Designing a Medication Screening Tool for the Geriatric Day Hospital at the Queen Elizabeth II Health Sciences Centre, Capital Health

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Performed at

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In partial fulfillment of the requirements of the Master of Health Informatics Program, Dalhousie University

Report of Internship for the period May 1st – August 27th, 2009

Date Submitted: August 28th, 2009

Revised Submitted: September 7th, 2009

Acknowledgement and Endorsement

This report has been written by me and has not received any previous academic credit at this or any other institution. This internship report has been written for fulfill the requirements for the internship performed for the Master of Health Informatics at Dalhousie. The medication screening tool has been designed and implemented at the Geriatric Day Hospital (GDH) under sponsorship of the Drug Use Management and Policy Research Residency chair.

I would like to thank the chair holder; Dr. Ingrid Sketris, a professor at the Dalhousie College of Pharmacy, and the Canadian Health Services Research Foundation (CHSRF) also, the Canadian Institutes for Health Research (CIHR) and the Nova Scotia Health Research Foundation (NSHRF) for providing me the sponsorship to fund this internship project.

Also, I would like to thank Dr.Susan Bowles and Dr.Paige Moorhouse for giving me the chance to improve my health informatics skills and for providing me with such a great opportunity. I would like also to thank the GDH for their enthusiasm throughout the project implementation especially Ms.Tracey Fisher. Also, I would like to extend my grateful thanks for my supervisor Dr.Grace Paterson and for all health informatics professors' for encouraging, and guiding me to improve the health care quality.

Abdulgader Almoeen

Executive Summary

The internship was completed at "The Geriatric Day Hospital (GDH) which is part of the centre for health care of the elderly at the QEII Health Sciences Centre, Halifax, Nova Scotia. The Day Hospital provides different types of services to help the elderly reach a higher level of function or maintain their present level so they can stay in their home"(Capital Health, 2009)(1). The internship was started May 1st, 2009 and finished August 27th, 2009. The main objective was to design a medication management module as a flag system and use it to address specific medication problems among elderly patients using criteria selected by GDH to address two common problem types:

1. Anticholinergic burden risk that is "The combined effect of multiple medications that block the effects of acetylcholine in the body. Acetylcholine is one of the key chemicals in nerve cells that carry information from one nerve cell to another. Nerve cells that communicate with acetylcholine, called cholinergic neurons, are important in the heart, sweat and saliva glands, eyes, bladder, stomach, intestines and the brain. Medications that block acetylcholine, called anticholinergic medications, may be strong or weak blockers. Anticholinergic burden comes from the combined effect of all of a patient's medications together to block acetylcholine". (ASCP, 2009)
2. Use of potentially inappropriate drugs (The Beers Criteria). (Beers et al. 1991, Beers 1997, and Fick, et al. 2003)

There is no designated pharmacist for the GDH therefore as a part of the medication management module, we had a second objective. This objective use to design a communication component (information flow) between the geriatric team and the pharmacist by improving the current workflow and the processes.

Last year, the GDH launched a new management system to capture the patient's clinical information. This information includes mental and physical status, symptoms, conditions, drugs, etc. There is a case manager that is not a clinician. Most of the time this case manger is responsible to enter this information into the system. The medication entries are not dynamic. Sometimes, medications are being entered manually (both generic/brand names) which might cause duplications and other drug-related problems and errors that may endanger the lives of elderly, leave them with poorly controlled symptoms, or at risk for falls, or any other drug-related side effects. Provision of pharmaceutical care by a pharmacist and use of a computer screening tool can help prevent falls, Anticholinergic burden, use of inappropriate drugs and other medication-related problems for the geriatrics population.

During the internship project phase, we had a major issue in trying to apply the rules to a non-standardized drug database. Also, we had another issue related to the drug classification coding system. Discussing this issue with the project members, we decided to look for a standardized drug database. However, the problem was solved by using the Health Canada Drug Product Database (DPD) and utilizing the Anatomical Therapeutically Chemical (ATC) drug classification coding system that is controlled by the World Health Organization (WHO) Collaborating Centre for Drug Statistics Methodology. This classification is chosen to be the proper drug coding system for our medication screening tool. "In the Anatomical Therapeutically Chemical (ATC) classification system, the drugs are divided into different groups according to the organ or system on which they act and their chemical, pharmacological and therapeutically properties. The drugs are classified in groups at five different levels." (WHO, 2009).

This internship was a most valuable learning experience that allowed the author to apply the knowledge obtained through the first year of the Health Informatics Master program. Also, it inspired the author to think in different ways and provided ideas for developing effective solutions for issues related to the medication management information. The medication screening tool gave the author the opportunity to apply project management skills and enable adoption of insights and experiences. Also, it provided the author with new thoughts and ideas for the future of medication management by using the lessons learned from this module.

This report outlines how the medication management module was designed in different phases and the obstacles that were encountered and dealt with. The report provides an overview of the drug use management and policy research residency and the GDH. It then outlines the relationship between the internship and Health Informatics. Also, in this report the author will provide conclusions and recommendations to improve the data quality and the knowledge sharing in GDH.

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1 Introduction

Drug use management and policy research residency is a placement position that is available for a suitably qualified graduate resident who is interested in conducting research and obtaining experience in a health care organization. Under this residency program, the author conducted his internship to involve a policy synthesis on using information technology to improve medication safety and to optimize drug prescribing. This program is sponsored by a chair that is held by Dr. Ingrid Sketris, a professor at the Dalhousie College of Pharmacy, and was awarded in July, 2000 by the Canadian Health Services Research Foundation (CHSRF). It is co-sponsored by the Canadian Institutes for Health Research (CIHR) and the Nova Scotia Health Research Foundation (NSHRF). (2)

The Geriatric Day Hospital (GDH) is "Part of the centre for health care of the elderly at the Queen Elizabeth II Health Sciences Centre, Capital Health. Halifax, Nova Scotia. The Day Hospital provides different types of services to help the elderly reach a higher level of function or maintain their present level so they can stay in their home and provide a comprehensive care for seniors on an outpatient setting" (Capital Health, 2009)(1).The GDH team is consist of geriatricians, a ward clerk, occupational therapists, physiotherapists, a social worker, registered nurses, psychiatrists and neurologists.

"As of April 1, 2009, Canada's population was an estimated 33,592,700. The Canadian population is aging. In 2001, the median age in Canada was 37.2 years. Seniors make up the fastest-growing age group. This trend is expected to continue for the next several decades due mainly to a decreased fertility rate, an increase in life expectancy, and the effects of the baby boom. In 2003, an estimated 4.6 million Canadians were 65 years of age or older, a number that is expected to double in the next 25 years. By 2041, about one in four Canadians is expected to be 65 or over."(Statistics Canada, 2009) (3)

Anticholinergics medications are known contributors for many side effects in the elderly, including dry eyes, dry mouth, urinary retention, delirium, tachycardia, constipation and others. A rating scale to measure Anticholinergic burden could be helpful to those providing care to elderly patients to guide interventions to reduce the risk of Anticholinergic-induced side effects and to improve the prescribing quality.(12,16,19) Anticholinergic burden risk is "The combined effect of multiple medications that block the effects of acetylcholine in the body. Acetylcholine is one of the key chemicals in nerve cells that carry information from one nerve cell to another. Nerve cells that communicate with acetylcholine, called cholinergic neurons, are important in the heart, sweat and saliva glands, eyes, bladder, stomach, intestines and the brain. Medications that block acetylcholine, called Anticholinergic medications, may be strong or weak blockers. Anticholinergic burden comes from the combined effect of all of a patient's medications together to block acetylcholine" (ASCP, 2009)

Using inappropriate drug as defined by the Beers criteria is one of the risk factors for adverse drug reactions in the elderly (8,9,10). The Beers Criteria (or Beers List) is "A list of medications that are generally considered inappropriate when given to elderly people. For a wide variety of individual reasons, the medications listed tend to cause side effects in the elderly due to the physiologic changes of aging"(Beers, 1991)(8). The list was originally created by geriatrician Mark H. Beers in 1991. The criteria were created through consensus of a panel of experts by using the Delphi method and the most recently updated in 2003 (10).

Last year, the GDH launched a new management system to capture the patient's clinical information. This information includes mental and physical status, symptoms, conditions, drugs, etc. There is a case manager that is not a clinician. Most of the time, this case manager is responsible to enter this information into the system. The medication entries are not dynamic. Sometimes, medications are being entered manually (both generic/brand names) which might cause duplications and other drug-related problems and errors that may endanger the lives of elderly, leave them with poorly controlled symptoms, or at risk for falls, or any other drug-related side effects.

The main internship objective was to design a medication management module as a flag system and use it to address two common medication problems that are: the Anticholinergic drug burden risk and the Beers criteria among elderly patients. It also involved designing a communication component (information flow) between the geriatric team and the pharmacist by improving the current workflow and the processes (Figure 1).

2 Description of the Organization

The Geriatric Day Hospital (GDH) is located on the first floor of the Camp Hill Veterans' Memorial Building that is located on 5955 Veterans' Memorial Lane. Halifax, Nova Scotia.

The GDH is "Part of the centre for health care of the elderly at the QEII Health Sciences Centre, Capital Health. Halifax, Nova Scotia. The Day Hospital provides different types of services to help the elderly reach a higher level of function or maintain their present level so they can stay in their home and provide a comprehensive care for seniors on an outpatient setting" (Capital Health, 2009)(1).The GDH team is consist of geriatricians, a ward clerk, occupational therapists, physiotherapists, a social worker, registered nurses, psychiatrists and neurologists.

Patients age 65 and over that require a team assessment where mobility and falls is the main concern, or that require an assessment involving at least two GDH disciplines such as medical assessment, physiotherapy, occupational therapy, medication monitoring, psychological treatment, social work services or counseling are eligible. The patient must be referred by a health professional to be seen in the GDH, and the family physician must be aware of the referral. The patients will go for a preliminary assessment and then attend the treatment centre twice a week for half a day for 6-8 weeks (if eligible). A discharge summary will be provided at the end of their treatment for the patient and a copy will be send to the family physician.

3 Works Performed for the Internship

3.1 Description and Role

The main purpose of the internship was to design a medication management module in the GDH, integrated within the current patient information system and the work flow. At the beginning of the internship, the author has several meeting with Dr. Ingrid Sketris, Dr.Susan Bowles and Dr.Paige Moorhouse to identify the clinical functionality outcomes of this module. Three clinical outcomes (Anticholinergic burden risk, Beers criteria, and the medication which may need adjustment based on the renal function) were proposed and only two of them (The Anticholinergic burden risk and the Beers

criteria) were selected by the GDH members. A proposed work plan was submitted (Appendix 5) to include the timeline with the main deliverables. Also, it included the project tasks and the members' responsibilities.

The role of the author was to:

1. Critical analysis of the literature to identify the Anticholinergics burden risk and the Beers criteria.
2. Select the most proper drug coding system.
3. List of the Beers criteria. (Appendix 1)
4. Create a scoring flag system for the Anticholinergic burden risk. (Appendix 2)
5. Customize the Beers list and the Anticholinergic burden risk medications based on Health Canada registered products. (Appendix 3)
6. Create an algorithm to apply these rules.
7. Design a prototype module (Include the work flow). (Figure 1, Section 3.4)

3.2 Research Phase, Standardization and Customization

Research with a critical analysis was conducted to identify the most updated knowledge about the Beers criteria and the Anticholinergic burden risk (Appendix 1, Appendix 2). Summarized tables were submitted to the project members to evaluate the clinical impact of this information and to provide a feedback about the best way of applying such tools. The use of the knowledge management approach allowed a direct connection between the explicit [literature] and the tacit [The GDH geriatricians' know-how] knowledge.

Both selected Beers criteria and Anticholinergic burden risk literatures were published based on a non-Canadian medication list. So, the author had to customize the medication list based on Health Canada Drug Product Database (DPD) by selecting the registered drugs only (Brand or Generic).

In the research phase, the author found the existing GDH drug database was not structured using any standardized classification coding system. Also, it allowed the end user to add new drug to the database in a non-standardized format. So, the question was: what is the best drug classification coding system for the Beers criteria and the Anticholinergic burden drugs?. To answer this question, the author had to conduct research about standardizing the drug database and the drug classification coding system and provide a brief summary to the project members.

The best solution was using the Health Canada DPD as a well designed drug database standard. But this database has more than 20,000 products. And most of them are not in-use at the GDH. So, the author had to analyze the DPD database (Appendix 4) and customize it for the GDH needs. The author provided the GDH with the final drug database which is around 7000 products in a standard format (See table 1 for more details).

