COVID-19 pandemic intensified the focus on the importance of antibiotics and thus motivated HCPs to make a pledge to support more effective use of antibiotics.

Although not included in the PQS requirements, activities have also been conducted to encourage students to engage with the AG campaign. For example, Figure 2 shows a high number of pledges in 2017, which coincided with the first AMR conference held by AG for undergraduate multidisciplinary students during World Antibiotic Awareness Week (WAAW) [23,24]. This was an opportunity for students to learn about the importance of AMR and collaborate through a 'One Health Approach' to reduce antibiotic use and become aware of making a pledge as part of their role in tackling antibiotic resistance. Following its initial success, the conference was held annually from 2018-2022. The event in 2021 also introduced online module learning sessions for students to understand how a multidisciplinary approach is needed to tackle AMR [25].

Pledges increased further in 2020, coinciding with the COVID-19 pandemic. At this time, most university teachings had moved online [26], making the virtual AG campaign ideal for highlighting the importance of correct antibiotic prescribing and the need to preserve the most potent antibiotics for serious infections [27].

The finding that community pharmacies were the main source of awareness and dissemination for the AG campaign supports the idea of healthcare workers in community settings being in an ideal position to interact with and guide the public on reducing antibiotic use [12]. It also further highlights the impact of policy initiatives, with the PQS being applicable to community pharmacy only. However, it should be noted that other options available for selection, such as 'NHS trust' (9%) and 'colleagues' (20%), which could also fall into the category 'community pharmacy'. Therefore, there is some uncertainty about the exact numbers. Conversely, for students, the main source of awareness being universities is expected, given that AMS is embedded into a large number of undergraduate healthcare courses, such as medicine, dentistry, and nursing [28]. Embedding AMR and AMS teaching in university curricula has been shown to be an effective way of increasing knowledge and awareness and highlights the need to ensure teaching in this area continues to be included in university curricula [29,30].

Finally, the paper highlights that the nature of an individual's pledge reflected the roles and opportunities available to them. For example, the most common pledge made by community pharmacists, pharmacy assistants and pharmacy technicians are directly relevant to the role and daily duties of these respondents who have more frequent patient interaction compared to other pharmacy team pledgers such as academic, primary and secondary care pharmacists. Similarly, primary and secondary care pharmacists most commonly chose "I will check that antibiotic prescriptions comply with local guidance and query those that do not" as this pledge would be an integral part of their job, such as when clinically checking prescriptions. It is also interesting that of those who created their own pledge the most common theme selected was infection prevention and control. This implies that some pharmacy professionals understand the importance of preventing infections in the first instance for reducing AMR [31]. However, the overall proportion selecting this option was low (<1%, 270/94,440) suggesting that additional efforts are needed to educate pharmacy professionals in the importance of IPC for the prevention of AMR. For the same reason i.e., relevance and opportunity (or lack of), pharmacy students were more likely to choose pledges that focused on education, such as asking the prescriber about the indication, while a higher proportion of academic pharmacists compared to other groups elected to create their own pledge (Table 4), likely due to the limited

number of pledges available for selection that were focused on research, education and training, which are key aspects of academic pharmacists' role.

Future Work

This study has demonstrated the high engagement levels of pharmacy students and of the pharmacy workforce with the AG campaign.

One significant challenge of observation research like this one is the inability to determine causality. Antibiotic consumption data from the 2021-22 ESPAUR report [18], shows antibiotic consumption decreasing over time, with a particularly prominent 11% reduction between 2019 to 2020 and a further percentage decrease in 2021. This aligns with the sharp peak of pledges seen during 2020 and 2021. However, the observational nature of the study design means causality between making a pledge, reduction in antibiotic prescribing and impact on AMR cannot be established. Therefore, it cannot be determined whether the AG campaign contributed to the 15% decrease in antibiotic consumption seen between 2017 to 2021.

Future research can consider options to establish the likely impact of the AG campaign and antibiotic prescribing and consumption behaviours to provide more robust evidence for the effectiveness of AMR related campaigns.

