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Maltese Antibiotic Stewardship Programme in the Community (MASPIC): protocol of a prospective quasiexperimental social marketing intervention

Erika A Saliba-Gustafsson,[1] Michael A Borg,[2,3] Senia Rosales-Klintz,[1] Anna Nyberg,[4] Cecilia StålsbyLundborg[1]

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[1]Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden
[2]Department of Infection Prevention and Control, Mater Dei Hospital, Msida, Malta
[3]Faculty of Medicine and Surgery, University of Malta, Msida, Malta
[4]Department of Marketing and Strategy, Stockholm School of Economics, Stockholm, Sweden

Correspondence to
Erika A Saliba-Gustafsson;
erika.saliba@ki.se

ABSTRACT

Introduction Antibiotic misuse is a key driver of antibiotic resistance. In 2015/2016, Maltese respondents reported the highest proportions of antibiotic consumption in Europe. Since antibiotics are prescription-only medicines in Malta, research on effective strategies targeting general practitioners' (GPs) knowledge and behaviour is needed. Multifaceted behaviour change (BC) interventions are likely to be effective. Social marketing (SM) can provide the tools to promote sustained BC; however, its utilisation in Europe is limited. This paper aims to describe the design and methods of a multifaceted SM intervention aimed at changing Maltese GPs' antibiotic prescribing behaviour for patients with acute respiratory tract infections (aRTIs).

Methods and analysis This 4-year quasiexperimental intervention study will be carried out in Malta and includes three phases: preintervention, intervention and postintervention. The preintervention phase intends to gain insight into the practices and attitudes of GPs, pharmacists and parents through interviews, focus group discussions and antibiotic prescribing surveillance. A 6-month intervention targeting GPs will be implemented following assessment of their prescribing intention and readiness for BC. The intervention will likely comprise: prescribing guidelines, patient educational materials, delayed antibiotic prescriptions and GP education. Outcomes will be evaluated in the postintervention phase through questionnaires based on the theory of planned behaviour and stages-of-change theory, as well as postintervention surveillance. The primary outcome will be the antibiotic prescribing rate for all patients with aRTIs. Secondary outcomes will include the proportion of diagnosis-specific antibiotic prescription and symptomatic relief medication prescribed, and the change in GPs stage-of-change and their intention to prescribe antibiotics.

Ethics and dissemination The project received ethical approval from the University of Malta's Research Ethics Committee. Should this intervention successfully decrease antibiotic prescribing, it may be scaled up locally and transferred to similar settings.

Trial registration number NCT03218930; Pre-results.

Strengths and limitations of this study

- This study is the first in Malta that attempts to establish an ongoing community surveillance system to gather timely data on diagnosis-specific antibiotic prescribing among general practitioners (GPs) in Malta.
- This study is also the first to employ social marketing techniques to design, deliver and evaluate the effectiveness of a behaviour change intervention to improve antibiotic prescribing in Malta.
- If effective, this intervention could easily be incorporated into routine clinical practice and scaled up locally and extrapolated to similar settings, particularly in the Mediterranean region, at a very low cost.
- In the long term, this intervention could help contribute towards reducing the development of antibiotic resistance, which is an ever-growing challenge.
- Given the country's size and number of active GPs, a randomised controlled trial will not be possible; therefore, the intervention's effect may be harder to assess; it may have a smaller effect than expected. In order to allow for better detection of the intervention's effectiveness on behaviour change, a quasiexperimental design shall be employed.

BACKGROUND

Access to effective antibiotic treatment is a prerequisite in healthcare today.[1] Unfortunately, however, widespread antibiotic use has accelerated the rate of antibiotic resistance (ABR) development.[2] Although the exact magnitude of this global problem and its impact on human health is largely unknown,[2] ABR in common bacterial pathogens has reached concerning levels in many parts of the world.[2] As a result, many available treatment options are becoming ineffective,[2] forcing us to resort to more potent, toxic and

costly drugs, often with considerable side effects.[3] Antibiotic-resistant infections pose substantial burden on patient outcomes and health expenditure, both at societal and individual levels.[2 4] They lead to significantly longer hospital stays, increased morbidity and mortality[3] among others.

ABR is complex and driven by many interrelated factors, including knowledge, attitudes, perceptions, expectations, time constraints, economic incentives, cultural factors, health system characteristics and regulations.[5–9] A recognised key driver is the use, misuse or overuse of antibiotics, as well as unregulated consumer access to antibiotics.[6 10 11] While antibiotic overuse plays a pivotal role, underuse through inadequate dosing and poor adherence also plays an important role.[6]

Although a correlation between outpatient antibiotic consumption and ABR has been shown in Europe, the association is complex.[12 13] While the highest concentrations of antibiotic prescribing is in inpatient settings,[14] the overall quantity of antibiotic prescribing is highest in the community.[15] Indeed, the highest rates of antibiotic prescription for systemic use are in primary care,[16] with respiratory tract infections (RTIs) being the most common diagnoses.[17] Studies have shown alarmingly high rates (between 50% up to almost 100%) of antibiotics prescribed for upper RTIs in outpatient settings, even though seldom required.[18–23]