Brand Name	Generic	DIN	ATC number	ATC Therapeutic Class	AHFS number	AHFS Therapeutic Class	Schedule
This is the brand name under which the drug product is marketed	Includes all the active ingredient(s)	A Drug Identification Number (DIN) is a number assigned by Health Canada to a drug product prior to being marketed in Canada.	The Anatomical Therapeutical Chemical (ATC) classification system and The purpose of the ATC system is to be used as a tool for drug utilization research in order to improve quality of drug use	The ATC Therapeutic Class	The American Hospital Formulary Service (AHFS) permits an easy review of information on a group of drugs with similar activities and uses	The AHFS Therapeutic Class	Each drug is assigned one or more of the schedules, according to the Food and Drug Regulations, and the Controlled Drugs Substances Act. For example: Over the Counter (OTC), Schedule G (control drugs)

Table 1: Source (Health Canada Drug Product Database DPD)(21)

After standardizing the drug database, the author had to select the best drug coding system for the Beers criteria and the Anticholinergic burden risk drugs. In the drug database, there are 3 different drug classification coding systems these include DIN, ATC and AHFS. After reviewing each of them, the ATC was the best choice as a coding system for the Beers and the Anticholinergic even though it had some drawbacks. "The purpose of the ATC system is to be used as a tool for drug utilization research in order to improve quality of drug use. In the ATC classification system, the drugs are divided into different groups according to the organ or system on which they act and their chemical, pharmacological and therapeutical properties. The drugs are classified in groups at five different levels." (WHO, 2009)

A quantified scale was established to classify the Beers list and the Anticholinerigc burden risk using criteria developed by the author under supervision of the GDH team members. (See Table 2-a and 2-b for more details)

Anti-cholinergic Activity	**Beers Criteria Severity**
3 = Significant 2 = Moderate 1 = Mild 0 = None	1 = Under The Beers Criteria 0 = None

Table 2-a: The quantified scale

Beer Criteria Limitation:

1) Oral medication only with some of the topical drugs based on GDH members selection
2) Include some of the combined drugs
3) Registered drugs in Canada only (Using Health Canada Drug Product Database)
4) Drug-related only (no disease-drug related) [independent of diagnosis or the condition]
5) High/low severity would not be considered for the study purposes
6) Exclude most of the Antibiotics

Anticholinergic Burden Risk Limitation:

1) It is a combination of 3 Tools (See Appendix 2 for more details)
2) Oral medication only with some of the topical drugs based on GDH members selection
3) Include some of the combined drugs
4) Registered drugs in Canada only (Using Health Canada Drug Product Database)
5) Exclude most of the Antibiotics
6) No consideration for the dose or the frequency

Table 2-b: The tools limitation

After establishing the drug database, the Beers criteria and the Anticholinergic burden risk scoring scale, a finalized table was developed by the author using a standardized coding system (Appendix 3).

3.3 Designing the rules algorithm

Research into existing rules algorithm was organized and studied with the GDH team members to ensure that the Beers criteria and the Anticholinergic risk can be presented in a valid and a customized way.

The author suggested only 2 types of messages as pop-up alert with a coloring system to reduce alert fatigue syndrome and to make the tool more useful.

Anticholinergic Alert Algorithm

1. The Anticholinergic burden risk classified into 3 groups:

Group A	**Group B**	**Group C**
3 Points (High Risk)	**2** Points (Moderate Risk)	**1** Point (Low Risk)

2. Fourteen signs and symptoms/conditions were selected as the most common clinical Anticholinergic drug-related adverse events:

Symptoms/ Conditions

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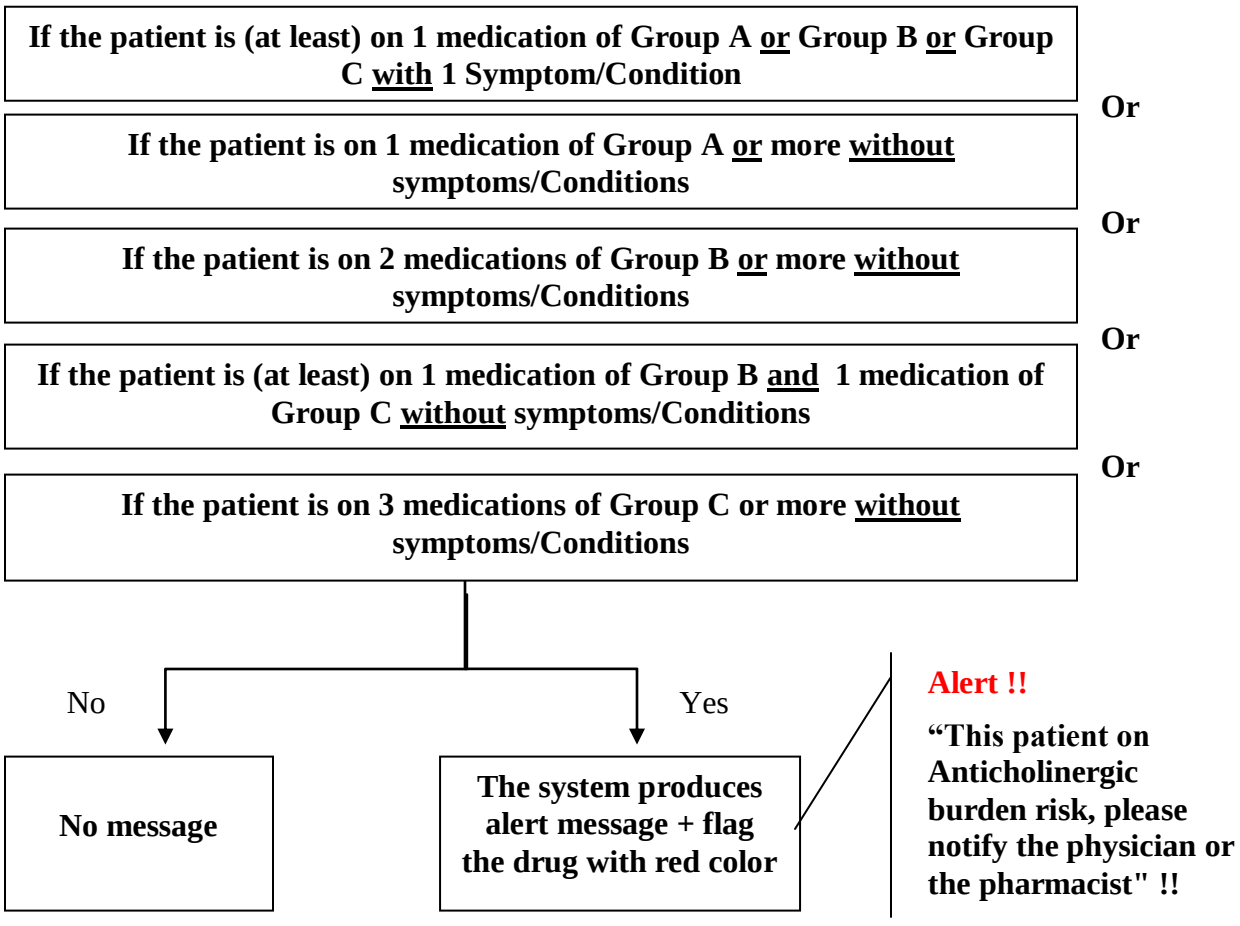
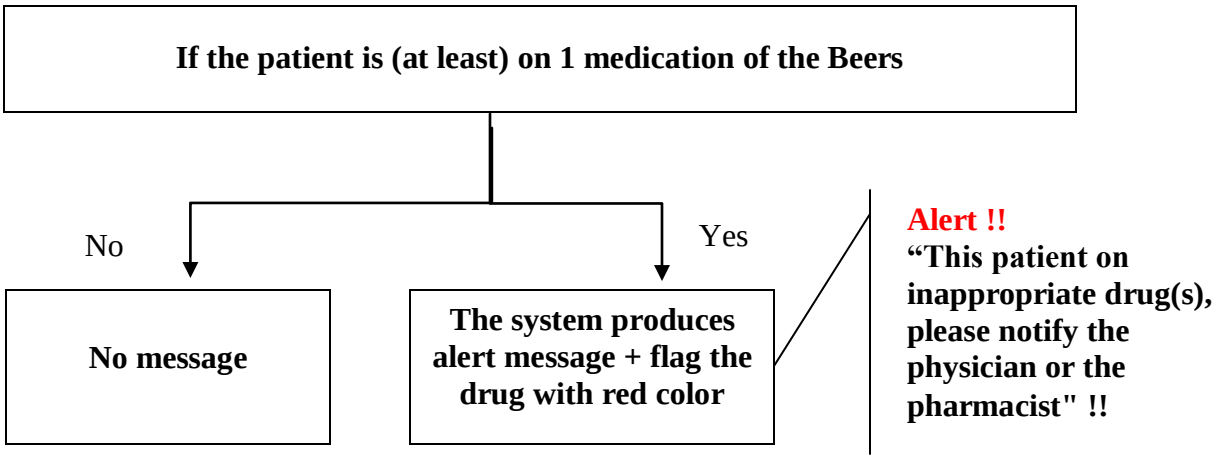
1. Dry Mouth
2. Dry Eyes
3. Delirium
4. Blurred Vision
5. Constipation
6. Dizziness
7. Drowsiness
8. Confusion
9. Urinary Retention
10. Falls
11. Increased Heart Rate
12. Decreased Sweating
13. Patient with Benign Prostatic Hypertrophy
14. Patient with Alzheimer's disease

3. Five rules were selected:



Beer's Criteria Alert Algorithm



3.4 Designing the medication management module

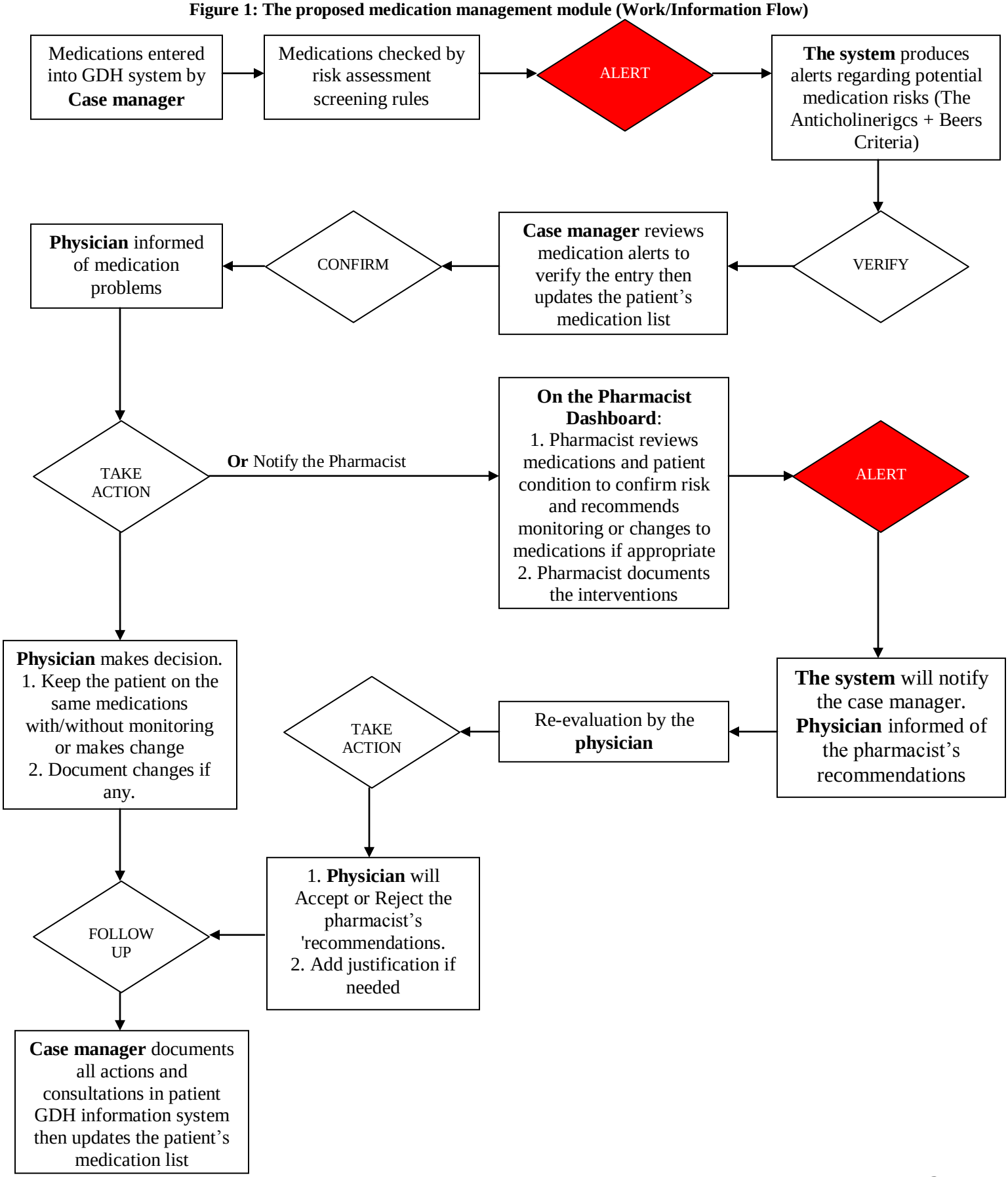
Many seniors feel that their fears about adverse events are not adequately addressed and many prescriptions have severe adverse events that are just as concerning as the illness itself. (18)

The existing GDH medication module followed a simple approach of data entry (capturing data) and most of the time the data is entered by a non-clinician case manager that may raise the medication errors.