Future work may also wish to investigate other patterns and trends seen from the data, especially following the addition of data on age and ethnicity, both of which are factors associated with health inequalities. Determining whether significant differences in rates of pledges occur by age group, ethnicity or geography would provide further insight into potential target audiences for enhanced engagement.

5. Conclusions

This paper shows the pharmacy workforce and pharmacy students, especially pharmacy assistants and community pharmacists, are highly engaged in efforts to reduce and prevent AMR.

The introduction of incentives targeted towards pharmacy professionals, like the PQS, may have been the most effective means of raising awareness and generating action on AG analysed herein. This indicates that similar incentives tailored to other HCPs could increase their engagement with the AG campaign. The implementation of such incentives deserves urgent investigation and could contribute greatly to addressing AMR. Finally, additional work to determine the causal impact of AMR awareness campaigns, such as AG, on prescribing and AMR is needed.

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Institutional Review Board Statement: The UKHSA has approval under the Regulation 3 of The Health Service (Control of Patient Information) Regulations 2020 and under Section 251 of the NHS Act 2006 to collect data for the purpose of diagnosing, recognising trends, controlling and preventing, and monitoring and managing risks to health. This work forms part of a service evaluation following the principles of routine data collection for promoting evidence on public health interventions and as such ethical approval was not deemed necessary for this work. This is on the grounds that data were presented at an aggregate level.

Informed Consent Statement: Participants were made aware via privacy statement on the Antibiotic Guardian website that data collected will be used for the purposes of analysing and evaluating the progress of the Antibiotic Guardian campaign and the individuals' rights regarding their personal data. Informed consent to contact those who made a pledge was also obtained via the online pledge form.

Data Availability Statement: Data is unavailable due to privacy reasons.

Conflicts of Interest: DAO was a member of the Public Health England group that developed the AG Campaign and continues to lead the campaign. ET and OQ are also members of the UKHSA group that manages the AG Campaign.

Abbreviations

The following abbreviations are used in this manuscript:

AG	Antibiotic Guardian
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
BAPCOG	Belgian Antibiotic Policy Coordination Committee
CDC	Centres for Disease Control and Prevention
CPCF	Community Pharmacy Contractual Framework
HCPs	healthcare professionals
PQS	Pharmacy Quality Scheme
UK	United Kingdom
UKHSA	United Kingdom Health Security Agency
WAAW	World Antibiotic Awareness Week

References

1. Browne, A.J., et al., *Global antibiotic consumption and usage in humans, 2000–18: a spatial modelling study*. The Lancet Planetary Health, 2021. **5**(12): p. e893-e904.
2. Shallcross, L.J. and D.S.C. Davies, *Antibiotic overuse: a key driver of antimicrobial resistance*. The British journal of general practice, 2014. **64**(629): p. 604.
3. Ventola, C.L., *The antibiotic resistance crisis: part 1: causes and threats*. Pharmacy and therapeutics, 2015. **40**(4): p. 277.
4. Organisation, W.H., *Antibiotic resistance Fact Sheet (online)*. 2020.
5. Terreni, M., M. Taccani, and M. Pregnotato, *New antibiotics for multidrug-resistant bacterial strains: latest research developments and future perspectives*. Molecules, 2021. **26**(9): p. 2671.
6. Mathew, P., S. Sivaraman, and S. Chandy, *Communication strategies for improving public awareness on appropriate antibiotic use: Bridging a vital gap for action on antibiotic resistance*. Journal of family medicine and primary care, 2019. **8**(6): p. 1867-1871.
7. Government, U., *UK 5 Year Antimicrobial Resistance Strategy 2013 to 2018*. 2013.
8. National Health Service., *Pharmacy Quality Scheme Guidance, 2020/21*. 2021.
9. National Health Service., *NHS Long Term Plan 2017 [Antimicrobial resistance]*. . 2017.
10. UK Health Security Agency., *English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) - Report 2022 to 2023*. 2023.
11. Bhattacharya, A., et al., *A process evaluation of the UK-wide Antibiotic Guardian campaign: developing engagement on antimicrobial resistance*. Journal of Public Health, 2017. **39**(2): p. e40-e47.
12. Hayhoe, B., et al., *Impact of integrating pharmacists into primary care teams on health systems indicators: a systematic review*. British Journal of General Practice, 2019.
13. Chaintarli, K., et al., *Impact of a United Kingdom-wide campaign to tackle antimicrobial resistance on self-reported knowledge and behaviour change*. BMC Public Health, 2016. **16**(1): p. 393.
14. Kesten, J.M., et al., *The Antibiotic Guardian campaign: a qualitative evaluation of an online pledge-based system focused on making better use of antibiotics*. BMC Public Health, 2017. **18**(1): p. 5.
15. Antibiotic Guardian Programme. *Branding Archive*. Available from: <https://antibioticguardian.com/branding-archive/>.
16. Newitt, S., et al., *Expansion of the 'Antibiotic Guardian' one health behavioural campaign across Europe to tackle antibiotic resistance: pilot phase and analysis of AMR knowledge*. The European Journal of Public Health, 2018. **28**(3): p. 437-439.

