

**Evidence Check**

# Improving antibiotic use in the community setting

An **Evidence Check** rapid review brokered by the Sax Institute for NPS Medicine Wise.  
February 2014.

**This report was prepared by:**

Nicole Mercovich, Gabrielle Cooper, Greg Kyle, Mark Naunton, Jackson Thomas.

September 2015  
© Sax Institute 2015.

This work is copyright. It may be reproduced in whole or in part for study training purposes subject to the inclusions of an acknowledgement of the source. It may not be reproduced for commercial usage or sale. Reproduction for purposes other than those indicated above requires written permission from the copyright owners.

**Enquiries regarding this report may be directed to the:**

Manager  
Knowledge Exchange Program  
Sax Institute  
[www.saxinstitute.org.au](http://www.saxinstitute.org.au)  
[knowledge.exchange@saxinstitute.org.au](mailto:knowledge.exchange@saxinstitute.org.au)  
Phone: +61 2 91889500

**Suggested Citation:**

Mercovich M, Cooper G, Kyle G, Nauton M, Thomas J. Improving antibiotic use in the community setting: an Evidence Check rapid review brokered by the Sax Institute ([www.saxinstitute.org.au](http://www.saxinstitute.org.au)) for NPS Medicine Wise, February 2014.

**Disclaimer:**

This **Evidence Check Review** was produced using the Evidence Check methodology in response to specific questions from the commissioning agency.

It is not necessarily a comprehensive review of all literature relating to the topic area. It was current at the time of production (but not necessarily at the time of publication). It is reproduced for general information and third parties rely upon it at their own risk.

# Improving antibiotic use in the community setting: an evidence review of strategies targeting health professionals

An **Evidence Check** rapid review brokered by the Sax Institute for NPS Medicine Wise.  
February 2014.

This report was prepared by Nicole Mercovich, Gabrielle Cooper, Greg Kyle, Mark Naunton, Jackson Thomas.

# Contents

List of tables and figures.....	5
List of abbreviations.....	5
<b>1 Executive summary.....</b>	<b>6</b>
Methods.....	6
Results.....	7
Urinary tract infection.....	7
Skin infections.....	7
Sexually transmitted infections.....	7
Evidence analysis.....	8
Recommendations.....	8
<b>2 Background.....</b>	<b>9</b>
<b>3 Methods.....</b>	<b>10</b>
<b>4 Results.....</b>	<b>14</b>
Urinary Tract Infections (11 Articles).....	14
Skin/Dermatological Infections (1 Article).....	19
Sexually Transmitted Infections (2 Articles).....	20
<b>5 Analysis of evidence.....</b>	<b>22</b>
Strategies used to change prescribing behaviour.....	22
Effectiveness of the interventions.....	23
Limitations.....	28
<b>6 Authors' conclusions and recommendations.....</b>	<b>29</b>
<b>7 References.....</b>	<b>30</b>
<b>8 Appendix 1.....</b>	<b>32</b>
List of databases searched for primary health care grey literature.....	32

## List of tables and figures

Table 1: Electronic database search terms

Table 2: Grey literature database search terms

Table 3: Keywords used to determine relevance of articles by title review

Table 4: Expanded searches for specific diagnoses under skin and sexually transmitted infections

Table 5: Summary of studies relating to urinary tract infections

Table 6: Summary of results relating to urinary tract infections in elderly populations

Table 7: Summary of results relating to skin/dermatological infections

Table 8: Summary of results relating to sexually transmitted infections

Table 9: Summary of study effectiveness

Figure 1: Process used to identify relevant articles for review

## List of abbreviations

AMR	Antimicrobial resistance
DI	Dermatological/skin infection
GP	General practitioner
GPs	General practitioners
HCPs	Healthcare professionals
PID	Pelvic inflammatory disease
STI	Sexually transmitted infection
UTI	Urinary tract infection

# 1 Executive summary

## Introduction

Antimicrobial resistance (AMR) is a worldwide public health concern. Despite national and international efforts to improve awareness of this issue among consumers, AMR is becoming increasingly more widespread. Inappropriate antibiotic prescribing is a major contributor to AMR, with decisions to initiate antibiotic therapy unnecessarily, inappropriate choice of agents, and duration of therapy all contributing factors. Improving prescribing behaviour and adherence to guidelines is a key factor in preventing antimicrobial resistance.

Hospitals in Australia, and overseas, have launched antibiotic stewardship programs to help reduce rates of inappropriate antibiotic use in order to reduce the growing prevalence of AMR. However, there have been few interventions established in the community or outpatient setting to minimise inappropriate antibiotic use.

The Australian National Prescribing Service (NPS) has previously evaluated interventions to reduce the prescribing and requests for antibiotics for upper respiratory tract infections (3). This evaluation found consistent, modest behavioural changes. The current review was commissioned to evaluate any similar successful or otherwise interventions in urinary tract infections (UTI), skin infections (DI [dermatological infections]) or sexually transmitted infections (STI).

## Methods

The major medical electronic databases available through the University of Canberra (Scopus, Pubmed and Informit) were searched for peer reviewed articles published between January 2008 and February 2014. A list of 14 active databases for primary health care grey literature was obtained from Primary Health Care Research and Information Service (PHCRIS). A manual search of each of the listed databases was undertaken.

The titles of the resultant publications were added to an EndNote database for management and grouped according to the search term generating each reference. Duplicate titles were removed and the remaining article titles were examined to determine relevance and included or excluded based on a pre-determined set of criteria. For all titles considered potentially relevant, abstracts were obtained and reviewed. For abstracts appearing to meet the inclusion criteria, the full text article was retrieved for review. All abstracts meeting any aspect of the exclusion criteria were excluded.

Only a single article met the criteria for inclusion under both DI and STI. Therefore a secondary search was performed using the same process described above, including keywords of specific diagnoses under these broader headings to attempt to identify a larger number of articles for review under DI and STI. The diagnoses used to perform the secondary search were chosen based on the common conditions headlining chapter titles in the Therapeutic Guidelines.<sup>18</sup>

The reference lists for each included study were reviewed to obtain additional titles which underwent the same process to determine relevance and potential for inclusion. Descriptive data (study type, publication date, study population and size, type of intervention evaluated, and outcomes in terms of efficacy of the intervention and the key elements) were extracted from included studies in order to report thematic similarities in findings.