In Malta, a southern European country, wholesale distribution records have shown that antibiotic consumption in primary care has increased steadily over the past decade, despite a reduction in over-the-counter sales.[24] In fact, in a 2016 European-wide study, 48% of the population reported taking antibiotics during the previous year; the highest in the European Union.[25] The top two indications were sore throat (22%; EU28 average 14%) and influenza (18%; EU28 average 16%).[25] This was accompanied by suboptimal levels of knowledge on antibiotics among the general population; only 27% of the Maltese interviewed knew that antibiotics do not kill viruses, and only 39% knew that antibiotics are ineffective against cold and influenza.[25] Although knowledge has increased slightly since the two preceding surveys,[26 27] awareness is still low compared with other European countries.

Through the European Antibiotic Awareness Day,[28] attempts to increase knowledge and awareness among the Maltese public, prescribers and pharmacists have been made and regulations enforced. Consequently, self-medication has fallen from 19% of Maltese respondents admitting taking antibiotics without a prescription in 2001 to 2% in 2016.[24 25] As doctors are considered the most trustworthy source of information on antibiotics by the Maltese,[25] they are important role models for their patients. The future challenge is to promote better antibiotic prescribing behaviour among general practitioners (GPs),[17 24 29] particularly since 97% of antibiotic consumption in Malta results from a medical prescription.[25]

Research on effective strategies targeting prescriber knowledge and behaviour are needed to promote appropriate antibiotic prescribing and consumption.[9 12 30] The local cultural context plays an important role and cannot be overlooked.[31] Hofstede's model of cultural dimensions describes how cultures vary along groups of fundamental dimensions, namely power distance, individualism, masculinity and uncertainty avoidance. Scandinavian countries show very low scores for power distance, masculinity and uncertainty avoidance; conversely, Mediterranean countries are characterised by high power distance and uncertainty avoidance, and medium to high masculinity scores.[32] Consequently, a positive association between power distance and outpatient antibiotic consumption, including self-medication, has been shown.[33] In countries with high uncertainty avoidance, antibiotic prescribing can provide the clinician with a subconscious reassurance of certainty. In such contexts, antibiotic prescribing would presumably be high and more likely prescribed 'just in case' when faced with dubious clinical presentations.[34] Since change generates uncertainty, such cultures tend to be more resistant to change making behaviour change initiatives more challenging, particularly since national culture and unspoken rules are key drivers behind inappropriate antibiotic prescribing behaviour.[34–36] Successful interventions must recognise local key drivers of prescribing and incorporate incentives to alter behaviour into stewardship programmes.[35]

While awareness campaigns and education are often recommended,[6 9 13] interventions targeted specifically at changing behaviour are more likely to be effective. Behavioural theories, such as the theory of planned behaviour[37] and the stages-of-change model,[38] and social science methods have been suggested as suitable approaches to better understand factors influencing prescribing practices.[39] These methods have thus far been underutilised in the development of interventions targeting antibiotic prescribing.[39] Other European countries have attempted to use a behaviour change approach to promote prudent antibiotic use, although most did not consider the behavioural determinants related to antibiotic use and prescribing.[39] Moreover, interventions that attempt to reduce inappropriate antibiotic prescribing tend to be more successful when they combine physician, patient and public education and when the design is multifaceted.[17 40–43] Social marketing (SM) may provide a different insight on the development of health promotion initiatives targeting the prevention of ABR.

SM is a behavioural science approach to promote social change by applying marketing theories and techniques to plan, implement and evaluate interventions to induce voluntary behaviour change.[44] It combines concepts from commercial marketing and health communication into the following principles: behavioural focus, 'customer' orientation, segmentation (ie, tailoring), competition (ie, understanding benefits and barriers), exchange (ie, emphasis on the benefits of changing one's behaviour), marketing mix (the '4Ps' of marketing: product, price, place and promotion) and long-term planning. It also

considers context-specific issues to tailor interventions conducive to the country's particular needs, thus increasing one's chances of success.[44] When applied correctly, SM interventions can provide the necessary tools to promote sustained behaviour change among targeted populations.[30] The utilisation of SM for the prevention and control of communicable diseases in Europe has however been limited.[44] This paper aims to describe the design and methods of a multifaceted SM intervention aimed at changing Maltese GPs' antibiotic prescribing behaviour for patients with acute RTIs.

METHODS

Study design

A 4-year quasiexperimental intervention study protocol, based on SM principles, was designed to assess whether a multifaceted SM intervention is effective at influencing GPs' antibiotic prescribing practices for acute RTIs. The SM intervention was developed in a multistage process, following a BEHAVE-based marketing plan[45] (figure 1). The BEHAVE framework allows you to address simple but essential questions prior to deciding what interventions to implement, namely (1) who is the audience?, (2) what do you want them to do? and (3) what factors influence their behaviour?[45] The study will be described stage-wise according to the three different phases: preintervention, intervention and postintervention.