The author proposed a proactive medication management module by using the Beers criteria and the Anticholinergic burden risk as quality indicators and combined them with an appropriately designed system, which could assist case managers in understanding risk, reporting problems, tracking patient history, and enable more informed decisions (Figure 1). Also, to increase the staff ability to accept the new module, the author module maintained around 95 % of the previous entry forms and the processes.

The idea of changing to this approach was applying the knowledge, improving the prescribing quality, reducing the medication errors and implementing a proactive approach instead of a reactive approach.

Figure 1: The proposed medication management module (Work/Information Flow)



In the GDH information system, when the patient comes into the GDH, he/she would go through different types of assessment modules. For the proposed medication module, the case manager will select all the applicable sign/symptoms out of the 14 symptoms/conditions that are chosen by the GDH team members as the most common clinical Anticholinergic drug-related side effects (Figure 2).

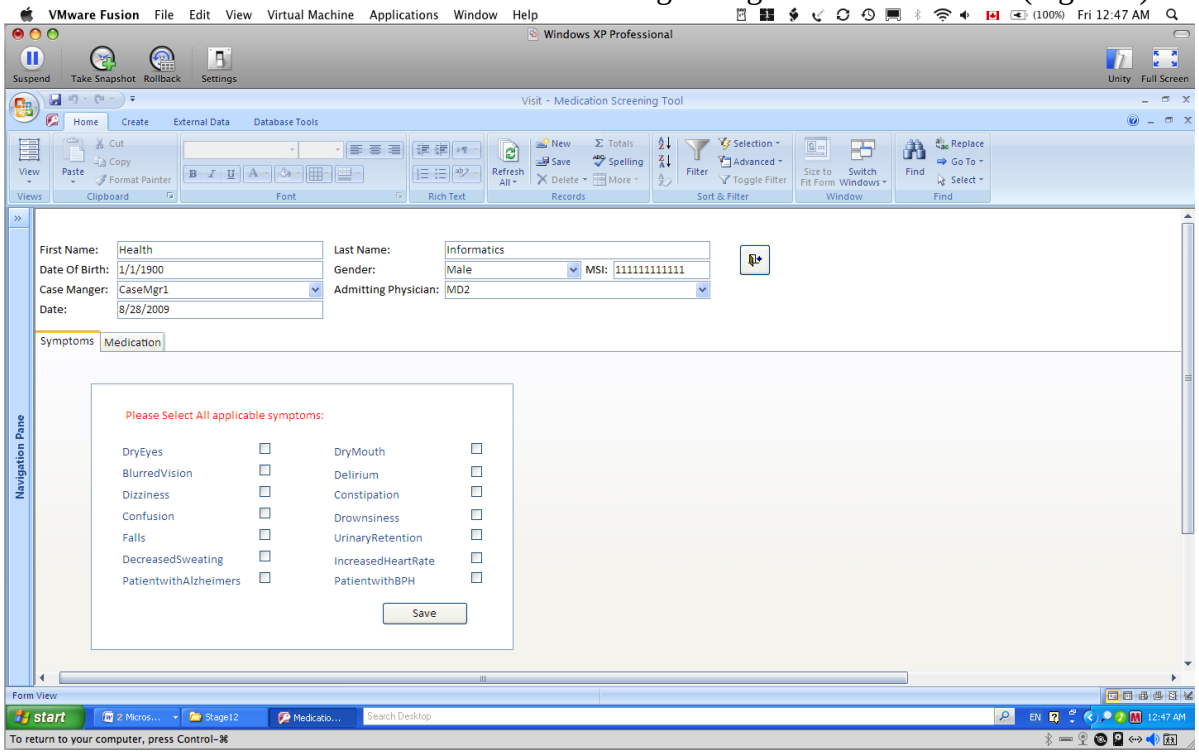


Figure 2: Select the symptoms screen (Prototype form)

Then, the case manager will type the medication name either by the brand or the generic (Figure 3).

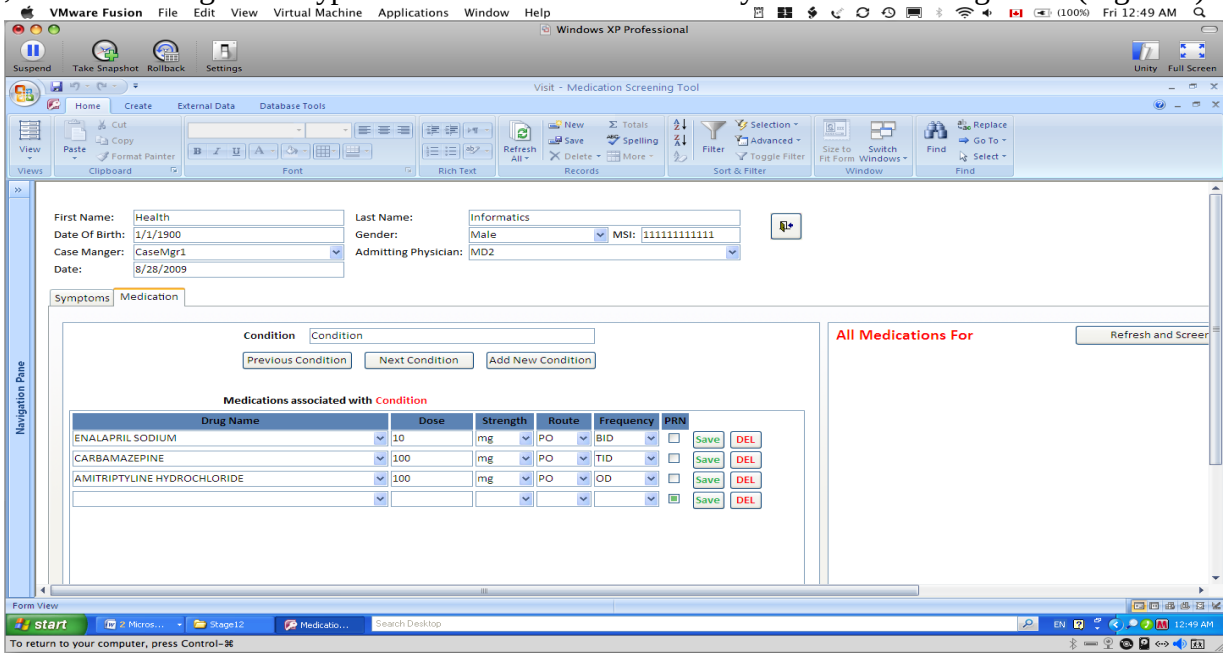


Figure 3: The medication entry screen (Prototype form)

After saving all the patient medications, the system will run the screening tool and apply the rules. If any drug in the list met the criteria, the system will produce an alert message to notify the case manager. In this scenario; the case manager will inform the physician to take action. Then,the physician either makes a decision or sends a notification to the pharmacist to review the patient's drug profile.(Figure 4,5)

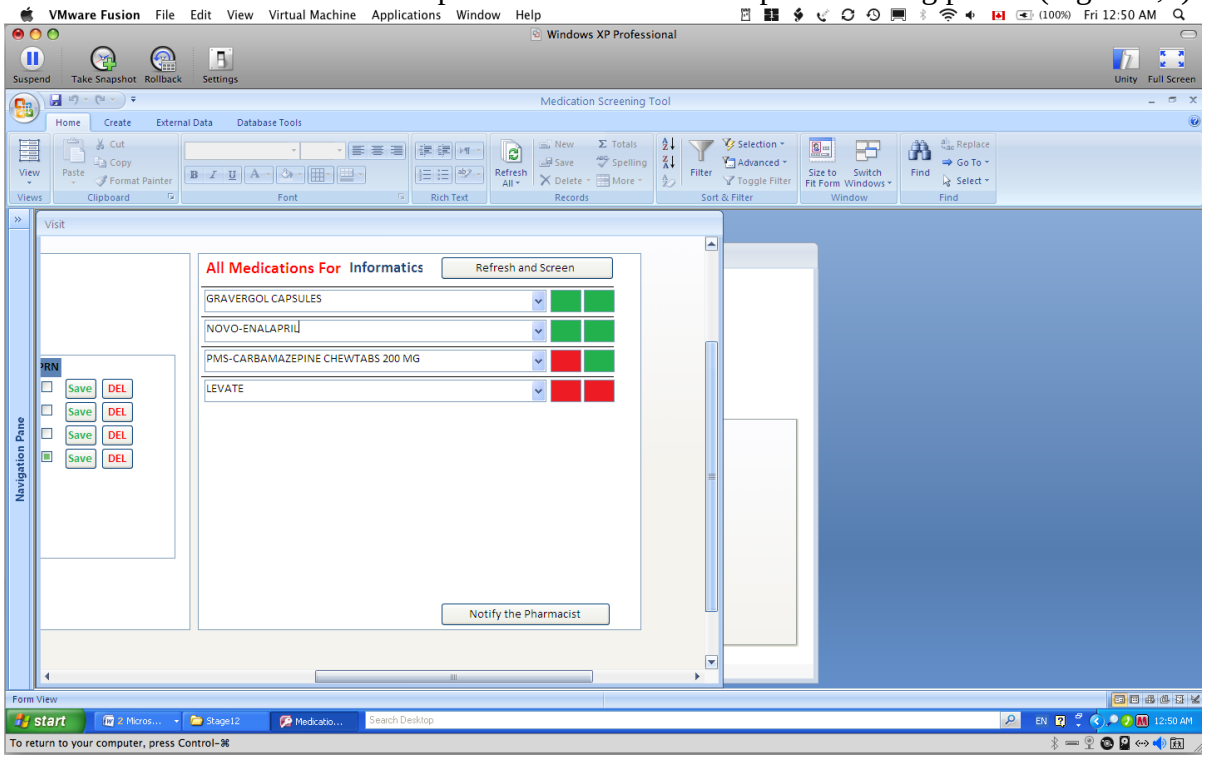


Figure 4: The integrated screening tool screen with notify the pharmacist option (Prototype form)

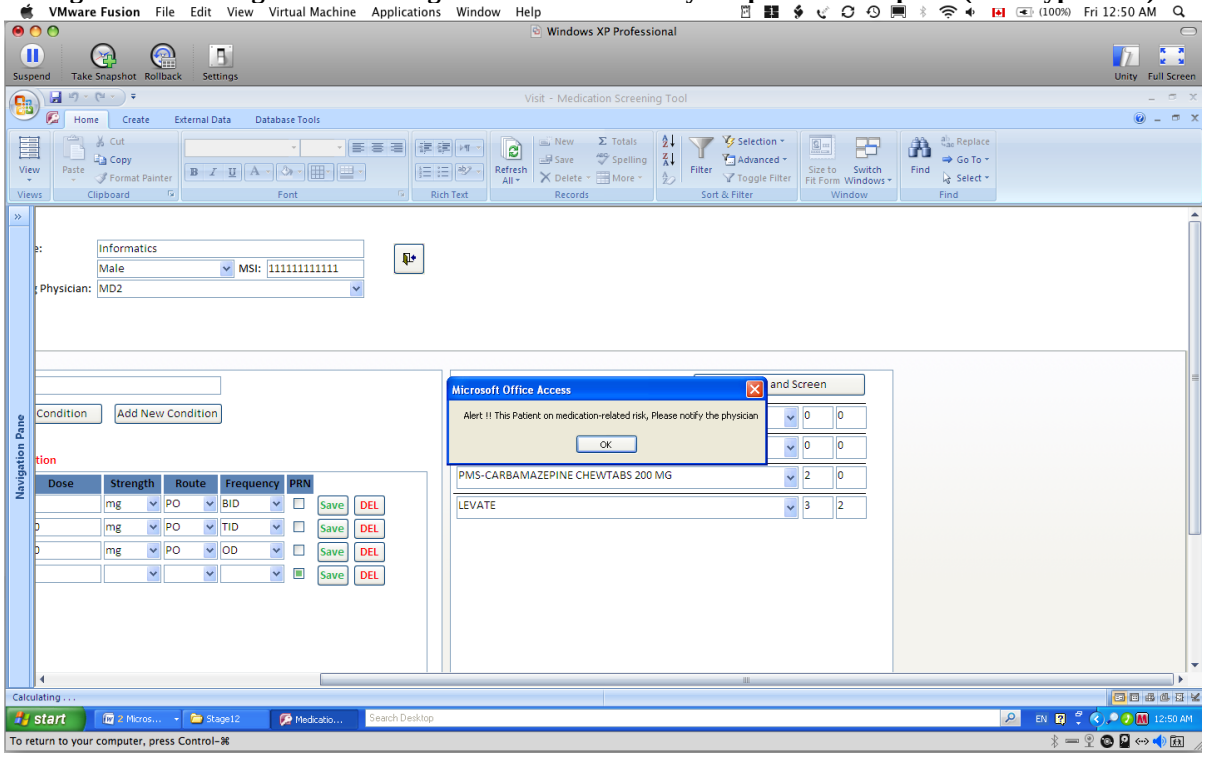


Figure 5: The alert message pop-up (Prototype form)