## Results

The preliminary search strategy yielded a total of 1,854 articles. Thirteen articles met the inclusion criteria for this review. Two articles fulfilled the criteria for inclusion under STI. Eleven articles evaluated prescribing interventions relating to UTI, one of these articles reported on a prescribing intervention for both UTI and DI. No additional resources meeting the inclusion criteria were identified in the grey literature.

### Urinary tract infection

A total of eleven articles relating to urinary tract infections (UTIs) were included. This review identified a range of studies with multiple methodologies and varying sample sizes. Two completed randomised controlled trials and one non-randomised controlled trial were the highest quality studies included under UTIs.

The non-randomised study which included a multi-faceted intervention combining small group educational sessions and on-site guidelines, demonstrated a 42.5% increase (from 26.9% to 69.4%) in the rate of appropriate antibiotics prescribed for UTIs at the time the intervention was established. This study was also the only publication which assessed sustainability of practice change following intervention. When appropriate prescribing rates were last reassessed at 17 months post-intervention, the proportion of appropriate prescriptions had reduced to 40.8%.

The single intervention evaluated in the randomised controlled trial demonstrated that providing general practitioners (GPs) with a guideline for managing UTIs does not improve rates of appropriate prescribing.

Qualitative interview analyses were more commonly published methodologies with four studies of this nature included in this review. Qualitative studies exploring the reasons behind “inappropriate” prescribing highlighted prescriber perceptions as a major factor. These could be the perception that AMR is not a serious problem, reluctance to change a successful regimen, or tailoring therapy to perceived patient needs/behaviours.

The single aged care facility based study observed a significant improvement in guideline adherence, in terms of an increase in delaying antibiotic initiation and use of quinolone antibiotics, following the multi-modal intervention in comparison to the randomly assigned control group.

The interventions that were most successful involved some degree of direct contact with the prescribers. Multi-modal interventions (print/email, didactic presentation and reminder materials) appear to have been effective. However, the follow-up in these studies was short and evidence of these interventions generating long term or permanent behaviour change in these studies is lacking.

### Skin infections

A single article was identified containing data relating to an intervention in antibiotic prescribing for DIs. The randomly assigned single intervention in this study reportedly demonstrated a small but statistically significant decrease of 2.7% in the proportion of broad spectrum antibiotics used to treat skin and soft tissue infections.

### Sexually transmitted infections

Two articles were identified containing data relating to STIs. One study obtained quantitative data on the age and practice location of participants and the treatments recommended. Qualitative data derived from the study were trends observed in attitudes towards AMR and adherence with antibiotic prescribing guidelines. The systematic review describing the efficacy of interventions aimed at improving management of pelvic inflammatory disease (PID) reported the most successful interventions are multi-modal in nature and targeted towards both the prescriber and patients.

## Evidence analysis

There is a definite lack of data in the recent published literature for interventions to change behaviour and attitudes of community based health practitioners prescribing antibiotics for urinary tract, sexually transmitted and skin infections. Overall the quality of data found in this review is quite low, with studies reviewed lacking either a control group, adequate population sizes, or statistical evaluation. No studies were found reporting interventions conducted with Australian practitioners.

The majority of data published in this area report short term changes, and where longer term sustainability has been assessed it has been found that one off interventions are unsustainable over long term. One study noted immediate reversion to previous practices once the intervention was removed. Another study reported that inappropriate prescribing rates in UTIs had significantly increased 17 months after the intervention had ceased. At the 17 month time interval appropriate prescribing rates were observed to still be higher than those at baseline, warranting further investigation into the reasons why some prescribers apparently continued to adhere to guidelines while others did not.

Variable efficacy was reported resulting from numerous strategies including single and multi-modal interventions. Single interventions were "hands on" experiences such as clinical vignette case studies, a decision support algorithm, and self-directed practice test and audit. Multi-modal interventions encompassed a combination of written guideline information (including email), didactic lectures, focus groups, posters and leaflets as reminders. In the short term studied, multi-modal strategies provided a larger impact than single intervention studies. Surveys alone appear to have had an effect on prescribers. This may be because survey respondents had to think about the issues encountered during the survey and then may have self-reflected on practice then changed their practice based on this reflection. This would be detected in a follow-up survey. Such a strategy relies on reflective practice to produce its beneficial outcome and could be considered an incidental benefit.

A major limitation of this review is the small number of articles found in the published literature on the specific topics. Excluding hospital interventions may have played a part in this as interventions in hospital may also be applicable in the community setting. Excluding articles that evaluated and discussed antibiotic prescribing interventions in other topics or in a general sense may have limited the quality of this review as the interventions evaluated in these studies may be applicable to the specific topics covered in this review. Other factors could include publication of relevant articles in non-indexed journals, or little active research conducted or published during the specified time period.

## Recommendations

The findings of this review indicate that there is a definite lack of data available reporting on effective interventions to improve antibiotic prescribing guideline adherence in UTI, STI and DI. The publications reviewed indicate that multi-modal, face-to-face educational interventions are a promising area for further research into sustainable and effective strategies to improve guideline adherence.



## 2 Background

Antimicrobial resistance (AMR) is a worldwide public health concern.<sup>1</sup> Despite national and international efforts to improve awareness of this issue among consumers, AMR is becoming increasingly more widespread.

Inappropriate antibiotic prescribing is a major contributor to AMR, with decisions to initiate antibiotic therapy unnecessarily, inappropriate choice of agents, and duration of therapy all contributing factors.

Hospitals in Australia, and overseas, have launched antibiotic stewardship programs to help reduce rates of inappropriate antibiotic use in order to reduce the growing prevalence of AMR. However, there have been few interventions established in the community or outpatient setting to minimise inappropriate antibiotic use.

Urinary tract infections (UTIs) are one of the most common diagnoses for which antibiotics are prescribed by general practitioners and therefore form an important area for intervention into reducing the proportion of inappropriate antibiotic use.<sup>2</sup>

The Australian National Prescribing Service (NPS) has previously evaluated interventions to reduce the prescribing and requests for antibiotics for upper respiratory tract infections.<sup>3</sup> This evaluation found consistent, modest behavioural changes. The current review was commissioned to evaluate any similar successful or otherwise interventions in urinary tract infections (UTI), skin infections (DI [dermatological infections]) or sexually transmitted infections (STI).

## 3 Methods

The major medical electronic databases available through the University of Canberra (Scopus, Pubmed and Informit) were searched for articles published between January 2008 and February 2014. The search terms and strategy utilised are shown in Table 1.