Study setting

The intervention will be rolled-out in Malta, a southern European country (316 km^2; 425 384 population; 2013 est.) and one of the smallest yet most densely populated countries in the world (1346 persons/km^2).[46] The nation has two official languages: Maltese and English. Malta has an integrated health services system organised at national level, primarily funded by taxation (65%) and complemented by private financing (out-of-pocket and insurance).[47] Hospital-based healthcare is predominantly public (96%) and free at point-of-care to all citizens, whereas approximately two-thirds of primary care is provided by the private sector[47] and mainly delivered by GPs. As from 2003, qualified doctors are expected to specialise as GPs; however, GPs practising prior to 2003 were granted certified specialisation through a grandfather clause, based on acquired experience.[48] All GPs are registered on the Malta Medical Council's Medical and Dental Specialists Register. Publicly financed health services in primary care are also free at point-of-delivery. Around 80% of antibiotic use in ambulatory care takes place through prescription following a paid consultation by a private GP. No reimbursement system exists, although a small proportion of the population are eligible to receive—free of charge—a restricted list of antibiotics directly from government pharmacies.

Primary care is available all day, all year round; GPs are essentially on-call 24/7, especially since most private GPs have strong family ties with their patients and often treat several generations within the same family. Most GP clinics in the public sector are walk-in clinics, and patients are not registered with any particular doctor or group practice, thereby impeding continuity of care. In the private sector, GPs work mostly in single-handed practices (group practices remain uncommon), and patients are free to choose their own GP. They often practice within retail pharmacies or private clinics,[47] although home visits are high on demand and relatively common. In this highly regulated system, antibiotics are prescription-only medicines, acquired from community pharmacies through a non-refundable personal purchase.[24 49] As of yet, pharmacies do not keep electronic records of prescriptions dispensed; therefore, prescription-level data are currently unavailable.[24] Likewise, GPs are not obliged to keep patient records, although some do so for personal use.

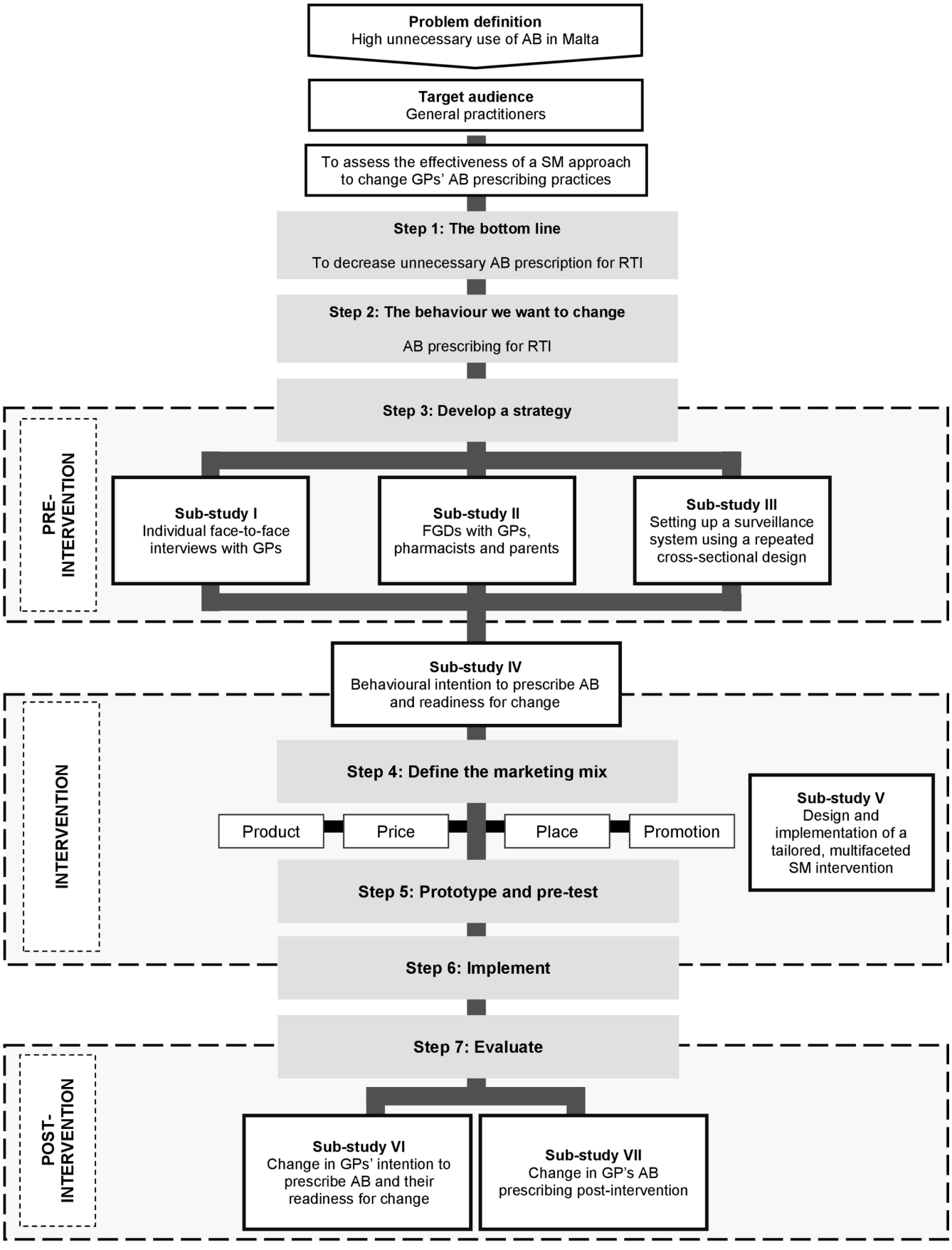
Formative research: the preintervention phase