There is no designated full time clinical pharmacist at the GDH. So, the author proposed alerts dashboard. This dashboard was developed for the consulting pharmacist. Alerts dashboard can identify and alert the pharmacist to possible Beers criteria or Anticholinergic burden risk intervention opportunities in real-time with little effort. This system provided a more effective method for communication between the geriatric team and the pharmacist. Also, it allowed the pharmacist to document all the interventions.Alerts dashboard can help streamline the clinical workflow.(Figure 6,7,8)

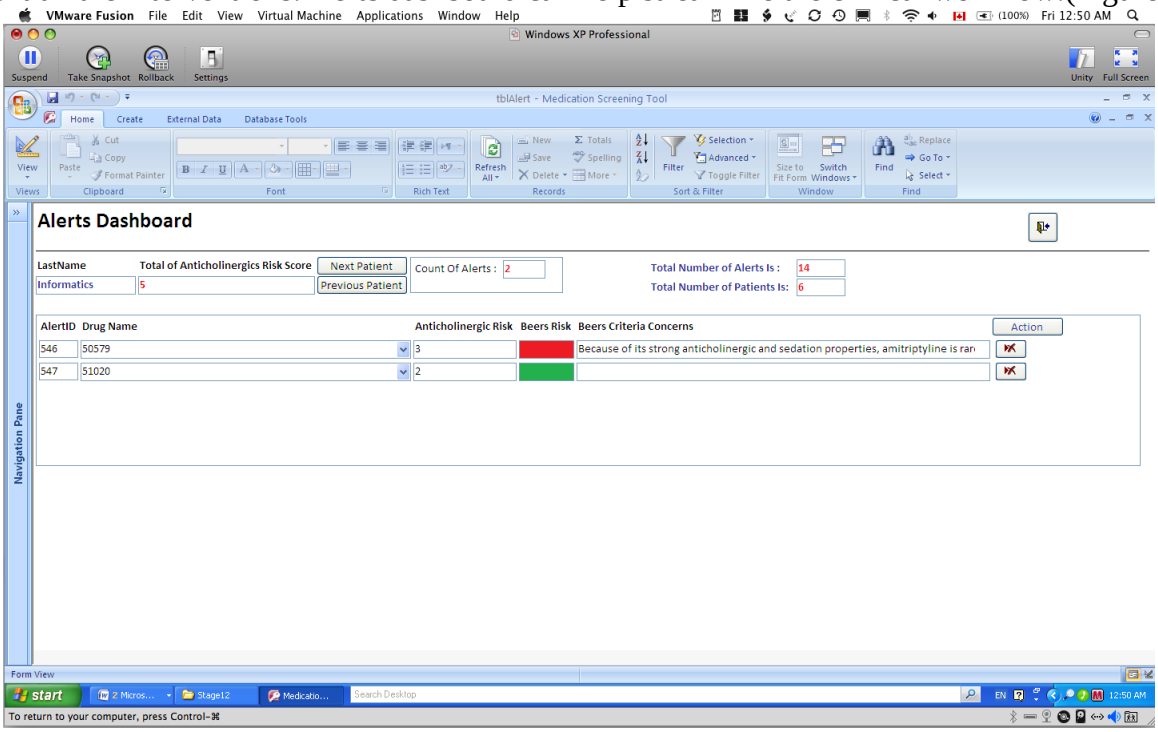


Figure 6: The alerts dashboard screen (Prototype form)

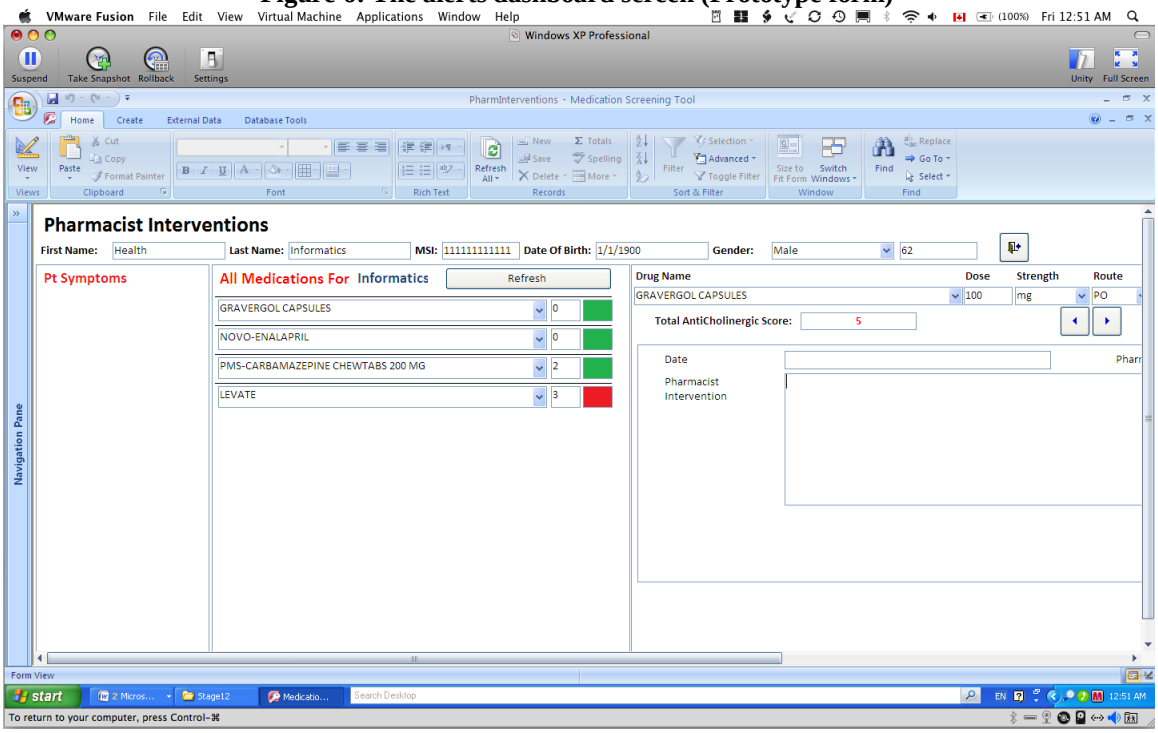


Figure 7: The pharmacist intervention screen part 1(Prototype form)

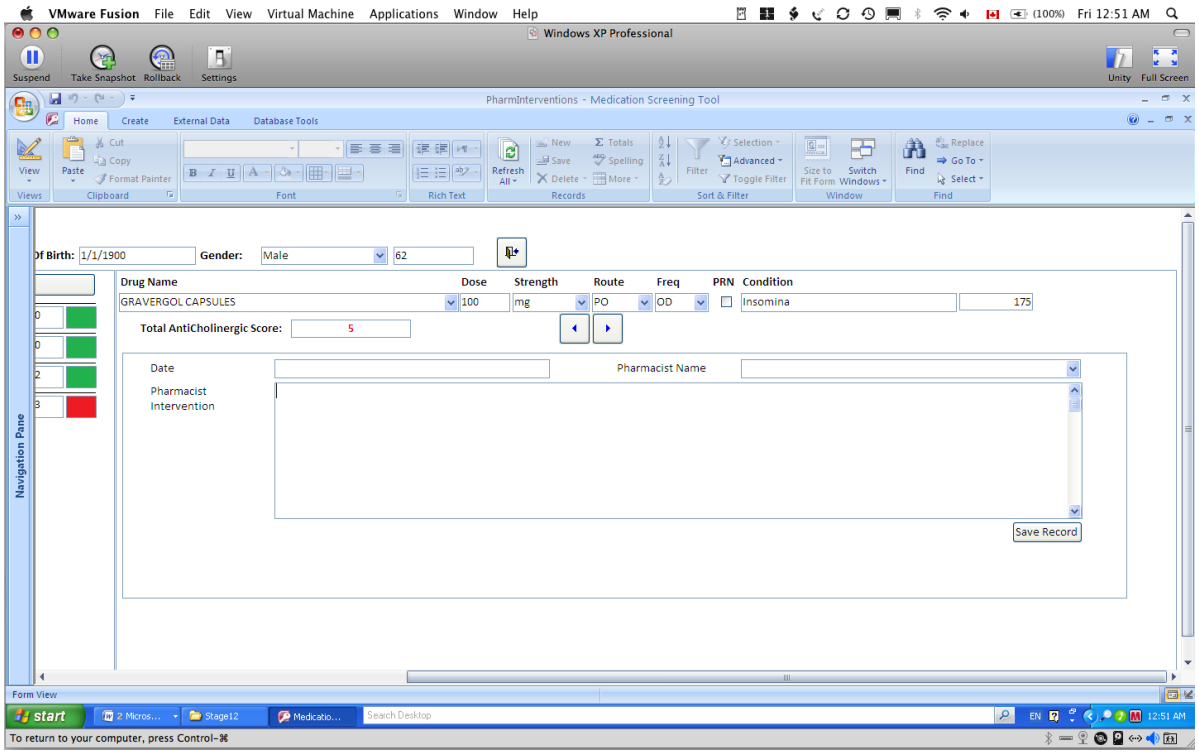


Figure 8: The pharmacist intervention screen part 2(Prototype form)

The documentation capability of the tool will allow the GDH to:

1. Analyze the clinical impact of the Beers Criteria and the Anticholineric burden risk.
2. Examine the acceptance rate of the pharmacist's recommendations in both clinical and administrative areas.
3. Track any drug changes with the justifications.

4 The Relationship with Health Informatics

Medication management and pharmaceutical care is "The responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life These outcomes are (i) cure of a disease; (ii) elimination or reduction of a patient's symptomatology; (iii) arresting or slowing of a disease process; or (iv) preventing a disease or symptomatology" (Helper, 1989)(22). The pharmacist's role is changing to be more medication management focused rather than a medication dispensing function.

The internship focused on managing medication in a sufficient way that can contribute to effective knowledge management and transfer the explicit and the tacit knowledge in a meaningful way that provides the best practice which is a discipline of Health Informatics.

There was a component of the internship that involved communication and serving as a bridge between the physicians, pharmacists, nurses (the clinical filed) and the technology side. Using the Health Informatics knowledge helped the author to use the tools learned in the health informatics education to engage both sides at the same table.

Also, there were large components of the internship that involved researching and critical analysis of the health literature and transferring the guidelines into algorithms. It was a great opportunity for the author to apply his primary background, which is health, and use it as the focus and use information technology as the enabler. This is one of the major concepts of Health Informaticians.

In fact, the medication management is a part of the new pharmacy era which is a sub-domain of the larger picture of health informatics that is the pharmacy informatics.

"Pharmacy informatics is the scientific field that focuses on medication-related data and knowledge within the continuum of healthcare systems - including its acquisition, storage, analysis, use and dissemination - in the delivery of optimal medication-related patient care and health outcomes. The pharmacy informaticist focuses on application of technology for pharmacists in supporting, streamlining, improving workflow, increasing patient safety with best practices and reliable systems." (HIMSS, 2006)

The internship responsibilities were designing a proactive medication management module which is a major part of Health Informatics mission that is keeping you healthy by using a prevention approach.

Strategic planning and management skills and leadership and designing are critical competencies for health informaticians. The internship is a project that provided the author with a good chance to practice all these skills.

In the last few months, I realize that "Health informatics training is a passport to an incredibly exciting professional journey, where information is the electricity of widely dispersed, yet integrated central nervous systems within which the public, providers, administrators and policy makers see information transform to knowledge, with profound influences on informed debate, understanding, power, and health outcomes." (Thomas Noseworthy, http://www.healthinformatics.dal.ca/ accessed August 27th, 2009)

5 Problem and Corresponding solution

The major issue encountered while designing the medication management module is lack of a standard. The drug database at GDH was designed in non-standard format. Also, the medication module was allowing the user to add new drugs to the drug database.

Further research was done on what was the best solution to handle this issue. The author kept in mind the benefits of health informatics knowledge of standards which are accepted rules or formats to enable consistent exchange of information that retains meaning.

After several meeting involving both the clinical and technical sides, the author proposed using the Health Canada Drug Product Database (DPD) as the most reliable drug products resource in Canada which is designed in a standard format.

From the clinical point of view, the core elements of a drug database are the full drug-related information available in a standard format and using a well defined classification coding system. The GDH drug databases contained only the drug name in different formats and this was a concern.