**Table 1: Electronic database search terms**

Search term	Scopus	Pubmed	Informit	Total
Antibiotic prescribing attitudes	264	98	23	385
Antibiotic prescribing interventions	375	137	57	569
Antimicrobial stewardship primary care <sup>#</sup>	17	13	0	30
General practitioner antibiotic guideline adherence	61	31	7	99
GP antibiotic guideline adherence	13	5	8	26
Inappropriate prescribing sexually transmitted infection	4	8	5	17
Inappropriate prescribing skin infection	31	4	21	56
Inappropriate prescribing urinary tract infection	67	28	19	114
Prescribing behaviour sexually transmitted infection	12	35	4	51
Prescribing behaviour skin infection	10	5	21	36
Prescribing behaviour urinary tract infection	19	10	17	46
Prescribing guideline adherence skin infection	16	28	0	44
Prescribing guideline adherence sexually transmitted infection	1	5	0	6
Prescribing guideline adherence urinary tract infection	32	17	9	58
Sexually transmitted infection prescribing guidelines	4	27	7	38
Skin infection prescribing guidelines	55	18	55	128
Urinary tract infection prescribing guidelines	86	34	31	151

<sup>#</sup> 'NOT Hospital' applied in advanced search criteria to limit results to community based publications

A review of the grey literature was conducted utilising Primary Health Care Research and Information Service (PHCRIS). A list of 14 active databases for primary health care grey literature was obtained from PHCRIS and is available in Appendix 1. Table 2 below contains the results of the literature search with the database number corresponding to the number allocated in the list in Appendix 1. The broad search term 'antibiotic prescribing' was used to individually search each of the listed databases for relevant data meeting the inclusion criteria. For databases where this search term yielded results in excess of 250, the search terms in Table 1 above that retrieved the largest number of results in the black literature search (sexually transmitted infection prescribing guidelines, skin infection prescribing guidelines, urinary tract infection prescribing guidelines) were utilised as search terms for a more directed search of these grey literature databases.

**Table 2: Grey literature database search terms**

Search term	Database (see Appendix 1 for name corresponding to number)														Included
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Antibiotic prescribing	9	1	0	0	0	0	121	13	0			2	0	2	0
sexually transmitted infection prescribing guidelines										3	720				0
skin infection prescribing guidelines										2	2904				0
urinary tract infection prescribing guidelines										37	209				0

The titles of the resultant articles were added to an EndNote database for management and grouped according to the search term generating each reference. Duplicate titles were removed and the remaining article titles were examined to determine relevance and included or excluded based on the keywords listed in Table 3.

**Table 3: Keywords used to determine relevance of articles by title review**

Inclusion keywords	Exclusion keywords
Antibiotic	Agriculture
Attitudes	Animal
Behaviour	Cancer
Dermatology	Environmental pollutants
Guidelines	Hospital
Health professional	Human immunodeficiency virus (or HIV)
Interventions	Immunosuppressed
Prescribing	Non-antibiotic medications
Sexually transmitted disease (or STD)	Non-bacterial infections (fungal, parasitic etc.)
Sexually transmitted infection (or STI)	Paediatric
Skin infection	Veterinary
Strategies	
Urinary tract infection (or UTI)	

For all titles considered potentially relevant based on the keyword parameters above, abstracts were obtained and reviewed. For abstracts appearing to meet the inclusion criteria below, the full text article was retrieved for review. All abstracts meeting any aspect of the exclusion criteria were excluded.

Criteria for Inclusion: Studies published in the English language that evaluated the effect of an intervention to improve community-based health professional adherence to antibiotic prescribing guidelines in adult urinary tract, sexually transmitted or skin infections.

Criteria for Exclusion: Studies conducted in a hospital or reporting data pertaining to a hospital setting, paediatric or non-human studies, studies conducted in non-OECD nations. Studies that did not specifically evaluate an intervention in improving adherence to antibiotic prescribing, or studies that did not include data on any of the three key areas of interest.

Only a single article met the criteria for inclusion under both DI and STI. Therefore a secondary search was performed using the same process described above, including keywords of specific diagnoses under these broader headings to attempt to identify a larger number of articles for review under DI and STI. The diagnoses used to perform the secondary search are shown in Table 4 below, with keywords chosen based on the common conditions headlining chapter titles in the Australian Antibiotic Therapeutic Guidelines.

**Table 4: Expanded searches for specific diagnoses under skin and sexually transmitted infections**

Antibiotic prescribing attitudes <i>OR</i> Antibiotic prescribing interventions <i>OR</i> General practitioner antibiotic guideline adherence <b>AND</b>	Scopus		Pubmed		Informit		Total	
	Retrieved	Included	Retrieved	Included	Retrieved	Included	Retrieved	Included
Acne	2	0	0	0	1	0	3	0
Boils	1	0	1	0	1	0	3	0
Carbuncles	0	0	0	0	1	0	1	0
Cellulitis	7	0	2	0	1	0	10	0
Chlamydia	3	1	0	0	1	0	4	1
Folliculitis	0	0	0	0	1	0	1	0
Gonorrhoea	0	0	3	0	1	0	4	0
Impetigo	0	0	0	0	1	0	1	0
Pressure sores	0	0	0	0	1	0	1	0
Psoriasis	0	0	0	0	1	0	1	0
Syphilis	0	0	0	0	1	0	1	0

The reference lists for each included study were reviewed to obtain additional titles which underwent the same process to determine relevance and potential for inclusion.

Descriptive data (study type, publication date, study population and size, type of intervention evaluated, and outcomes in terms of efficacy of the intervention and the key elements) were extracted from included studies. The heterogeneous nature of the included studies precluded combining data in a meta-analysis; therefore studies and their potential implications for improving adherence to antibiotic prescribing

guidelines in the three key areas of interest are reported individually. Thematic similarities in findings will be reported.

# 4 Results

The results of the database search methodology are summarised in Figure 1. The preliminary search strategy yielded a total of 1,854 articles. Only 13 articles met the inclusion criteria for this review. Two articles fulfilled the criteria for inclusion in this review under STI. Eleven articles evaluated prescribing interventions relating to UTI, one of these articles reported on a prescribing intervention for both UTI and DI. No additional resources meeting the inclusion criteria were identified in the grey literature.