One of the pediments of any successful SM intervention is an in-depth understanding of the target audience.[50] Without thoroughly understanding how the target audience view antibiotic use and resistance within their own context, there would be little chance for success in achieving behaviour change.[50] Formative research is the best way to gain insight into the practices and attitudes of potential audience members and can be achieved through focus group discussions (FGDs) and individual interviews, among others.

The preintervention phase consists of three substudies that will inform subsequent substudies and the development of the intervention strategy. During this phase, baseline data will be collected using mixed methods.

Individual face-to-face interviews with GPs (substudy I)

In order to design a tailored intervention, understanding key issues, particularly contextual factors, which influence GPs' antibiotic prescribing practices, is essential. Therefore, this substudy seeks to explore GPs' views and understanding of prudent antibiotic prescribing as well as factors that influence their antibiotic prescribing practices. It further aims to understand the variation in GPs' perceptions on delayed antibiotic prescribing (defined later). For this qualitative exploratory study, individual semistructured interviews will be held with a quota sample of 15–20 active GPs registered at the Malta Medical Council. In quota sampling, the intention is to ensure that the strata within the sample under study are proportional to those in the population being studied.[51] GPs are eligible to participate regardless of whether they work on a part-time or full-time basis or in the public and/or private sectors, the latter distinction considered advantageous. All eligible GPs registered at the Malta Medical Council, and to whom a phone number is available, will be included as possible interviewees. Once the list is finalised, GPs will be divided into strata based on the following characteristics and in the following order: (1) years of experience, (2) sex and (3) locality of residence. GPs from within each stratum will be contacted by phone



NOTE. AB – antibiotic; FGD – focus group discussion; GP – general practitioner; SM – social marketing; RTI – respiratory tract infections

Figure 1 A BEHAVE-based marketing plan for a social marketing intervention.

in a stepwise fashion until 15–20 GPs are recruited, alternatively until data saturation is reached. These measures will ensure that the sample of interviewees is as representative of the population characteristics as possible.

A semistructured interview guide (with prompts) will be designed and developed based on a thorough literature search and adapted according to the local context. The guide will be pilot-tested with a purposive sample of up to five GPs, following which it will adjusted accordingly. Interviews will be held in English and/or Maltese by one member of the research team who is fluent in both languages and are expected to last around 45 minutes. The recorded interviews will be transcribed verbatim and translated if necessary. Data will be analysed using content analysis and phenomenography. An overview of the design of this substudy and subsequent ones can be found in table 1.

Findings will be used to identify competing behaviours as well as barriers and facilitators to behaviour change. By understanding what GPs want, they can be offered optimal conditions for exchange, that is, offering them something they consider worthwhile in exchange for them changing their behaviour. This is based on the premise that if people believe that something is of benefit to them, they will act on it; barriers stop them from acting. Therefore. the intervention should ensure that activities will maximise the benefits while reducing the barriers that are considered important to the target audience.[52]

FGDs with GPs, pharmacists and parents (substudy II)

Correct antibiotic use depends on various key stakeholders, including pharmacists, the general public and GPs, among others. In order to gain a better understanding of the antibiotic prescription–use–dispensation dynamic in Malta through these three different stakeholders, FGDs will be held. Since young children are likely to visit their GP often, parents of children under the age of 12 will be targeted. Two to three FGDs will be conducted for each individual stakeholder—parents, GPs and community pharmacists (six to nine groups in total)—each consisting of between 6 and 10 participants. The target groups will be recruited differently. GPs participating in interviews will be reinvited to participate in the group discussions. For community pharmacists and parents, snowball sampling[51] will be employed. Snowball sampling will be used in order to gain access to participants interested in discussing the topic, thus reducing the risk for non-participative interviewees. Other sampling methods would be too time-consuming to employ and may risk inviting persons who will not contribute to the discussion.