A critical analysis of the DPD was performed by the author (Appendix 4), This database has more than 20,000 products. Most of the products are not in-use at the GDH. So, the author had to customize it to suit the GDH needs. The author provided the GDH with the final drug database which is around 7000 products in a standard format using three classification coding system.

Furthermore the issue remained as which drug coding classification system should be used in the drug database and in the rules. The author conducted a comparison review involving the three DPD drug classification systems and he found the ATC coding system was the proper one. At the same time, the author proposed keeping the other coding system for future use.

6 Conclusions

Medication-related problems and errors endanger the lives of elderly, leaving them with poorly controlled symptoms, or at risk for falls, constipation, dry mouth and other drug-related side effects.

The medication management screening tool is designed to address these important safety and quality of life issues. Case managers use the Beers criteria and the Anticholinergic screening tool and a pharmacist consultant reviews the patient's medications profile for potentially harmful problems and brings these problems to the attention of their physicians in a proactive approach which can help prevent: falls, Anticholinergic burden, use of inappropriate drugs and other medication-related problems for the geriatric population. Also, it will improve the prescribing quality.

The medication screening tool will improve the efficiency and the quality of care by providing GDH with a good medication-related outcomes measurement tool. Also, it will help the geriatric research unit in developing prescribing quality indicators using the Beers criteria and the Anticholinergic burden risk.

The documentation capability of the tool will allow the GDH to analyze the clinical impact of the Beers Criteria and the Anticholineric burden risk in more efficient way and it will allow them to examine the acceptance rate of the pharmacist's recommendations in both clinical and administrative areas.

7 Recommendations

It is recommended that the GDH continue toward continuous quality improvement. A standard of prescribing quality using the medication screening tool needs to be implemented and evaluated.

The Beers criteria and the Anticholinergic burden risk are new proactive intervention approaches in GDH. Further studies of the effectiveness of such tools are warranted.

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9 Appendices

9.1 Appendix 1 (The Beers Criteria)

Table 1: Selected tools of published criteria on inappropriate medications in the elderly patients

	The Criteria and Authors	Published Year	Country	Criteria Number	Population age
1	Beers MH, Ouslander JG, Rollingher I, Reuben DB, Brooks J, Beck JC. **Explicit criteria for determining inappropriate medication use in nursing home residents. UCLA Division of Geriatric Medicine**. Arch Intern Med. 1991 Sep;151(9):1825-32.	1991	United State of America	30	≥ 65
2	Beers MH. **Explicit criteria for determining potentially inappropriate medication use by the elderly**. An update. Arch Intern Med. 1997 Jul 28;157(14):1531-6.	1997	United State of America	28	≥ 65
3	Donna M. Fick, James W. Cooper, William E. Wade, Jennifer L. Waller, J. Ross Maclean, and Mark H. Beers. **Updating the Beers Criteria for Potentially Inappropriate Medication Use in Older Adults: Results of a US Consensus Panel of Experts**. Arch Intern Med, Dec 2003; 163: 2716 - 2724.	2003	United State of America	68	≥ 65

Table2: Beers 1991 [Beers MH, Ouslander JG, Rollingher I, Reuben DB, Brooks J, Beck JC. **Explicit criteria for determining inappropriate medication use in nursing home residents. UCLA Division of Geriatric Medicine**. Arch Intern Med. 1991 Sep;151(9):1825-32.] :

Drug	Beers Criteria Concerns
Chlordiazepoxide	Long acting benzodiazepines, All use should be avoided; use short-acting benzodiazepines if needed
Diazepam	Long Acting benzodiazepines, All use should be avoided; use short-acting benzodiazepines if needed
Flurazepam	Long Acting benzodiazepines, All use should be avoided; use short-acting benzodiazepines if needed
Meprobamate	All use should be avoided, except in those already addicted
Oxazepam	Any single dose > 30 mg should be avoided (Short acting benzodiazepines, Nightly use for > 4 weeks should be avoided)
Triazolam	Short acting benzodiazepines, Nightly use for > 4 weeks should be avoided
Alprazolam	Short acting benzodiazepines, Nightly use for > 4 weeks should be avoided
Pentobarbital	Short duration barbiturates, All use should be avoided, except in those already addicted; safer sedative hypnotics are available
Secobarbital	Short duration barbiturates, All use should be avoided, except in those already addicted; safer sedative hypnotics are available
Triazolam	Any single dose > 0.25 mg should be avoided
Amitriptyline	All use should be avoided; use less anticholinergic antidepressant if needed
Amitriptyline/Perphenazine (Triavil)	All use should be avoided; if needed, prescribe individual components at proper geriatric doses; avoid amitriptyline

Haloperidol	Doses > 3mg/d should be avoided; patients with known psychotic disorders may require higher doses
Thioridazine	Doses >30 mg/d should be avoided; patients with known psychotic disorders may require higher doses
Hydrochlorothiazide	Doses >50 mg/d should be avoided
Methyldopa	All use should be avoided; safer antihypertensives are available
Propranolol	All use should be avoided, except if used to control violent behaviors other β-blockers offer less CNS penetration or more β selectivity
Reserpine	All use should be avoided; safer antihypertensives are available
Indomethacin	All use should be avoided; other NSAIDs cause less CNS toxic reaction
Phenylbutazone	All use should be avoided; other NSAIDs are less toxic
Chlorpropamide	All use should be avoided; other oral hypoglycemic have shorter half-lives and do not cause SIADH
Propoxyphene	All use should be avoided; other analgesics are safer and more effective
Pentazocine	All use should be avoided; other narcotics are more effective and safer
Cyclandelate	All use should be avoided; effectiveness is in doubt
Isoxsuprine	All use should be avoided; effectiveness is in doubt
Dipyridamole	All use should be avoided; effectiveness at low doses is in doubt; toxic reaction is high at higher doses; aspirin is safer alternative
Cimetidine	Doses >900 mg/d and therapy beyond 12 wk should be avoided
Ranitidine	Doses >300 mg/d and therapy beyond 12 wk should be avoided
Oral antibiotics	Therapy > 4wk should be avoided except when treating osteomyelities, prostatitis, tuberculosis, or endocarditis
Oxymetazoline	Daily use for >2 wk should be avoided
Phenylephrine	Daily use for >2 wk should be avoided
Pseudoephedrine	Daily use for >2 wk should be avoided
Iron	Doses > 325 mg/d should ne avoided; they do not substantially increase iron absorption and increase side effects
Cyclobenzaprine	All use should be avoided; potential for toxic reaction is greater than potential benefit
Orphenidrate	All use should be avoided; potential for toxic reaction is greater than potential benefit
Methocarbamol	All use should be avoided; potential for toxic reaction is greater than potential benefit
Carisoprodol	All use should be avoided; potential for toxic reaction is greater than potential benefit
GI antispasmodics	All long-term use should be avoided; potential for toxic reaction is greater than potential benefit
Trimethobenzamide	All use should be avoided

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

Table 3: Beers 1997 (update) [Beers MH. **Explicit criteria for determining potentially inappropriate medication use by the elderly**. An update. Arch Intern Med. 1997 Jul 28;157(14):1531-6.]:

Drug	Beers Criteria Concerns
Propoxyphene and combination products	Propoxyphene should generally be avoided in the elderly. It offers few analgesic advantages over acetaminophen, yet has the side effects of other narcotic drugs
Indomethacin (Indocin, Indocin SR)	Of all available nonsteriodal, ant0inflammatory drugs, indomethacin produces the most central nervous system side eeftcs and should, therefore, be avoided in the elderly
Phenylbutazone (Butazolidin)	Phenylbutazone may produce serious hematological side effect and should not be used in elderly patients
Pentazocine (Talwin)	Pentazocine is a narcotic analgesic that causes more central nervous system side effects. Including confusion and hallucinations, more commonly than other narcotic drugs, Additionally, it is a mixed agonist and antagonist, For both reasons, its use should generally be avoided in the elderly.
Trimethobenzamide (Tigan)	Trimethobenzamide is one of the least effective antiemetic drugs, yet it can cause extrapyramidal side effects, When possible, it should be avoided in the elderly.
Methocarbamol (Robaxin)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by the elderly is questionable. Whenever possible, they should not be used by the elderly.
Carisoprodol (Soma)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by the elderly is questionable. Whenever possible, they should not be used by the elderly.
Oxybutynin (Ditropan)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by the elderly is questionable. Whenever possible, they should not be used by the elderly.
Chlorzoxaxone (Paraflex)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by the elderly is questionable. Whenever possible, they should not be used by the elderly.
Metaxalone (Skelaxin)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by the elderly is questionable. Whenever possible, they should not be used by the elderly.
Flurazepam (Dalmane)	Benzodiazepine hypnotic has an extremely long half-life in the elderly (often days), producing prolonged sedation and increasing the incidence of falls and fractures, Medium – or short-acting benzodiazepines are preferable.
Amitriptyline (Elavil)	Because of its strong anticholinergic and sedating properties, amitriptyline is rarely the antidepressant of choice for the elderly.
Chlordiazepoxide-Amitriptyline (Limbitrol)	Because of its strong anticholinergic and sedating properties, amitriptyline is rarely the antidepressant of choice for the elderly.
Perphenazine – Amitriptyline (Triavil)	Because of its strong anticholinergic and sedating properties, amitriptyline is rarely the antidepressant of choice for the elderly.
Doxepin (Sinequan)	Because of its strong anticholinergic and sedating properties, doxepin is rarely the

	antidepressant of choice for the elderly.
Meprobamate(Miltown, Equanil)	Meprobamate is a highly addictive and sedating anxiolytic. Avoid in elderly patients. Those using meprobamate for prolonged periods may be addicted and may need to be withdrawn slowly.
Lorazepam 3 mg (Ativan)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Oxazepam 60 mg (Serax)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Alprazolam 2 mg (Xanax)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Temazepam 15 mg (Restoril)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Zolpidem 5 mg (Ambien)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Triazolam 0.25 mg (Halcion)	Because of increased sensitivity to benzodiazepines in the elderly, smaller doses may be effective as well as safer, Total daily doses should rarely exceed the following suggested maximums.
Chlordiazepoxide (Librium)	Chlordiazepoxide and diazepam have a long half-life in the elderly (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required
Chlordiazepoxide-amitriptyline (Limbitrol)	Chlordiazepoxide and diazepam have a long half-life in the elderly (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required
Clidinium-chlordiazepoxide (Librax)	Chlordiazepoxide and diazepam have a long half-life in the elderly (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required
Diazepam (Valium)	Chlordiazepoxide and diazepam have a long half-life in the elderly (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required
Disopyramide (Norpace, Norpace CR)	Disopyramide, of all antiarrhythmic drugs, is the most potent negative inotrope and therefore may induce heart failure in the elderly. It is also strongly anticholinergic. When appropriate, other antiarrhythmic drugs should be used.
Digoxin (Lanoxin)	Because of decreased renal clearance of digoxin, doses in the elderly should rarely exceed 0.125 mg daily, except when treating atrial arrhythmias.
Dipyridamole (Persantine)	Dipyridamole frequently causes orthostatic hypertension in the elderly. I has been proven beneficial only in patients with artificial heart valves. Whenever possible, its use in the elderly should be avoided.
Methyldopa (Aldomet)	Methyldopa may cause bradycardia and exacerbate depression in the elderly. Alternate treatments for hypertension are generally preferred.
Methyldopa-hydrochlorothiazide (Aldoril)	Methyldopa may cause bradycardia and exacerbate depression in the elderly. Alternate treatments for hypertension are generally preferred.

Reserpine (Serpasil)	Reserpine imposes unnecessary risk in the elderly, inducing depression, impotence, sedation, and orthostatic hypotension. Safer alternatives exist.
Reserpine-hydrochlorothiazide (Hydropres)	Reserpine imposes unnecessary risk in the elderly, inducing depression, impotence, sedation, and orthostatic hypotension. Safer alternatives exist.
Chlorpropamide (Diabinese)	Chlorpropamide has a prolonged half-life in the elderly and can cause prolonged and serious hypoglycemia. Additionally, it is the only oral hypoglycemic agent that cause SIADH, Avoid in the elderly.
Dicyclomine (Bentyl)	Gastrointestinal antispasmodic drugs are highly anticholinergic and generally produce substantial toxic effects in the elderly. Additionally, their effectiveness at doses tolerated by the elderly is questionable. All these drugs are best avoided in the elderly, especially for long-term use.
Hyoscyamine (Levsin, Levsinex)	Gastrointestinal antispasmodic drugs are highly anticholinergic and generally produce substantial toxic effects in the elderly. Additionally, their effectiveness at doses tolerated by the elderly is questionable. All these drugs are best avoided in the elderly, especially for long-term use.
Propantheline (Pro-Banthine)	Gastrointestinal antispasmodic drugs are highly anticholinergic and generally produce substantial toxic effects in the elderly. Additionally, their effectiveness at doses tolerated by the elderly is questionable. All these drugs are best avoided in the elderly, especially for long-term use.
Belladonna Alkaloids (Donnatal and others)	Gastrointestinal antispasmodic drugs are highly anticholinergic and generally produce substantial toxic effects in the elderly. Additionally, their effectiveness at doses tolerated by the elderly is questionable. All these drugs are best avoided in the elderly, especially for long-term use.
Clidinium-chlordiazepoxide (Librax)	Gastrointestinal antispasmodic drugs are highly anticholinergic and generally produce substantial toxic effects in the elderly. Additionally, their effectiveness at doses tolerated by the elderly is questionable. All these drugs are best avoided in the elderly, especially for long-term use.
Single or Combination preparations : Chlorpheniramine (Chlor-Trimeton)	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Single or Combination preparations : Diphenhydramine (Benedryl)	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Single or Combination preparations : Hydroxyzine (Vistaril, Atarax)	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Single or Combination preparations : Cyproheptadine (Periactin)	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Single or Combination preparations : Promethazine	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.