17. Morohunranti Sekinat SANUSI, E.T., Vanessa CARTER, Adrian BRINK, Yewande ALIMU, Saran SHANTIKUMAR, Diane ASHIRU-OREDOPE, *Analysis of International Antibiotic Guardian Pledges: with a Focus on Africa*. Journal of Antimicrobial Chemotherapy - Antimicrobial Resistance, 2025.
18. UK Health Security Agency., *English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) - Report 2021 to 2022*. 2022.
19. Council, G.P. *Survey of registered pharmacy professionals*. In: Council GP, editor. 2019. p. 62. 2019; Available from: <https://www.pharmacyregulation.org/sites/default/files/document/gphc-2019-survey-pharmacy-professionals-main-report-2019.pdf>.
20. Committee, P.S.N., *Pharmacy Quality Scheme*. 2022.
21. Hayes, C.V., et al., *The national implementation of a community pharmacy antimicrobial stewardship intervention (PAMSI) through the English pharmacy quality scheme 2020 to 2022*. Antibiotics, 2023. **12**(4): p. 793.
22. Seaton, D., et al., *Evaluating UK pharmacy workers' knowledge, attitudes and behaviour towards antimicrobial stewardship and assessing the impact of training in community pharmacy*. Pharmacy, 2022. **10**(4): p. 98.
23. UK Health Security Agency, *National Student AMR Conference Online Module Learning Sessions*. 2017.
24. Antibiotic Guardian., *First National Students AMR Conference*. 2017.
25. UK Health Security Agency., *National Student AMR Conference Online Module Learning Sessions*. 2021.
26. Morling, A.C., S.-Y. Wang, and M.J. Spark, *Exploring the experiences of pharmacy students and their transition to online learning during COVID-19*. Pharmacy, 2022. **10**(5): p. 110.
27. Ohl, C.A. and V.P. Luther, *Health care provider education as a tool to enhance antibiotic stewardship practices*. Infectious Disease Clinics, 2014. **28**(2): p. 177-193.
28. England, H.E., *Embedding national antimicrobial prescribing and stewardship competences into curricula: A survey of health education institutions*. 2016.
29. Nasr, Z.G., D.M. Abbara, and K.J. Wilby, *A scoping review of antimicrobial stewardship teaching in pharmacy education curricula*. American Journal of Pharmaceutical Education, 2021. **85**(6): p. 8415.
30. Li, P.Y., et al., *Assessment of health and science undergraduate students' knowledge, attitudes, education and training related to antibiotic use and antimicrobial resistance in 27 EU/EEA universities*. Access Microbiology, 2025. **7**(10): p. 001030. v4.
31. Fleming, N., *AMR: effective infection prevention and control measures*. Practice Nursing, 2019. **30**(8): p. 390-395.

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