Community pharmacists will be invited to participate through local professional associations and social networks. Those interested will be asked to recommend up to three other pharmacists they believe would be interested in participating in this study. Parents will be invited through schools via school administration and staff members with whom the researchers already have contact with. Parents interested in participating will be asked to recommend up to three parents. Although this type of sampling method will allow us to gain timely access to both stakeholders, it is limited in the fact that there is a high possibility that those interested recommend their close peers thus restricting the inferences that can be made about the rest of the population. This however is not the main goal of this substudy.

Both GPs and community pharmacists must be actively working at their time of participation, while parents must be the caregiver of at least one child under 12 years of age. A discussion guide (with prompts) will be developed, and FGDs will be held in English and/or Maltese by one member of the research team who is fluent in both languages, together with an observer/note-taker. FGDs are expected to last no longer than 2 hours. The recorded FGDs will be transcribed verbatim and translated if necessary. Data will be analysed using content analysis.

Setting up a surveillance system using a repeated cross-sectional design (substudy III)

Effective surveillance is the foundation for national and international efforts to contain ABR.[6] One of the strategic objectives of the 2015 global action plan on antimicrobial resistance is to strengthen knowledge through surveillance and research.[53] There are currently large knowledge gaps on antibiotic use in many regions of the world due to the lack of adequate surveillance systems.[6] The lack of data is often greater in the community setting.[2] Such data would help assess and monitor the situation, better understand ABR trends, define optimal treatment for patients, identify key areas for interventions to contain resistance and monitor their impact and inform public health policy.[2 6]

In Malta, ABR and consumption data are routinely collected within tertiary care, and wholesale data are collected within the community setting; however, community antibiotic consumption data at prescription-level are still unavailable,[24] and as mentioned earlier, GPs are not obliged to keep patient records. Without ongoing surveillance, it is challenging, if not impossible, to devise strategies tailored towards specific needs for the local context. Furthermore, it would be difficult to measure whether any intervention in such a community would have an impact on antibiotic prescribing. In order to better understand the antibiotic prescribing patterns of GPs for respiratory tract complaints in Malta, we will set up a basic surveillance system to present the baseline 1 year diagnosis-specific antibiotic prescribing patterns for respiratory tract complaints.

All GPs registered on the Malta Medical Council's Specialists Register will be invited to participate. The invitation will also extend to GP trainees. In order to fulfil eligibility criteria, GPs must be actively practising at the time of recruitment, with no distinction made between those working on a part-time or full-time basis. In order to attract as many GPs as possible, postal invitations will be sent to all GPs registered at the Malta Medical Council and

Table 1 Objective, study design, data collection and analysis methods for each phase of the project

Phase	Substudy	Main objective/s	Study design	Data collection and analysis methods
Preintervention	I	(1) To explore GPs' views and understanding of prudent antibiotic prescribing as well as factors which influence their antibiotic prescribing practices. (2) To understand the variation in GPs' perceptions on delayed antibiotic prescribing	Qualitative exploratory	▶ Quota sample of active registered GPs ▶ Individual semistructured interviews ▶ Content analysis and phenomenography
	II	To gain a better understanding of the antibiotic prescription–use–dispensation dynamic in Malta through three different stakeholders	Qualitative exploratory	▶ Quota sample of active registered GPs ▶ Snowball sample of parents and community pharmacists ▶ Focus group discussions ▶ Content analysis
	III	To present the baseline 1 year diagnosis-specific antibiotic prescribing patterns for respiratory tract complaints in Malta	Repeated cross-sectional surveillance	▶ Total population sampling ▶ One-year prospective surveillance ▶ Descriptive statistics and mixed effects logistic regression models
Intervention	IV	To determine GPs' behavioural intention (attitudes, subjective norms and perceived behavioural control) to prescribe antibiotics and their readiness for behaviour change	Cross-sectional	▶ Purposive sampling ▶ Self-administered questionnaire ▶ Data will be analysed using appropriate statistical methods
	V	To design, develop and implement a tailored, multifaceted SM intervention to improve antibiotic prescribing for acute respiratory tract infections among GPs	Intervention implementation	▶ Verbal feedback and feedback questionnaires ▶ Collection of delayed antibiotic prescriptions ▶ Ongoing surveillance/monitoring ▶ Logs ▶ Descriptive analysis of process indicator data
Postintervention	VI	To measure the change in GPs' intention to prescribe antibiotics and their readiness for behaviour change	Repeated cross-sectional	▶ Self-administered questionnaire ▶ Descriptive statistics and Wilcoxon signed-rank test
	VII	To evaluate the impact of an SM intervention on GPs' antibiotic prescribing for acute respiratory tract complaints in Malta	Repeated cross-sectional surveillance	▶ One-year prospective surveillance ▶ Paired, before-and-after evaluation of antibiotic prescribing ▶ Interrupted time series analysis with segmented regression

GP, general practitioner; SM, social marketing.

to whom postal addresses are publicly available. This will be followed by one postal reminder. Other recruitment strategies will also be explored, including sending out email invitations through local professional organisations and colleges and publishing a public announcement on a local medical professionals' network (TheSynapse; www.thesynapse.eu), in an attempt to reach out to those GPs without an available postal address. Phone calls will also be made to recruit as many interested GPs as possible. GP trainees will be recruited via email invitation through the Malta College of Family Doctors, who are responsible for ensuring the quality of academic training in the GP foundation programme.