(Phenergan)	
Single or Combination preparations : Tripeiennamine	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Single or Combination preparations : Dexchlorpheniramine (Polaramine)	All nonprescription and many prescription antihistamines have potent anticholinergic properties. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in the elderly.
Diphenhydramine (Benadryl)	Diphenhydramine is potently anticholinergic and usually should not be used as a hypnotic in the elderly. When used to treat or prevent allergic reactions, it should be used in the smallest possible dose and with great caution.
Ergot Mesyloids (Hydergine)	Hydergibe (ergot mesyloids) and the cerebral vasodilators have not been shown to be effective, in the doses studied, for the treatment of dementia or any other condition.
Cyclospasmol	Hydergibe (ergot mesyloids) and the cerebral vasodilators have not been shown to be effective, in the doses studied, for the treatment of dementia or any other condition.
Iron supplements, > 325 mg	Iron supplements rarely need to be given in doses exceeding 325 mg of ferrous sulfate daily. When doses are higher, total absorption is not substantially increased, but constipation is more likely to occur.
All barbiturates except Phenobarbital	Barbiturates cause more side effects than most other sedative or hypnotic drugs in the elderly and are highly addictive. They should not be started as new therapy in the elderly except when used to control seizures.
Meperidine	Meperidine is not an effective oral analgesic and has many disadvantages to other narcotic drugs. Avoid in the elderly
Ticlopidine	Ticlopidine has been shown to be no better than aspirin in preventing clotting and is considerably more toxic. Avoid in the elderly.

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

Table 4: Updated Beers 2002 [Donna M. Fick, James W. Cooper, William E. Wade, Jennifer L. Waller, J. Ross Maclean, and Mark H. Beers. **Updating the Beers Criteria for Potentially Inappropriate Medication Use in Older Adults: Results of a US Consensus Panel of Experts**. Arch Intern Med, Dec 2003; 163: 2716 - 2724.] :

Drug	Beers Criteria Concerns
Propoxyphene (Dravon)	Offers few analgesic advantages over acetaminophen, yet has the adverse effects of other narcotic drugs.
Propoxyphene Combination products (Dravon with ASA, Dravon-N, and Dravocet-N)	Offers few analgesic advantages over acetaminophen, yet has the adverse effects of other narcotic drugs.
Indomethacin (Indocin, Indocin SR)	Of all available nonsteriodal anti-inflammatory drugs, this drug produces the most CNS adverse effects.
Pentazocine (Talwin)	Narcotic analgesic that causes more CNS adverse effects, including confusion and hallucinations, more commonly than other narcotic drugs. Addionally, it is a mixed agonist and antagonist.
Trimethobenzamide (Tigan)	One of the least effective antiemetic drugs, yet it can cause extrapyramidal adverse effects.
Methocarbamol (Robaxin)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Carisoprodol (Soma)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Chlorzoxazone (Paraflex)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Metaxalone (Skelaxin)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Cyclobenzaprine (Flexeril)	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Oxybutynin (Ditropan). Do not consider the extended-release Ditropan XL.	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Flurazepam (Dalmane)	This benzodiazepine hypnotic has an extremely long half-life in elderly patients (often days), producing prolonged sedation and increasing the incidence of falls and fracture. Medium- or short-acting benzodiazepines are preferable.
Amitriptyline (Elavil)	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.
Chlordiazepoxide-amitriptyline	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.

(Limbitrol)	
Perphenazine-amitriptyline (Triavil)	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.
Doxepin (Sinequan)	Because of its strong anticholinergic and sedating properties, doxepin is rarely the antidepressant of choice for elderly patients.
Meprobamate (Miltown and Equanil)	This is a highly addictive and sedating anxiolytic. Those using meprobamate for prolonged periods may become addicted and may need to be withdrawn slowly.
Doses of short-acting benzodiazepines: doses greater than Lorazepam (Ativan), 3 mg;	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.
Doses of short-acting benzodiazepines: doses greater than Oxazepam (Serax), 60 mg;	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.
Doses of short-acting benzodiazepines: doses greater than Alprazolam (Xanax), 2 mg;	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.
Doses of short-acting benzodiazepines: doses greater than Temazepam (Restoril), 15 mg;	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.
Doses of short-acting benzodiazepines: doses greater than Triazolam (Halcion), 0.25 mg	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.
Long-acting benzodiazepines: Chlordiazepoxide (Librium)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting benzodiazepines: Chlordiazepoxide-amitriptyline (Limbitrol)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting benzodiazepines: Clidinium-chlordiazepoxide (Librax)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting	These drugs have a long half-life in elderly patients (often several days), producing prolonged

benzodiazepines: Diazepam (Valium)	sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting benzodiazepines: Quazepam (Doral)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting benzodiazepines: Halazepam (Paxipam)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Long-acting benzodiazepines: Chlorazepate (Tranxene)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Disopyramide (Norpace and Norpace CR)	Of all antiarrhythmic drugs, this is the most potent negative inotrope and therefore may induce heart failure in elderly patients. It is also strongly anticholinergic. Other antiarrhythmic drugs should be used.
Digoxin (Lanoxin) (should not exceed 0.125 mg/d except when treating atrial arrhythmias)	Decreased renal clearance may lead to increased risk of toxic effects.
Short-acting Dipyridamole (Persantine). Do not consider the long-acting dipyridamole (which has better properties than the short-acting in older adults) except with patients with artificial heart valves	May cause orthostatic hypotension.
Methyldopa (Aldomet)	May cause bradycardia and exacerbate depression in elderly patients.
Methyldopa-hydrochlorothiazide (Aldoril)	May cause bradycardia and exacerbate depression in elderly patients.
Reserpine at doses > 0.25 mg	May induce depression, impotence, sedation, and orthostatic hypotension.
Chlorpropamide (Diabinese)	It has a prolonged half-life in elderly patients and could cause prolonged hypoglycemia. Additionally, it is the only oral hypoglycemic agent that causes SIADH.
Dicyclomine (Bentyl)	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Hyoscyamine (Levsin and Levsinex)	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Propantheline (Pro-Banthine)	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Belladonna alkaloids	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These

(Donnatal and others)	drugs should be avoided (especially for long-term use).
Clidinium-chlordiazepoxide (Librax)	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Chlorpheniramine (Chlor-Trimeton)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Diphenhydramine (Benadryl)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Hydroxyzine (Vistaril and Atarax)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Cyproheptadine (Periactin)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Promethazine (Phenergan)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Tripelennamine	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Dexchlorpheniramine (Polaramine)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Diphenhydramine (Benadryl)	May cause confusion and sedation. Should not be used as a hypnotic, and when used to treat emergency allergic reactions, it should be used in the smallest possible dose.
Ergot mesyloids (Hydergine)	Have not been shown to be effective in the doses studied.
Cyclandelate (Cyclospasmol)	Have not been shown to be effective in the doses studied.
Ferrous sulfate >325 mg/d	Doses >325 mg/d do not dramatically increase the amount absorbed but greatly increase the incidence of constipation.
All barbiturates (except phenobarbital) except when used to control seizures	Are highly addictive and cause more adverse effects than most sedative or hypnotic drugs in elderly patients.
Meperidine (Demerol)	Not an effective oral analgesic in doses commonly used. May cause confusion and has many disadvantages to other narcotic drugs.
Ticlopidine (Ticlid)	Has been shown to be no better than aspirin in preventing clotting and may be considerably more toxic. Safer, more effective alternatives exist.
Ketorolac (Toradol)	Immediate and long-term use should be avoided in older persons, since a significant number have asymptomatic GI pathologic conditions.
Amphetamines and anorexic agents	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.
Naproxen (Naprosyn,	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart

Avaprox, and Aleve)	failure.
Oxaprozin (Daypro)	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.
Piroxicam (Feldene)	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.
Daily fluoxetine (Prozac)	Long half-life of drug and risk of producing excessive CNS stimulation, sleep disturbances, and increasing agitation. Safer alternatives exist.
Bisacodyl (Dulcolax)	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Cascara Sagrada	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Neoloid	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Amiodarone (Cordarone)	Associated with QT interval problems and risk of provoking torsades de pointes. Lack of efficacy in older adults.
Orphenadrine (Norflex)	Causes more sedation and anticholinergic adverse effects than safer alternatives.
Guanethidine (Ismelin)	May cause orthostatic hypotension. Safer alternatives exist.
Guanadrel (Hylorel)	May cause orthostatic hypotension.
Cyclandelate (Cyclospasmol)	Lack of efficacy.
Isoxsurpine (Vasodilan)	Lack of efficacy.
Nitrofurantoin (Macrodantin)	Potential for renal impairment. Safer alternatives available.
Doxazosin (Cardura)	Potential for hypotension, dry mouth, and urinary problems.
Methyltestosterone (Android, Virilon, and Testrad)	Potential for prostatic hypertrophy and cardiac problems.
Thioridazine (Mellaril)	Greater potential for CNS and extrapyramidal adverse effects.
Mesoridazine (Serentil)	CNS and extrapyramidal adverse effects.
Short acting nifedipine (Procardia and Adalat)	Potential for hypotension and constipation.
Clonidine (Catapres)	Potential for orthostatic hypotension and CNS adverse effects.
Mineral oil	Potential for aspiration and adverse effects. Safer alternatives available.
Cimetidine (Tagamet)	CNS adverse effects including confusion.
Ethacrynic acid (Edecrin)	Potential for hypertension and fluid imbalances. Safer alternatives available.
Desiccated thyroid	Concerns about cardiac effects. Safer alternatives available.
Amphetamines (excluding methylphenidate hydrochloride and	CNS stimulant adverse effects.

anorexics)	
Estrogens only (oral)	Evidence of the carcinogenic (breast and endometrial cancer) potential of these agents and lack of cardioprotective effect in older women.

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

Table 5: Changes From 1997 Beers Criteria to New 2002 Criteria. [Donna M. Fick, James W. Cooper, William E. Wade, Jennifer L. Waller, J. Ross Maclean, and Mark H. Beers. **Updating the Beers Criteria for Potentially Inappropriate Medication Use in Older Adults: Results of a US Consensus Panel of Experts**. Arch Intern Med, Dec 2003; 163: 2716 - 2724.]

Drug
Medicines Modified Since 1997 Beers Criteria
Reserpine (Serpasil and Hydropres) in doses > 0.25 mg was added to the list Iron Supplements > 325 mg (Only Ferrous Sulfate) Extended-release oxybutynin (Ditropan XL) Short-acting dipyridamole (Persantine) [Do not consider the long-acting dipyridamole except with patients with artificial heart valves]
Medicines Dropped Since 1997 Beers Criteria
Phenylbutazone (Butazolidin)
Medicines Added Since 1997 Beers Criteria
Ketorolac tromethamine (Toradol) Orphenadrine (Norflex) Guanethidine (Ismelin) Guanadrel (Hylorel) Cyclandelate (Cyclospasmol) Isoxsuprine (Vasodilan) Nitrofurantoin (Macrodantin) Doxazosin (Cardura) Methyltestosterone (Android, Virilon, and Testrad) Mesoridazine (Serentil) Clonidine (Catapres) Mineral oil Cimetidine (Tagamet) Ethacrynic acid (Edecrin) Desiccated thyroid Ferrous sulfate >325 mg Amphetamines (excluding methylpenidate and anorexics) Thioridazine (Mellaril) Short-acting nifedipine (Procardia and Adalat) Daily fluoxetine (Prozac) Stimulant laxatives may exacerbate bowel dysfunction (except in presence of chronic pain requiring opiate analgesics) Amiodarone (Cordarone) Non–COX-selective NSAIDs (naproxen [Naprosyn], oxaprozin, and piroxicam) Reserpine doses >0.25 mg/d Estrogens in older women

9.2 Appendix 2 (The Anticholinergic Burden Risk)

Table 1: Selected tools of published Anticholinergic Burden Risk in the elderly patients

	Tool Name	The Criteria and Authors	Published Year
1	**Anticholinergic Risk Scale (ARS)**	Rudolph JL, et al. **The Anticholinergic Risk Scale and Anticholinergic Adverse Effects in Older Persons**. Arch Intern Med. 2008;168(5):508-513.	2008
2	**Anticholinergic Cognitive Burden (ACB) scoring of drugs**	Boustani M, et al. **Impact of anticholinergics on the aging brain: a review and practical application**. Aging Health 2008;4:311–20.	2008
3	**The Anticholinergic Drug Scale (ADS)**	Carnahan RM, et al. **The Anticholinergic Drug Scale as a Measue of Drug-Related Anticholinergic Burden: Associations With Serum Anticholinergic Activity.** J.Clin.Pharmacol.2006;46;1481-86.	2006

Table 2: **Anticholinergic Risk Scale (ARS)** [Rudolph JL, et al. The Anticholinergic Risk Scale and Anticholinergic Adverse Effects in Older Persons. Arch Intern Med. 2008;168(5):508-513.]