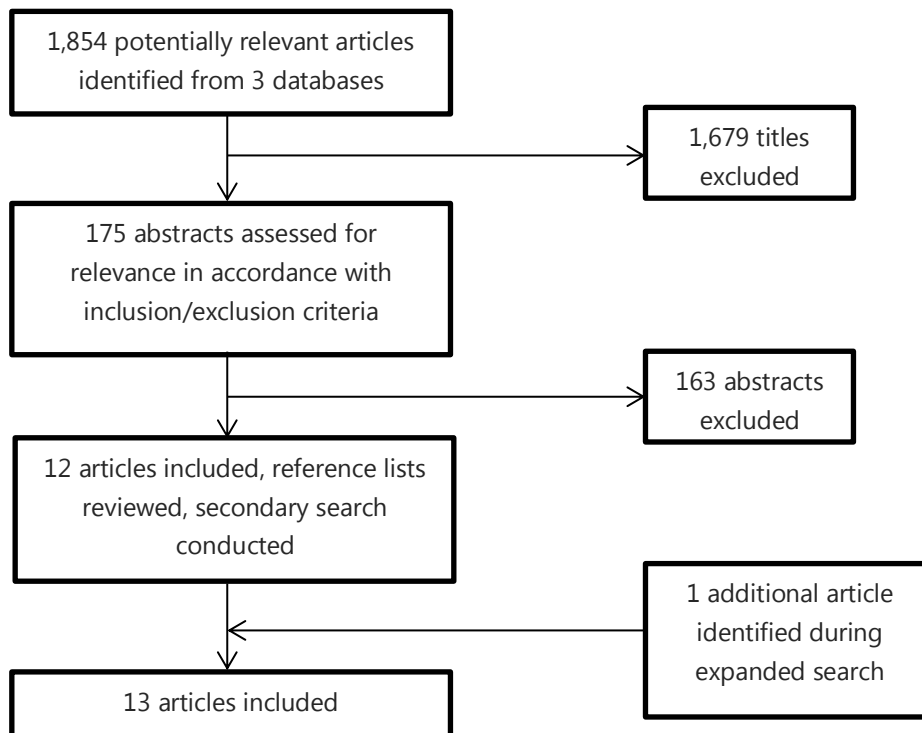


Figure 1: Process used to identify relevant articles for review

## Urinary Tract Infections (11 Articles)

A total of 10 articles relating to urinary tract infections were included and have been summarised in Table 4. An additional study reported a prescribing intervention in a nursing home setting. Due to the clinical differences in prescribing to the elderly population (e.g. altered pharmacokinetics), this study will be discussed separately with data summarised in Table 5. One study contained data relating to urinary tract and skin infections, therefore the data relating to each infection type has been reported separately under the relevant heading.

**Table 5: Summary of studies relating to urinary tract infections**

Source & Evidence type	Study type/ method	Population/ setting	Intervention/outcome measure	Brief findings
Lugtenberg M, et al. 2010, Netherlands. <sup>2</sup>  Peer reviewed paper	Qualitative interview analysis	13 Dutch general practitioners	Focus group analysis to identify barriers to guideline adherence in uncomplicated UTIs and potential interventions to improve adherence	Qualitative data reporting, statistical significance of results not assessed. Participants reported lack of acceptability and organisational constraints (pharmacy drug availability) as barriers to guideline adherence. Suggested interventions were small group education sessions, improved organisation/coordination of out-of-hours care, and improved availability of preferred drugs
Björkman I, et al. 2013, Sweden. <sup>4</sup>  Peer reviewed paper	Qualitative interview analysis	20 Swedish general practitioners	Semi-structured face-to-face interviews containing open ended questions to identify association between prescriber attitudes towards AMR and adherence to UTI antibiotic prescribing guidelines	Researchers suggest a correlation between compliance with prescribing guidelines and GP perception that AMR is a serious problem. No statistical analysis applied to the findings to assess significance
Duane S, et al. 2013, Ireland. <sup>5</sup>  Peer reviewed paper	Three arm Randomised controlled trial – study protocol report	30 Irish general practices; number of participating GPs not yet available	Components targeting both GPs and patients.  Interactive workshops, audit and feedback reports, automated electronic prescribing prompts for both study arms. Delayed prescribing will be recommended to one of the study arms  Multimedia applications and information leaflets for patients	Not yet available, study ongoing.

Source & Evidence type	Study type/ method	Population/ setting	Intervention/outcome measure	Brief findings
Jenkins TC, et al. 2013, United States of America. <sup>6</sup>  Peer reviewed paper	Two arm Randomised controlled trial	8 American health clinics, totalling 80 general practitioners (46 in study arm, 34 control arm)	Single page decision support prescribing algorithm aimed at assisting prescribers to determine if antibiotics are indicated and the most appropriate choice of agent, aiming to reduce use of broad spectrum antibiotics  Placement of patient educational materials in waiting areas	Increased use of broad spectrum antibiotics for urinary tract infections in the study group, contradicting the recommended use of narrow spectrum antibiotics provided in the decision support algorithm
Kuehlein T, et al. 2011, Germany. <sup>7</sup>  Peer reviewed paper	Qualitative interview analysis	18 German general practitioners	Pre-intervention focus group examining prescribing behaviour  Self-conducted prescribing practice test  Post-intervention focus group examining results of practice test and implications for future prescribing behaviour	Former hospital training, perceived common therapy and reluctance to change successful regimen identified as drivers of prescribing behaviour. Practice test of trimethoprim over other agents showed 94% success rate and favourably changed prescriber opinions. Self-reflection and ownership of data were main drivers in altering prescribing habits
McNulty CA, et al. 2011, Great Britain. <sup>8</sup>  Peer reviewed paper	Prospective interrupted time series observational study and qualitative survey analysis	7 British general practices, 222 Healthcare professionals (HCPs)	Altering antibiotic susceptibility pathology reporting to observe effect on choice of antibiotic prescribed for urinary tract infections  Survey of antibiotic prescribing practices following receipt of a urine pathology report	Observed an increase in the rate of prescribing of the intervention antibiotic in accordance with the susceptibility reports, concluding pathology susceptibility reporting of specific agents had a direct effect on the choice of antibiotic. Questionnaire did not identify any other significant practice changes