Participating GPs will be required to manually collect surveillance data for all patients seen with a respiratory tract compliant, over a predetermined 1-week period (with no substitutions), every month, for a total duration of 1 year, resulting in a total of 12 surveillance weeks. A surveillance form will be developed for this purpose following a thorough literature search. It will also be based on data collected in the previous substudies as well as previous work carried out in other European countries.[54 55] It will include data on: (1) patient characteristics such as age, comorbidities and lifestyle factors, (2) clinical characteristics such as duration of symptoms, signs and symptoms, (3) diagnostics and (4) prescription. The form will be adapted to the local context through piloting and face validity testing. GPs will also be required to provide the total number of patients seen during the surveillance week, irrespective of their compliant, using a designated tally chart.

In order to promote compliance, GPs will receive three text messages in conjunction with each surveillance week: one a day prior to the initiation of the surveillance week, another on the day and the third at the end of the surveillance week. Once the surveillance week is over, they will be requested to submit all forms filled together with a tally chart by postal mail using prepaid postal envelopes. Phone contact will be regularly maintained to provide encouragement and resolve queries. While no direct incentives will be provided to promote GP participation, GPs will be provided with certificates of participation at the end of each intervention phase that will allow them to redeem continuing medical education credits through the Malta College of Family Doctors. GPs will also receive 3 monthly feedback reports summarising the data collected during the preceding three surveillance weeks (individual and aggregated). Although a form of audit and feedback, the primary intention is not to change prescribing behaviour at this point rather to encourage GPs to continue participation by maintaining regular contact. For this reason, we opted not to actively carry out any peer comparison, although GPs could compare their personal report with the aggregate results.

Descriptive statistics will be used to describe all variables collected through the surveillance. The 1 year antibiotic prescribing patterns as well as diagnosis-specific antibiotic prescribing rates and characteristics will be reported. Should the data permit, it will be further analysed to look into factors that influence GPs' antibiotic prescribing using mixed effects logistic regression models to take into account clustering at GP level.

Intervention development, design and implementation: the intervention phase

Following the completion of substudy III, members of the research team will carry out outreach visits to all participating GPs, who will be invited to extend their participation to the intervention and postintervention phases of the project (described below). The intervention phase is expected to last 6 months.

Behavioural intention to prescribe antibiotics and readiness for change (substudy IV)

Changing prescribing behaviour is complex; however, behavioural theories can help better understand and influence it through stronger and enhanced development and delivery of tailored interventions.[52] In order to further tailor the intervention according to participating GPs' needs, this cross-sectional survey aims to determine GPs' behavioural intention (attitudes, subjective norms and perceived behavioural control) to prescribe antibiotics and their readiness for behaviour change. Two questionnaires will be developed for this purpose using the main constructs of selected behaviour change theories, namely (1) the theory of planned behaviour, which is a conceptual framework for understanding social behaviour, focusing on the intention to perform a specific behaviour[37] and (2) the stages-of-change model, which describes the behaviour change process: precontemplation, contemplation, preparation, action, maintenance and relapse.[38] Potential topics will include: current antibiotic prescribing practices, knowledge-based questions on antibiotics (focusing on RTIs), likely repercussions of antibiotic misuse, external influences to antibiotic prescribing and guideline adherence. Questionnaires will be delivered to GPs prior to the initiation of the intervention (baseline) and once the intervention is complete (substudy VI). Data will be analysed using appropriate statistical methods.

Design and implementation of a tailored, multifaceted SM intervention (substudy V)

All intervention materials will be designed following thorough formative research and consideration of local cultural factors and needs. The intervention will also be tailored according to GPs' stage of behaviour change. Furthermore, ratification of all intervention materials by the local National Antibiotic Committee will be sought prior to their dissemination. A number of strategies within primary care have been outlined in an effort to combat the development of ABR.[31] Based on findings from the previous substudies, multiple components will be developed for this intervention, each described below.

Dissemination of antibiotic prescribing guidelines

Prescribing guidelines aid clinicians in translating best evidence to practice. Although several countries

have issued national antibiotic guidelines, there is little recent evidence that assesses its impact on prescribing behaviour.[31] It has been shown however that guideline dissemination alone is not sufficient to restrict antibiotic prescribing.[17] For this reason, hard and soft copies of the updated national guidelines shall be disseminated to every participating GP in combination with other strategies outlined below. Guidelines will be published in English.