3 Points	2 Points	1 Point
Amitriptyline hydrochloride	Amantadine hydrochloride	Carbidopa-levodopa
Atropine products	Baclofen	Entacapone
Benztropine mesylate	Cetirizine hydrochloride	Haloperidol
Carisoprodol	Cimetidine	Methocarbamol
Chlorpheniramine maleate	Clozapine	Metoclopramide hydrochloride
Chlorpromazine hydrochloride	Cyclobenzaprine hydrochloride	Mirtazapine
Cyproheptadine hydrochloride	Desipramine hydrochloride	Paroxetine hydrochloride
Dicyclomine hydrochloride	Loperamide hydrochloride	Pramipexole dihydrochloride
Diphenhydramine hydrochloride	Loratadine	Quetiapine fumarate
Fluphenazine hydrochloride	Nortriptyline hydrochloride	Ranitidine hydrochloride
Hydroxyzine hydrochloride	Olanzapine	Risperidone
Hydroxyzine pamoate	Prochlorperazine maleate	Selegiline hydrochloride
Hyoscyamine products	Pseudoephedrine hydrochloride	Trazodone hydrochloride
Imipramine hydrochloride	Triprolidine hydrochloride	Ziprasidone
Meclizine hydrochloride	Tolterodine tartrate	
Oxybutynin chloride		
Perphenazine		
Promethazine hydrochloride		
Thioridazine hydrochloride		
Thiothixene		
Tizanidine hydrochloride		
Trifluoperazine hydrochloride		

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

Table 3: **The Anticholinergic Drug Scale (ADS)** [Carnahan RM, et al. The Anticholinergic Drug Scale as a Measue of Drug-Related Anticholinergic Burden: Associations With Serum Anticholinergic Activity. J.Clin.Pharmacol.2006;46;1481-86.]

Level 3	**Level 2**	**Level 1**
Amitriptyline	Carbamazepine	Alprazolam
Atropine	Cimetidine	Amantadine
Benztropine	Cyclobenzaprine	Ampicillin
Brompheniramine	Cyproheptadine	Azathioprine
Carbinoxamine	Disopyramide	Bromocriptine
Chlorpheniramine	Loxapine	Captopril
Chlorpromazine	Meperidine	Cefamandole
Clemastine	Methotrimeprazine	Cefoxitin
Clomipramine	Molindone	Cephalothin
Clozapine	Oxcarbazepine	Chlordiazepoxide
Darifenacin	Pimozide	Chlorthalidone
Desipramine	Ranitidine	Clindamycin
Dicyclomine		Clonazepam
Dimenhydrinate		Clorazepate
Diphenhydramine		Codeine
Doxepin		Cortisone
Flavoxate		Cycloserine
Hydroxyzine		Cyclosporine
Hyoscyamine		Dexamethasone
Imipramine		Diazepam
Meclizine		Digitoxin
Nortriptyline		Digoxin
Orphenadrine		Diltiazem
Oxybutynin		Dipyridamole
Procyclidine		Divalproex sodium
Promethazine		Estazolam
Propantheline		Famotidine
Protriptyline		Fentanyl
Pyrilamine		Fluoxetine
Scopolamine		Fluphenazine
Thioridazine		Flurazepam
Tolterodine		Fluticasone-salmeterol
Trihexyphenidy		Fluvoxamine
Trimipramine		Furosemide
		Gentamicin
		Hydralazine
		Hydrocortisone
		Isosorbide
		Isosorbide dinitrate
		Isosorbide mononitrate
		Ketotifen ophthalmic
		Loperamide
		Lorazepam
		Methylprednisolone
		Midazolam

		Morphine
		Nifedipine
		Nizatidine
		Olanzapine
		Oxazepam
		Oxycodone
		Pancuronium
		Paroxetine
		Perphenazine
		Phenelzine
		Piperacillin
		Prednisolone
		Prednisone
		Prochlorperazine
		Sertraline
		Temazepam
		Theophylline
		Thiothixene
		Tramadol
		Triamcinolone
		Triamterene
		Triazolam
		Trifluoperazine
		Valproic acid
		Vancomycin
		Warfarin

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

Table 4: **Anticholinergic Cognitive Burden (ACB) scoring of drugs** [Boustani M, et al. Impact of anticholinergics on the aging brain: a review and practical application. Aging Health 2008;4:311–20.]

Score 3	**Score 2**	**Score 1**
Amitriptyline	Amantadine	Alimemazine
Amoxapine	Belladone alkaloids	Alverine
Atropine	Carbamazepine	Alprazolam
Benztropine	Cyclobenzaprine	Atenolol
Brompheniramine	Cyproheptadine	Brompheniramine maleate
Carbinoxamine	Empracet	Bupropion hydrochloride
Chlorpheniramine	Loxapine	Captopril
Chlorpromazine	Meperidine	Chlorthalidone
Clemastine	Methotrimeprazine	Cimetidine hydrochloride
Clomipramine	Molindone	Ranitidine
Clozapine	Oxcarbazepine	Clorazepate
Darifenacin	Pethidine hydrochloride	Codeine
Desipramine	Pimozide	Colchicine
Dicyclomine		Coumadin
Dimenhydrinate		Diazepam
Diphenhydramine		Digoxin
Doxepin		Dipyridamole
Flavoxate		Disopyramide phosphate
Hydroxyzine		Fentanyl
Hyoscyamine		Furosemide
Imipramine		Fluvoxamine
Meclizine		Haloperidol
Nortriptyline		Hydralazine
Olanzapine		Hydrocortisone
Orphenadrine		Isosorbide
Oxybutynin		Loperamide
Paroxetine		Metoprolol
Perphenazine		Morphine
Procyclidine		Nifedipine
Promazine		Prednisone
Promethazine		Quinidine
Propentheline		Risperidone
Pyrilamine		Theophylline
Quetiapine		Trazodone
Scopolamine		Triamterene
Thioridazine		
Tolterodine		
Trifluoperazine		
Trihexyphenidy		
Trimipramine		

(Note: Highlighted drugs are not registered (Not active) in Health Canada DPD – [07-07-2009 File])

9.3 Appendix 3 (Selected Medications *)

Drug	ATC	Anti Cholinergic Risk	Beers Criteria Risk	Beers Criteria Concerns
Alimemazine (Trimeprazine)	R06AD01	1	0	
Alprazolam	N05BA12	1	1	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums. (doses greater than Alprazolam (Xanax), 2 mg)
Amantadine	N04BB01	1	0	
Amiodarone	C01BD01	0	1	Associated with QT interval problems and risk of provoking torsades de pointes. Lack of efficacy in older adults.
Amitriptyline	N06AA09	3	1	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.
Amphetamine	N06BA01	0	1	CNS stimulant adverse effects. (excluding methylphenidate hydrochloride and anorexics)
Atenolol	C07AB03	1	0	
Atenolol and other diuretics	C07CB03	1	0	
Atomoxetine	N06BA09	0	1	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.
Atropine	S01FA01	3	0	
Azathioprine	L04AX01	1	0	
Baclofen	M03BX01	2	0	
Belladonna alkaloids	A03B	2	1	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Benztropine	N04AC01	3	0	
Bisacodyl	A06AB02	0	1	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Bisacodyl Combinations	A06AB52	0	1	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Bromocriptine	G02CB01	1	0	
Brompheniramine maleate	R06AB01	1	0	
Bupropion hydrochloride	N06AX12	1	0	
Caffeine	N06BC01	0	1	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.
Captopril	C09AA01	1	0	

Carbamazepine	N03AF01	2	0	
Carbidopa-levodopa	N04BA02	1	0	
Cascara Sagrada	A06AB07	0	1	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Cascara Sagrada Combinations	A06AB57	0	1	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Cetirizine hydrochloride	R06AE07	2	0	
Chlorazepate (Clorazepate)	N05BA05	1	1	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Chlordiazepoxide	N05BA02	1	1	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Chlorpheniramine	R06AB04	3	1	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Chlorpromazine	N05AA01	3	0	
Chlorpropamide	A10BB02	0	1	It has a prolonged half-life in elderly patients and could cause prolonged hypoglycemia. Additionally, it is the only oral hypoglycemic agent that causes SIADH.
Chlorthalidone	C03BA04	1	0	
Chlorzoxazone	M03BB03	0	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Chlorzoxazone Combinations	M03BB53	0	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Cimetidine	A02BA01	2	1	CNS adverse effects including confusion.
Clemastine	R06AA04	3	0	
Clidinium-chlordiazepoxide	A03CA02	0	1	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required. GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Clindamycin	J01FF01	1	0	
Clomipramine	N06AA04	3	0	
Clonazepam	N03AE01	1	0	
Clonidine	C02AC01	0	1	Potential for orthostatic hypotension and CNS adverse effects.
Clonidine	N02CX02	0	1	Potential for orthostatic hypotension and CNS adverse effects.
Clozapine	N05AH02	3	0	
Codeine	R05DA04	1	0	

Codeine, combinations excl. psycholeptics	N02AA59	1	0	
Codeine, combinations with psycholeptics	N02AA79	1	0	
Colchicine	M04AC01	1	0	
Cortisone	H02AB10	1	0	
Cyclobenzaprine	M03BX08	2	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Cyclosporine	L04AD01	1	0	
Cyproheptadine	R06AX02	2	1	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Darifenacin	G04BD10	3	0	
Desiccated thyroid	H03AA05	0	1	Concerns about cardiac effects. Safer alternatives available.
Desipramine	N06AA01	3	0	
Dexamethasone	S03BA01	1	0	
Dexamethasone	H02AB02	1	0	
Dexamethasone	S01BA01	1	0	
Dexamethasone and antiinfectives	S01CA01	1	0	
Dexamethasone and antiinfectives	S03CA01	1	0	
Dexamethasone and antiinfectives	S02CA06	1	0	
Dexamfetamine	N06BA02	0	1	CNS stimulant adverse effects. (excluding methylphenidate hydrochloride and anorexics)
Diazepam	N05BA01	1	1	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.
Dicyclomine	A03AA07	3	1	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Digoxin	C01AA05	1	1	Decreased renal clearance may lead to increased risk of toxic effects. (should not exceed 0.125 mg/d except when treating atrial arrhythmias)
Diltiazem	C08DB01	1	0	
Diphenhydramine or Dimenhydrinate	R06AA02	3	1	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Diphenhydramine Combinations	R06AA52	3	1	May cause confusion and sedation. Should not be used as a hypnotic, and when used to treat emergency allergic reactions, it should be used in the smallest possible dose.
Diphenoxylate	A07DA01	3	0	