Source & Evidence type	Study type/ method	Population/ setting	Intervention/outcome measure	Brief findings
Slekovec C, et al. 2012, France. <sup>9</sup>  Peer reviewed paper	Observational interrupted time series quantitative analysis	French GPs, approx. 200 voluntary participants in intervention training sessions observations based on unknown number of GPs from approx. 2200 in region	Guidelines for UTI prescribing mailed to all GPs in region and made available online. Over the subsequent month voluntary training sessions held inclusive of didactic lecture, clinical examples and information on AMR using general and local data	Observed a change in prescribing habits following dispatch of guidelines and workshops trending towards better adherence with guidelines
Stuck A, et al. 2012, Switzerland. <sup>10</sup>  Peer reviewed paper	Quantitative observational analysis	11,799 patient prescriptions written by voluntary members of the Swiss Sentinel Surveillance Network (109 GPs)	Identification of prescriber characteristics indicating low guideline adherence as a basis to formulate targeted interventions. Physicians ranked as high prescribers based on prescription data discerning a proportion of >16% of antibiotic prescriptions written for influenza type illness as a surrogate for liberal prescribing attitude. This was compared with the rate of guideline adherence for UTI prescribing. Physicians were surveyed on their perception of patient's attitude as favouring antibiotic prescription or neutral	Liberal attitudes towards antibiotic prescribing were associated with inappropriate antibiotic choice for UTI. Physicians with high prescribing rates were significantly associated with the perception that their patients favoured the prescribing of antibiotics as treatment for UTI
Velasco E, et al. 2012, Germany. <sup>11</sup>  Peer reviewed paper	Qualitative interview analysis	468 German general practitioners	Survey to determine factors affecting the prescribing of specific antibiotics	Authors observed prescribers who favour an inappropriate agent as first line trended towards favouring prescribing antibiotics to patients' personal needs, such as perceived as unlikely to return for a follow up consultation

Source & Evidence type	Study type/ method	Population/ setting	Intervention/outcome measure	Brief findings
Willems L, et al. 2012, Belgium. <sup>12</sup>  Peer reviewed paper	Two arm non-randomised controlled study	2 purposefully selected health clinics (one intervention and one control) in Belgium inclusive of 134 and 98 GPs respectively	Emails highlighting the current prescribing guidelines sent to GPs at beginning of project, a presentation given to GPs while on duty to educate on AMR and treatment guidelines. The resting area for GPs at the clinic had two posters and three handouts reiterating the guidelines	Intervention group demonstrated an increase in the rate of appropriate antibiotic prescriptions compared with control group

This review identified a range of studies with multiple methodologies and varying sample sizes. Two completed randomised controlled trials and one non-randomised controlled trial were the highest quality studies included in this review.

The non-randomised study which included a multi-faceted intervention combining small group educational sessions and on-site guidelines, demonstrated a 42.5% increase (from 26.9% to 69.4%) in the rate of appropriate antibiotics prescribed for UTIs at the time the intervention was established.<sup>12</sup> This study was also the only publication which assessed sustainability of practice change following intervention. When appropriate prescribing rates were last reassessed at 17 months post-intervention, the proportion of appropriate prescriptions had reduced to 40.8%.

The single intervention evaluated in the randomised controlled trial demonstrated that providing GPs with a guideline for managing UTIs does not improve rates of appropriate prescribing.<sup>6</sup> In fact the decision support tool appeared to increase broad spectrum antibiotic prescribing<sup>6</sup>; however, this may have been appropriate empiric therapy, or the lack of information available or gathered by the prescriber may have skewed the data by having a 'fall-back' position of using a broad spectrum antibiotic if information was lacking.

Qualitative interview analyses were more commonly published methodologies with four studies of this nature included in this review. Qualitative studies exploring the reasons behind "inappropriate" prescribing highlighted prescriber perceptions as a major factor. These could be the perception that AMR is not a serious problem<sup>4</sup>, reluctance to change a successful regimen<sup>7</sup>, or tailoring therapy to perceived patient needs/behaviours.<sup>10,11</sup>

**Table 6: Summary of results relating to urinary tract infections in elderly populations**

Source & Evidence type	Study type/ method	Population/ setting	Intervention/outcome measure	Brief findings
Pettersson E, et al. 2011, Sweden. <sup>13</sup>  Peer reviewed paper	Two arm cluster randomised controlled trial	58 Swedish aged care facilities	Small group education sessions with nurses and general practitioners at the aged care facilities, feedback on prescribing, presentation of guidelines and written materials	Proportion of inappropriate antibiotic choice decreased significantly in the intervention group compared to control group  Proportion of antibiotic prescriptions following UTI diagnosis decreased significantly in intervention group compared to control with more cases handled as 'wait and see' before prescribing

The single aged care facility based study observed a significant improvement in guideline adherence, in terms of an increase in delaying antibiotic initiation and use of quinolone antibiotics, following the multi-modal intervention in comparison to the randomly assigned control group.<sup>13</sup>

The interventions that were most successful involved some degree of direct contact with the prescribers. Multi-modal interventions (print/email, didactic presentation and reminder materials) appear to have been effective.<sup>7-9,12,13</sup> However, the follow-up in these studies was short, and evidence of these interventions generating long term or permanent behaviour change in these studies is lacking.

### **Skin/Dermatological Infections (1 Article)**

A single article was identified containing data relating to an intervention in antibiotic prescribing for skin infections. This article also contained data relating to UTIs which has been reported above in Table 4. The randomly assigned single intervention in this study reportedly demonstrated a small but statistically significant decrease of 2.7% in the proportion of broad spectrum antibiotics used to treat skin and soft tissue infections.

**Table 7: Summary of results relating to skin/dermatological infections**

<b>Source &amp; Evidence type</b>	<b>Study type/ method</b>	<b>Population/ setting</b>	<b>Intervention/outcome measure</b>	<b>Brief findings</b>
Jenkins TC, et al. 2013, United States of America. <sup>6</sup>  Peer reviewed paper	Two arm Randomised controlled trial	8 American health clinics, totalling 80 general practitioners (46 in study arm, 34 in control arm)	Single page decision support prescribing algorithm aimed at assisting prescribers to determine if antibiotics are indicated and the most appropriate choice of agent, aiming to reduce use of broad spectrum antibiotics.  Placement of patient educational materials in waiting areas	Reported a decrease in the use of broad spectrum antibiotics for skin and soft tissue infections in the study group

### **Sexually Transmitted Infections (2 Articles)**

Two articles were identified containing data relating to sexually transmitted infections. One study obtained quantitative data on the age and practice location of participants and the treatments recommended. Qualitative data derived from the study were trends observed in attitudes towards AMR and adherence with antibiotic prescribing guidelines. The systematic review describing the efficacy of interventions aimed at improving management of pelvic inflammatory disease (PID) reported the most successful interventions are multi-modal in nature and targeted towards both the prescriber and patients.<sup>14</sup>