Distribution of educational materials (including posters and booklets)

Over the past decade, the popularity of patient information leaflets in primary care has increased.[31] They can be referred to by doctors during consultations, and patients may also take them to home read later.[31] A number of studies have shown that the use of patient information booklets can help to reduce antibiotic prescribing rates[56] and provide patients with valuable information on the typical duration of illness, how to recognise signs of severe illness and increase awareness on antibiotic use.[57 58] They also lead to increased knowledge and confidence among GPs, although some report certain barriers such as lack of time and problems changing their consultation style.[57]

Should posters be developed, they will be pretested during FGDs with parents and GPs will be asked to provide input during outreach visits. Patient booklets would be developed together with a medical illustrator and could include information on viral versus bacterial infections, how to manage symptoms without antibiotics, how ABR develops and how to use antibiotics responsibly. The booklet will be distributed to a number of people from various backgrounds prior to large-scale printing in order to receive feedback on readability, attractiveness and user-friendliness and subsequently revised accordingly. Posters and booklets will be made available at all clinics of participating GPs, and booklets will be used during patient consultations.

Delayed antibiotic prescription

Delayed antibiotic prescribing refers to a scenario where a doctor prescribes an antibiotic course on the condition that they should only be taken if symptoms persist or deteriorate after a given time period (generally between 48 and 72 hours). A systematic review showed that delayed antibiotic prescribing results in marked reductions in antibiotic use and no significant differences in reconsultation or complication rates.[59] Although some national guidelines recommend delayed prescribing, its uptake in clinical practice remains low.[60 61] The motivation behind its use varies from managing diagnostic uncertainty and avoiding conflicts with patients (particularly those who tend to put pressure on doctors to prescribe), to a tool for patient education and to promote shared decision making.[61 62] Some prescribers, however, feel uncomfortable shifting clinical responsibility onto their patients.[61]

Should Maltese GPs seem receptive to this prescription method, a delayed antibiotic prescription pad will be developed and distributed to GPs for use during consultations where a delayed prescription is deemed appropriate by the GP.

Delivery of educational sessions

A recent review of interventions to improve antibiotic use for RTIs showed that educational sessions, although laborious, seem more effective than audit and feedback and distribution of written patient information.[17] Educational sessions can include: information on the core principles of prudent antibiotic use, introduction to new tools (such as guidelines), diagnostic skills training and patient communication techniques.[31] A few studies have shown that sessions incorporating these topics can lead to sustained improvements in antibiotic use that last over 2–4 years.[63 64] The extent of the impact in other studies has generally been quite modest.[58 65–68]

Educational sessions will form a core part in the planned intervention and will be delivered in accordance with GP preferences. Topics will likely include those mentioned above as well as any other topics addressing specific needs identified during the formative research phase. In order to ease attendance, sessions will be delivered face-to-face but also streamed live and recorded for those unable to attend in person. Recorded sessions and all relevant materials will be uploaded to Ping Pong, the online learning platform used at Karolinska Institutet.

Process indicators

Several process indicator data will be collected throughout the intervention period, which will also help assess compliance with the intervention protocol. Table 2 summarises a few indicators according to the intervention components previously described.

Postintervention phase: intervention evaluation

Outcome parameters

Primary outcome

The antibiotic prescribing rate for all patients with acute respiratory tract complaints, with the exception of pneumonia cases which will be excluded entirely.

Secondary outcomes

Secondary outcomes include the:

i. proportion of diagnosis-specific antibiotic prescription, specifically for the common cold, acute pharyngitis, acute sinusitis, acute bronchitis, acute tonsillitis, acute otitis media, allergy and influenza
ii. proportion of symptomatic relief medication prescribed
iii. change in GPs' stage-of-change
iv. change in GPs' behavioural intention to prescribe antibiotics.

In order to evaluate the effect of the intervention on GPs' antibiotic prescribing, their intention to prescribe

Table 2 Process indicators collected during intervention period

Intervention components	Implementation outcomes (process indicators)	Data collection methods
Antibiotic prescribing guidelines	► No. of guidelines distributed ► Frequency of reference to guidelines ► Usefulness of guidelines in practice	► Surveillance/monitoring ► Survey (postintervention)
Posters	► No. of posters printed ► No. of posters disseminated, per GP ► No. of posters displayed in clinics ► No. of QR code log-ins	► Surveillance/monitoring ► Logs ► Survey (postintervention)
Booklets	► No. of booklets printed ► No. of booklets disseminated, per GP ► No. of QR code log-ins	► Surveillance/monitoring ► Logs ► Survey (postintervention)
Delayed antibiotic prescription pads	► No. of pads printed ► No. of pads disseminated, per GP ► No. of delayed antibiotic prescriptions issued ► No. of QR code log-ins	► Surveillance/monitoring ► Logs ► Collection of issued prescriptions ► Survey (postintervention)
Educational sessions	► No. of sessions held ► % attendance to sessions ► % attendance to sessions, by mode (face-to-face, online (live), online (recorded)) ► Satisfaction with session content and delivery	► Surveillance/monitoring ► Feedback questionnaires ► Survey (postintervention)

GP, general practitioner; QR, quick response.

antibiotics and stage-of-change, two sub-studies are planned and are described below.

Change in GPs' intention to prescribe antibiotics and their readiness for change (substudy VI)

Following the completion of the intervention phase, all participating GPs will be asked to complete the same two questionnaires outlined in substudy IV with the aim of measuring the change in their intention to prescribe antibiotics and readiness for behaviour change postintervention. Apart from descriptive and comparative statistics, the plan is to analyse paired data using Wilcoxon signed-rank test.

Change in GP's antibiotic prescribing postintervention (substudy VII)

Following participation in the intervention phase, GPs will complete another year of surveillance using identical tools and methods used in substudy III. Apart from analysing the change in diagnosis-specific antibiotic prescribing patterns for respiratory tract complaints postintervention, the impact of the SM intervention on GPs' antibiotic prescribing will also be evaluated. As before, GPs will also receive 3 monthly feedback reports (individual and aggregated). Descriptive statistics will be used to describe all variables collected through the surveillance. The 1 year antibiotic prescribing patterns as well as diagnosis-specific antibiotic prescribing rates and characteristics will also be reported. Finally, the change in antibiotic prescribing preintervention and postintervention will be evaluated using interrupted time series analysis with segmented regression. Data will be clustered at GP level.

Study status

The project was initiated in August 2014 and is ongoing. The preintervention phase ran from August 2014 to April 2016. The intervention phase has just come to completion. The project is now in the postintervention phase.

ETHICS AND DISSEMINATION

Ethical considerations

Each component of the project received ethical approval from the University of Malta's Research Ethics Committee when needed.

Several ethical issues have been considered. For all substudies, participants received verbal information about the study's purpose and their role as participants, in addition to information letters and informed consent. Participants were told that participation is voluntary and that they are free to withdraw without consequences. For the qualitative substudies, permission was requested to record the sessions. For the surveillance and intervention components, no information gathered risks compromising the patient's identity; no names and identifiable variables were collected. Nonetheless, standard data management protocols will be employed to ensure data safety. All data will be stored in a safe location and made confidential through the use of unique identifier codes kept in a separate file and accessible only to one

team member. Moreover, no identifiable material will be published publicly.

There are no anticipated risks associated with participation apart from the time required to participate. We believe, rather, that informants could benefit from being given the opportunity to self-reflect on their own antibiotic use. In exchange for participation, GPs and pharmacists received certificates, allowing them to earn Continuing Professional Development (CPD) points from their respective colleges. Furthermore, GPs participating in surveillance received 3 monthly feedback reports (individual and overall). Overall feedback is presented in an aggregate manner and does not include any GP or patient information that may compromise their identity.

Dissemination plan

We plan to present our results at leading international and national conferences. We also plan to publish results in peer-reviewed scientific journals and disseminate them locally through local professional organisations. We intend to share our ultimate findings to the National Antibiotic Committee, which reports directly to the Superintendent of Public Health of Malta.

DISCUSSION

ABR respects no borders. It is a global problem with increasing magnitude, and it is critical that this escalating situation is addressed promptly. Although not a simple task, especially due to underlying cultural dimensions,[32 36] strategic behaviour change initiatives to promote prudent antibiotic use and prescribing are urgently required[30] and are attainable, as shown by other European countries.[32] There is a need to propose simple solutions that consider local cultures and can be scaled up to become self-sustainable.[35]

To our knowledge, this community intervention is unique in Malta. It is the first to establish a community surveillance system and employ SM techniques to design, deliver and evaluate the effectiveness of a behaviour change intervention to improve antibiotic prescribing. As mentioned earlier, although SM techniques are promising to promote sustained behaviour change among selected groups,[30] its utilisation for the prevention and control of communicable diseases in Europe has thus far been limited.[44]

Changing antibiotic prescribing behaviour is complex and requires multifaceted interventions.[5] This study uses various approaches in an attempt to change GPs' prescribing behaviour, generating evidence towards the effectiveness of tailored, multifaceted SM interventions in this field. It will allow us to gain insight into GPs' diagnosis-specific antibiotic prescribing practices over time which, in Malta, has been hard to achieve so far. Should this intervention successfully decrease antibiotic prescribing rates, it may be scaled up locally and transferred to similar settings at a very low cost.

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Contributors All authors were all involved in the conception, planning and design of this study as well as the development of all data collection instruments. EAS-G managed the project; she recruited all participants, led data collection and analysis, designed educational materials and coordinated their printing, delivered an educational session and liaised with the various stakeholders involved. EAS-G wrote the first draft of this manuscript and made all necessary amendments after review. MAB delivered one educational session. MAB, SR-K, AN and CSL were involved in manuscript review and critique, and all authors contributed to the final approval of the manuscript. All authors are in agreement that they are accountable for all aspects of the work and that all questions related to its accuracy have been appropriately investigated and resolved.

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