**Table 8: Summary of results relating to sexually transmitted infections**

<b>Source &amp; Evidence type</b>	<b>Study type/ method</b>	<b>Population/ setting</b>	<b>Intervention/outcome measure</b>	<b>Brief findings</b>
Falchi A, et al. 2011, France. <sup>15</sup>  Peer reviewed paper	Quantitative and qualitative survey analysis	1000 French general practitioners	Electronic clinical vignette describing male patient with typical gonococcal urethritis and questionnaire regarding antibiotic treatment	Adherence with guidelines was low; GPs with 10 years or less experience in practice had better adherence rates with antibiotic prescribing guidelines  Barriers to guideline adherence identified in this study were lack of awareness, and lack of agreement with guidelines. Authors discuss large volume of biomedical information updates and preferential use of electronic guideline information in younger GPs compared with older practitioners as possible contributing factors
Liu B, et al. 2012, Australia. <sup>14</sup>  Peer reviewed paper	Systematic review using Medline and EMBASE databases	Articles published January 2000 to April 2012 with control group in study design	Review of two RCTs and an interrupted time-series study to investigate the success of strategies trialled to improve adherence to guidelines in the management of PID	Limited data, however multi-faceted patient and practitioner interventions, and concise, conveniently located guideline summaries appear to be strategies which improve guideline adherence

# 5 Analysis of evidence

There is a definite lack of data in the recently published literature for interventions to change behaviour and attitudes of community-based health practitioners prescribing antibiotics for urinary tract, sexually transmitted and skin infections. No studies were found reporting interventions conducted with Australian practitioners, the closest being an Australian literature review published on international data relating to PID.<sup>14</sup> This area of research can be difficult as changing behaviour is a complex outcome in a dynamic environment. The majority of data published in this area report short term changes, and where longer term sustainability has been assessed it has been found that one-off interventions are unsustainable over the long term.<sup>12</sup>

Prescribers are continually bombarded with messages about prescribing.<sup>15</sup> These originate from pharmaceutical companies, colleagues, specialists, professional organisations, mass media and evidence based organisations. The psychology of utilising these media and messages to change behaviour is exhaustive, complex and beyond the scope of this review. The large volume of biomedical data directed towards GPs has been described as a barrier to guideline adherence.<sup>15</sup>

## Strategies used to change prescribing behaviour

Pharmaceutical companies use multi-modal marketing to promote their products by capturing a broader audience, and also to reinforce their message through multiple channels.<sup>16</sup> Variable efficacy was reported resulting from numerous strategies including single and multi-modal interventions. Single interventions were “hands on” experiences such as clinical vignette case studies<sup>15</sup>, a decision support algorithm<sup>6</sup>, and self-directed practice test and audit.<sup>7</sup> Multi-modal interventions encompassed a combination of written guideline information (including email), didactic lectures, focus groups, posters and leaflets as reminders.<sup>5,9,12,13</sup>

Follow-up on interventions to evaluate sustainability was a poorly conducted aspect in the studies included in this review. Therefore only a short term view of efficacy is assumed in all included studies. One study noted immediate reversion to previous practices once the intervention was removed<sup>8</sup>, and another reported that inappropriate prescribing rates in UTIs had significantly increased 17 months after the intervention had ceased<sup>12</sup>. At the 17 month time interval appropriate prescribing rates were observed to still be higher than those at baseline, warranting further investigation into the reasons why some prescribers apparently continued to adhere to guidelines while others did not<sup>12</sup>. Since prescribers are human there are a range of factors that can dilute the intended message over time, requiring reinforcement. In the short term studied, multi-modal strategies provided a larger impact than single intervention studies. One intervention, a single sheet decision support algorithm<sup>6</sup>, appears to have had a paradoxical result. In one specific area (DIs) a significant decrease in the use of broad spectrum antibiotics was observed, however in a different area (UTIs) the opposite was observed with an increase in the use of broad spectrum antibiotics compared to baseline and the control group. The reasons for this paradoxical effect were not discussed by the authors, but may have been due to recommendations to commence empiric therapy without performing urine culture in the algorithm.

Surveys alone appear to have had an effect on prescribers. This may be because survey respondents had to think about the issues encountered during the survey, and then may have self-reflected on practice before changing their practice based on this reflection. If so, this would be detected in a follow-up survey. Such a

strategy relies on reflective practice to produce its beneficial outcome and could be considered an incidental benefit.

McNulty et al altered microbial sensitivity reports during an intervention period to determine if this would elicit a change in prescribing behaviour.<sup>8</sup> A significant increase in the proportion of intervention antibiotics prescribed was observed, demonstrating that hard sensitivity data can be used to guide antibiotic choice when sensitivity is requested.<sup>8</sup> This is ideal practice, however culture and sensitivity are not commonly performed in community practice for initial presentations for uncomplicated UTIs due to cost and delay in initiating treatment. Empiric treatment is usually effective and the infection is often resolved or close to resolution by the time the results are available to guide antibiotic choice, therefore the usefulness of this information in practice is limited.

### Effectiveness of the interventions

Overall the quality of data found in this review is quite low, with studies reviewed lacking either a control group, adequate population sizes, or statistical evaluation.<sup>3,4,7-11,15</sup> Studies reviewed were assigned a quality rating by the research team based on the GRADE approach.<sup>17</sup> The highest quality study included in this review was another systematic literature review<sup>14</sup>, however this publication was based on a small amount of data and the primary finding reported by these authors was that more research is needed.

**Table 9: Summary of study effectiveness**

Study	Brief description	Number of participants	Actual result	Reviewer quality rating
Björkman I, et al. 2013, Sweden. <sup>4</sup>  Qualitative interview analysis	Semi-structured face-to-face interviews containing open ended questions to identify association between prescriber attitudes towards AMR and adherence to UTI antibiotic prescribing guidelines	20 general practitioners	Being a qualitative study, there was no statistical analysis applied to the findings to assess significance  Researchers report correlation between compliance with prescribing guidelines and GP perception that AMR is a serious problem	VERY LOW
Duane S, et al. 2013, Ireland. <sup>5</sup>  Three arm Randomised controlled trial – study protocol report	Components targeting both GPs and patients  Interactive workshops, audit and feedback reports, automated electronic prescribing prompts for both study arms. Delayed prescribing will be recommended to one of the study arms.  Multimedia applications and information leaflets for patients	30 general practices; number of participating GPs not yet available	Not yet available, study ongoing	N/A

Study	Brief description	Number of participants	Actual result	Reviewer quality rating
<p>Falchi A, et al. 2011, France.<sup>15</sup></p> <p>Quantitative survey analysis</p>	<p>Electronic clinical vignette describing male patient with typical gonococcal urethritis and questionnaire regarding antibiotic treatment. No control group or specific intervention to alter prescribing rates</p>	<p>1000 general practitioners</p>	<p>35% response rate. 20.2% recorded adherence to guidelines. GPs with 10 years' or less experience in practice had significantly better adherence rates with antibiotic prescribing guidelines. Non-significant correlation and observation that barriers to guideline adherence were lack of awareness and agreement with guidelines; large volume of biomedical information updates and preferential use of electronic guideline information in younger GPs</p>	<p>LOW</p>
<p>Jenkins TC, et al. 2013, United States of America.<sup>6</sup></p> <p>Two arm Randomised controlled trial</p>	<p>Single page decision support prescribing algorithm aimed at assisting prescribers to determine if antibiotics are indicated and the most appropriate choice of agent, aiming to reduce use of broad spectrum antibiotics</p> <p>Placement of patient educational materials in waiting areas</p>	<p>80 general practitioners (46 in study arm, 34 control arm)</p>	<p>2.7% and 2.9% decreased use of broad spectrum antibiotics for skin and soft tissue infections in the study group compared to baseline and control respectively. 3.5% and 13.5% increased use of broad spectrum antibiotics for urinary tract infections in the study group compared to baseline and control respectively</p>	<p>MODERATE</p>



Study	Brief description	Number of participants	Actual result	Reviewer quality rating
Kuehle T, et al. 2011, Germany. <sup>7</sup>  Qualitative interview analysis	Pre-intervention focus group examining prescribing behaviour  Self-conducted prescribing practice test  Post-intervention focus group examining results of practice test and implications for future prescribing behaviour	18 general practitioners	Being a qualitative study, there was no statistical analysis applied to the findings to assess significance  Former hospital training, perceived common therapy and reluctance to change successful regimen identified as drivers of prescribing behaviour. Practice test of trimethoprim over other agents showed 94% success rate and favourably changed prescriber opinions. Self-reflection and ownership of data were main drivers in altering prescribing habits	VERY LOW
Liu B, et al. 2012, Australia. <sup>14</sup>  Systematic literature review	Systematic review using Medline and EMBase databases for articles published January 2000 to April 2012, with study design inclusive of a control group to investigate the success of strategies trialled to improve adherence to guidelines in the management of PID	Two RCTs and an interrupted time-series study	Limited data obtained; however multi-faceted patient and practitioner interventions, and concise, conveniently located guideline summaries appear to improve guideline adherence. But further research is required	MODERATE
Lugtenberg M, et al. 2010, Netherlands. <sup>3</sup>  Qualitative interview analysis	Focus group analysis to identify barriers to guideline adherence in uncomplicated UTIs and potential interventions to improve adherence	13 general practitioners	Being a qualitative study, there was no statistical analysis applied to the findings to assess significance.  Participants reported lack of acceptability and organisational constraints (pharmacy drug availability) as barriers to guideline adherence. Suggested interventions were small group education sessions, improved organisation and coordination of out-of-hours care, and improved availability of preferred drugs	LOW

Study	Brief description	Number of participants	Actual result	Reviewer quality rating
McNulty, CA, et al. 2011, Great Britain. <sup>8</sup>  Prospective interrupted time series observation and qualitative survey analysis	Altered antibiotic susceptibility pathology reporting to observe effect on choice of antibiotic prescribed for urinary tract infections  Survey of antibiotic prescribing practices following receipt of a urine pathology report	222 HCPs, 217 of which were GPs	Observed a significant increase in the rate of prescribing of the intervention antibiotic on sensitivity reports of 10.1% in surveys and 2.6% on prescription review, concluding pathology susceptibility reporting of specific agents had a direct effect on the choice of antibiotic	LOW
Pettersson E, et al. 2011, Sweden. <sup>13</sup>  Two arm cluster randomised controlled trial	Small group education sessions with nurses and general practitioners at the aged care facilities, feedback on prescribing, presentation of guidelines and written materials	164 HCPs, 13 of which were GPs	Proportion of inappropriate antibiotic choice decreased significantly in the intervention group compared to control group  Proportion of antibiotic prescriptions following UTI diagnosis decreased significantly in intervention group compared to control with more cases handled as 'wait and see' before prescribing	MODERATE
Slekovec, C., et al. 2012, France. (9)  Observational interrupted time series quantitative analysis	Guidelines for UTI prescribing mailed to all GPs in region and made available online. Over the subsequent month voluntary training sessions held inclusive of didactic lecture, clinical examples and information on AMR using general and local data	Approximately 200 voluntary GP participants in intervention training sessions. Observations based on unknown number of GPs from approximately 2200 in region	Observed significant increases in nitrofurantoin and fosfomycintrometamol prescription rates and significant decrease in norfloxacin as outcome measures for changes in prescribing habits and better adherence with guidelines	LOW

<b>Study</b>	<b>Brief description</b>	<b>Number of participants</b>	<b>Actual result</b>	<b>Reviewer quality rating</b>
Stuck, A., et al. 2012, Switzerland. (10)  Quantitative observational analysis	Physicians ranked as high prescribers based on prescription data (>16% of antibiotic prescriptions written for influenza type illness) as surrogate for liberal prescribing attitude, then compared with rate of guideline adherence for UTI prescribing. Physicians were surveyed on their perception of patient's attitude as favouring antibiotic prescription or neutral to formulate targeted interventions	11,799 patient prescriptions written by voluntary members of the Swiss Sentinel Surveillance Network (109 GPs)	37% of physicians ranked as high prescribers.  Liberal attitudes towards antibiotic prescribing were associated with inappropriate antibiotic choice for UTI but not statistically significant. Physicians with high prescribing rates were significantly associated with the perception that their patients favoured the prescribing of antibiotics as treatment for UTI	VERY LOW
<b>Study</b>	<b>Brief description</b>	<b>Number of participants</b>	<b>Actual result</b>	<b>Reviewer quality rating</b>
Velasco, E., et al. 2012, Germany. (11)  Qualitative interview analysis	Survey to determine factors affecting the prescribing of specific antibiotics.	468 general practitioners	Being a qualitative study, there was no statistical analysis applied to the findings to assess significance  Authors observed prescribers favouring an inappropriate agent as first line trended towards favouring prescribing based on patients' personal needs, such as perceived as unlikely to return for follow up consultation	VERY LOW

Study	Brief description	Number of participants	Actual result	Reviewer quality rating
Willems, L., et al. 2012, Belgium. (12)  Two arm non-randomised controlled study	Emails highlighting the current prescribing guidelines sent to GPs at beginning of project, a presentation given to GPs while on duty to educate on AMR and treatment guidelines. The resting area for GPs at the clinic had two posters and three handouts reiterating the guidelines	2 purposefully selected health clinics (one intervention and one control) inclusive of 134 and 98 GPs respectively	Intervention group demonstrated a 42.5% (from 26.9 to 69.4%) increase in the rate of appropriate antibiotic prescriptions compared with control group at time on intervention, decreasing to 40.8% 17 month post-intervention intervals respectively  Statistical significance of results not assessed by authors	MODERATE

### Limitations

A major limitation of this review is the small number of articles found in the published literature on the specific topics. Excluding hospital interventions may have played a part in this as interventions in hospital may also be applicable in the community setting. Excluding articles that evaluated and discussed antibiotic prescribing interventions in other topics or in a general sense may have limited the quality of this review as the interventions evaluated in these studies may be applicable to the specific topics covered in this review. Other factors could include publication of relevant articles in non-indexed journals, little active research conducted or published during the specified time period, and difficulty accessing the grey literature due to time constraints.

## 6 Authors' conclusions and recommendations

The findings of this review indicate that there is a definite lack of published quality literature since 2008 available reporting on effective interventions to improve antibiotic prescribing guideline adherence in UTI, STI and DI. The publications reviewed indicate that multi-modal, face-to-face educational interventions are a promising area for further research into sustainable and effective strategies to improve guideline adherence in the three key areas discussed.

# 7 References

1. Hardy-Holbrook R, Aristidi S, Chandnani V, Dewindt D, Dinh K. Antibiotic resistance and prescribing in Australia: current attitudes and practice of GPs. *Healthcare Infection* 2013;18(4):147-51.
2. Lugtenberg M, Burgers JS, Zegers-Van Schaick JM, Westert GP. Guidelines on uncomplicated urinary tract infections are difficult to follow: perceived barriers and suggested interventions. *BMC Family Practice* 2010;11.
3. Wutzke SE, Artist MA, Kehoe LA, Fletcher M, Mackson JM, et al. Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia. *Health Promotion International* 2006;22(1):53-64.
4. Björkman I, Berg J, Viberg N, Stålsby Lundborg C. Awareness of antibiotic resistance and antibiotic prescribing in UTI treatment: A qualitative study among primary care physicians in Sweden. *Scandinavian Journal of Primary Health Care* 2013;31(1):50-55.
5. Duane S, Callan A, Galvin S, Murphy AW, Domegan C, et al. Supporting the improvement and management of prescribing for urinary tract infections (SIMPLE): protocol for a cluster randomized trial. *Trials* 2013;441.
6. Jenkins TC, Irwin A, Coombs L, Dealleaume L, Ross SE, et al. Effects of clinical pathways for common outpatient infections on antibiotic prescribing. *American Journal of Medicine* 2013;126(4):327-35.e12.
7. Kuehlein T, Goetz K, Laux G, Gutscher A, Szecsenyi J, et al. Antibiotics in urinary-tract infections. Sustained change in prescribing habits by practice test and self-reflection: a mixed methods before-after study. *BMJ Quality and Safety* 2011;20(6):522-26.
8. McNulty CA, Lasseter GM, Charlett A, Lovering A, Howell-Jones R, et al. Does laboratory antibiotic susceptibility reporting influence primary care prescribing in urinary tract infection and other infections? *Journal of Antimicrobial Chemotherapy* 2011;66(6):1396-404.
9. Slekovec C, Leroy J, Vernaz-Hegi N, Faller JP, Sekri D, et al. Impact of a region wide antimicrobial stewardship guideline on urinary tract infection prescription patterns. *International Journal of Clinical Pharmacy* 2012;34(2):325-29.
10. Stuck AK, Täuber MG, Schabel M, Lehmann T, Suter H, et al. Determinants of quinolone versus trimethoprim-sulfamethoxazole use for outpatient urinary tract infection. *Antimicrobial Agents and Chemotherapy* 2012;56(3):1359-63.
11. Velasco E, Noll I, Espelage W, Ziegelmann A, Krause G, et al. A survey of outpatient antibiotic prescribing for cystitis. *Deutsches Ärzteblatt International* 2012;109(50):878-84.
12. Willems L, Denckens P, Philips H, Henriquez R, Remmen R. Can we improve adherence to guidelines for the treatment of lower urinary tract infection? A simple, multifaceted intervention in out-of-hours services. *Journal of Antimicrobial Chemotherapy* 2012;67(12):2997-3000.
13. Pettersson E, Vernby Å, Mölsted S, Lundborg CS. Can a multifaceted educational intervention targeting both nurses and physicians change the prescribing of antibiotics to nursing home residents? A cluster randomized controlled trial. *Journal of Antimicrobial Chemotherapy* 2011;66(11):2659-66.

14. Liu B, Donovan B, Hocking JS, Knox J, Silver B, et al. Improving adherence to guidelines for the diagnosis and management of pelvic inflammatory disease: a systematic review. *Infectious Diseases in Obstetrics and Gynecology* 2012;2012.
15. Falchi A, Lasserre A, Gallay A, Blanchon T, Sednaoui P, et al. A survey of primary care physician practices in antibiotic prescribing for the treatment of uncomplicated male gonococcal urethritis. *BMC Family Practice* 2011;12:35.
16. Kyle GJ, Nissen LM, Tett SE. Pharmaceutical company influences on medication prescribing and their potential impact on quality use of medicines. *Journal of Clinical Pharmacy and Therapeutics* 2008;33(5):553-9.
17. Schünemann HJ, Oxman AD, Vist GE, Higgins JP, Deeks JJ, et al. Cochrane handbook for systematic reviews of interventions: Chapter 12: Interpreting results and drawing conclusions. The Cochrane Collaboration 2008.
18. Therapeutic Guidelines Limited. eTG complete [Internet] 2013 Mar [cited 2014 Mar 3]. Available from: <http://online.tg.org.au/ip/desktop/index.htm>

# 8 Appendix 1

## List of databases searched for primary health care grey literature

- Roadmap of Australian primary health care research
- Australian Drug Information Network
- Australian Indigenous HealthInfoNet
- CareSearch
- CDC WONDER
- Evidence Direct
- HealthInSite
- Health Services Research Projects in Progress
- JBI COnNECT+
- MD Consult
- NHS Evidence
- New York Academy of Medicine Grey Literature Report
- PsycEXTRA
- Social Care Online