Dipyridamole	B01AC07	1	1	May cause orthostatic hypotension. (Do not consider the long-acting dipyridamole (which has better properties than the short-acting in older adults) except with patients with artificial heart valves)
Disopyramide	C01BA03	2	1	Of all antiarrhythmic drugs, this is the most potent negative inotrope and therefore may induce heart failure in elderly patients. It is also strongly anticholinergic. Other antiarrhythmic drugs should be used.
Divalproex sodium or Valproic acid	N03AG01	1	0	
Doxazosin	C02CA04	0	1	Potential for hypotension, dry mouth, and urinary problems.
Doxepin	N06AA12	3	1	Because of its strong anticholinergic and sedating properties, doxepin is rarely the antidepressant of choice for elderly patients.
Entacapone	N04BX02	1	0	
Ergot mesyloids	C04AE01	0	1	Have not been shown to be effective in the doses studied.
Estrogens	G03C	0	1	Estrogens only (oral), Evidence of the carcinogenic (breast and endometrial cancer) potential of these agents and lack of cardioprotective effect in older women.
Ethacrynic acid	C03CC01	0	1	Potential for hypertension and fluid imbalances. Safer alternatives available.
Famotidine	A02BA03	1	0	
Famotidine, combinations	A02BA53	1	0	
Fentanyl	N02AB03	1	0	
Ferrous sulfate	B03AA07	0	1	Doses >325 mg/d do not dramatically increase the amount absorbed but greatly increase the incidence of constipation.
Flavoxate	G04BD02	3	0	
Fluoxetine	N06AB03	1	1	Long half-life of drug and risk of producing excessive CNS stimulation, sleep disturbances, and increasing agitation. Safer alternatives exist.
Fluphenazine	N05AB02	1	0	
Flurazepam	N05CD01	1	1	This benzodiazepine hypnotic has an extremely long half-life in elderly patients (often days), producing prolonged sedation and increasing the incidence of falls and fracture. Medium- or short-acting benzodiazepines are preferable.
Fluticasone-salmeterol	R03AK06	1	0	
Fluvoxamine	N06AB08	1	0	
Furosemide	C03CA01	1	0	
Guanethidine	C02CC02	0	1	May cause orthostatic hypotension. Safer alternatives exist.
Haloperidol	N05AD01	1	0	
Hydralazine	C02DB02	1	0	
Hydrocortisone	H02AB09	1	0	
Hydrocortisone and antiinfectives	S02CA03	1	0	
Hydrocortisone and antiinfectives	S03CA04	1	0	
Hydroxyzine	N05BB01	3	1	All nonprescription and many prescription antihistamines may have

				potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Hyoscyamine	A03BA03	3	1	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness. These drugs should be avoided (especially for long-term use).
Imipramine	N06AA02	3	0	
Indomethacin	M01AB01	0	1	Of all available nonsteriodal anti-inflammatory drugs, this drug produces the most CNS adverse effects.
Isosorbide dinitrate	C01DA08	1	0	
Isosorbide mononitrate	C01DA14	1	0	
Ketorolac	M01AB15	0	1	Immediate and long-term use should be avoided in older persons, since a significant number have asymptomatic GI pathologic conditions.
Ketotifen ophthalmic	S01GX08	1	0	
Levodopa, decarboxylase inhibitor and COMT inhibitor	N04BA03	1	0	
Loperamide	A07DA03	1	0	
Loperamide, combinations	A07DA53	1	0	
Loratadine	R06AX13	2	0	
Lorazepam	N05BA06	1	1	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums. (doses greater than Lorazepam (Ativan), 3 mg)
Loxapine	N05AH01	2	0	
Meclizine	R06AE05	3	0	
Meperidine or Pethidine hydrochloride	N02AB02	2	1	Not an effective oral analgesic in doses commonly used. May cause confusion and has many disadvantages to other narcotic drugs.
Methocarbamol	M03BA03	1	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Methocarbamol Combinations	M03BA53	1	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.
Methotrimeprazine	N05AA02	2	0	
Methyldopa	C02AB02	0	1	May cause bradycardia and exacerbate depression in elderly patients.
Methyldopa-hydrochlorothiazide	C02LB01	0	1	May cause bradycardia and exacerbate depression in elderly patients.
Methylphenidate	N06BA04	0	1	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.

Methylprednisolone	H02AB04	1	0	
Methylprednisolone, combinations	H02BX01	1	0	
Metoclopramide hydrochloride	A03FA01	1	0	
Metoprolol	C07AB02	1	0	
Mineral oil	A06AA01	0	1	Potential for aspiration and adverse effects. Safer alternatives available.
Mirtazapine	N06AX11	1	0	
Modafinil	N06BA07	0	1	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.
Morphine	N02AA01	1	0	
Naproxen	M01AE02	0	1	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.
Neoloid (Castor Oil)	A06AB05	0	1	Long-term use, may exacerbate bowel dysfunction except in the presence of opiate analgesic use.
Nifedipine	C08CA05	1	1	Short acting nifedipine: Potential for hypotension and constipation.
Nifedipine Combinations	C08CA55	1	1	Short acting nifedipine: Potential for hypotension and constipation.
Nitrofurantoin	J01XE01	0	1	Potential for renal impairment. Safer alternatives available.
Nizatidine	A02BA04	1	0	
Nortriptyline	N06AA10	3	0	
Olanzapine	N05AH03	1	0	
Orphenadrine	M03BC01	3	1	Causes more sedation and anticholinergic adverse effects than safer alternatives.
Oxaprozin	M01AE12	0	1	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.
Oxazepam	N05BA04	1	1	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums. (doses greater than Oxazepam (Serax), 60 mg)
Oxcarbazepine	N03AF02	2	0	
Oxybutynin	G04BD04	3	1	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable. (Do not consider the extended-release Ditopan XL)
Oxycodone	N02AA05	1	0	
Paroxetine	N06AB05	1	0	
Pentazocine	N02AD01	0	1	Narcotic analgesic that causes more CNS adverse effects, including confusion and hallucinations, more commonly than other narcotic drugs. Addionally, it is a mixed agonist and antagonist.
Perphenazine	N05AB03	1	1	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.
Perphenazine-amitriptyline	N06CA01	3	1	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly

				patients.
Phenelzine	N06AF03	1	0	
Phenobarbital	N03AA02	0	1	All barbiturates (except phenobarbital) except when used to control seizures are highly addictive and cause more adverse effects than most sedative or hypnotic drugs in elderly patients.
Pimozide	N05AG02	2	0	
Piroxicam	M01AC01	0	1	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.
Pramipexole dihydrochloride	N04BC05	1	0	
Prednisolone	H02AB06	1	0	
Prednisolone and antiinfectives	S01CA02	1	0	
Prednisolone Opthalmic	S01BA04	1	0	
Prednisone	H02AB07	1	0	
Primidone	N03AA03	0	1	All barbiturates (except phenobarbital) except when used to control seizures are highly addictive and cause more adverse effects than most sedative or hypnotic drugs in elderly patients.
Prochlorperazine	N05AB04	1	0	
Procyclidine	N04AA04	3	0	
Promethazine	R06AD02	3	1	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.
Propoxyphene	N02AC04	0	1	Offers few analgesic advantages over acetaminophen, yet has the adverse effects of other narcotic drugs.
Pseudoephedrine Combination	R01BA52	2	0	
Pseudoephedrine hydrochloride	R01BA02	2	0	
Pyrilamine (Mepyramine)	R06AC01	3	0	
Quinidine	C01BA01	1	0	
Ranitidine	A02BA02	2	0	
Risperidone	N05AX08	1	0	
Scopolamine	A04AD01	3	0	
Selegiline hydrochloride	N04BD01	1	0	
Sertraline	N06AB06	1	0	
Sibutramine	A08AA10	0	1	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.
Temazepam	N05CD07	1	1	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums. (doses greater than Temazepam (Restoril), 15 mg)
Theophylline	R03DA04	1	0	
Theophylline,	R03DA54	1	0	

combinations excl. psycholeptics				
Thiothixene	N05AF04	1	0	
Ticlopidine	B01AC05	0	1	Has been shown to be no better than aspirin in preventing clotting and may be considerably more toxic. Safer, more effective alternatives exist.
Tizanidine hydrochloride	M03BX02	3	0	
Tolterodine	G04BD07	3	0	
Tramadol	N02AX02	1	0	
Tramadol, combinations	N02AX52	1	0	
Trazodone	N06AX05	1	0	
Triamcinolone	R01AD11	1	0	
Triamterene	C03DB02	1	0	
Triazolam	N05CD05	1	1	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums. (doses greater than Triazolam (Halcion), 0.25 mg)
Trifluoperazine	N05AB06	1	0	
Trihexyphenidy	N04AA01	3	0	
Trimipramine	N06AA06	3	0	
Triprolidine hydrochloride	R06AX07	2	0	
Vancomycin	A07AA09	1	0	
Warfarin	B01AA03	1	0	
Ziprasidone	N05AE04	1	0	

* Selection was based on:
1. Registered drugs (Generic name) in Canada Only
2. Oral medication only with some of the topical drugs based on GDH members selection
3. The Anticholinergic Drug Scale (ADS) for drugs with different Anticholinergic score
4. Most of the Antibiotics were excluded

The Keys

Anti-cholinergic Activity

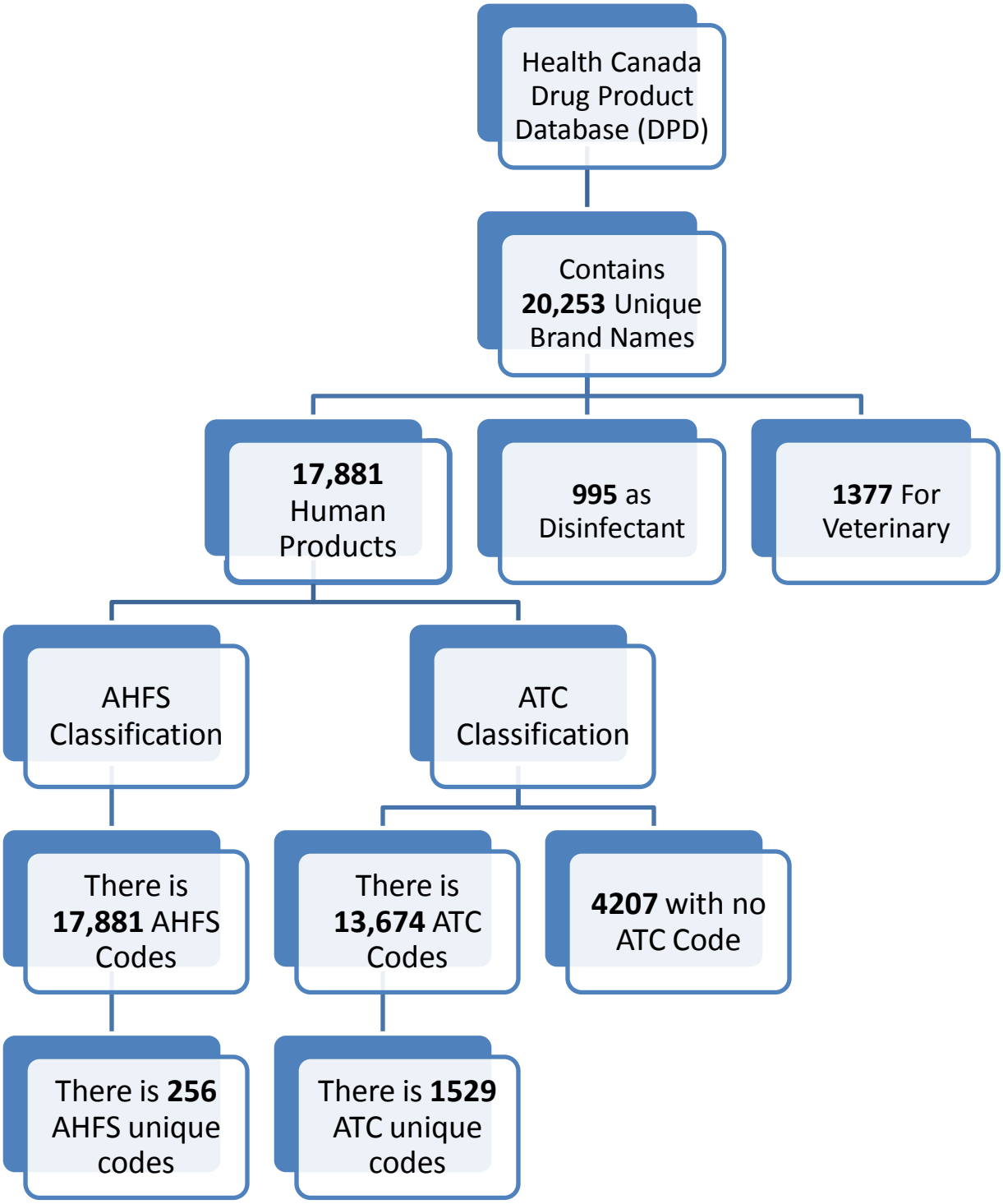
3 = Significant
2 = Moderate
1 = Mild
0 = None

Beers Criteria Severity

1 = Under Beers Criteria
0 = None

9.4 Appendix 4 (Health Canada Drug Product Database Analysis)

Health Canada Drug Product Database (DPD) Brief Analysis
[Last Update: 07 July 2009]



9.5 Appendix 5 (The Proposed Work Plan)

Task	Respon-sible	Start Date	Target Date	Deliverable
PHASE 1: LITERATURE REVIEW (ANALYSIS PHASE)				
1. Establish a framework of working	AA SB PM TF	05/01/09	05/05/09	Identify the team responsibilities
2. Comprehensive search, articles review, provide a summary about the best practical anti-cholinergic risk measurement method + the limitations	AA	05/06/09	05/20/09	Identify the best practical method and provide the outcome measurement indicators
3. Provide the most updated Beers criteria list + the limitations	AA	05/06/09	05/20/09	Identify the top high-risk medications causing harm or potential harm in GDH, based on Beers criteria
4. Develop the rules	AA	05/10/09	05/20/09	Set of anti-cholinergic and beers criteria rules
5. Review the clinical point of view regarding the anti-cholinergic drugs and the Beers criteria	SB PM	05/20/09	06/04/09	Identify the common medication system issues, using, in part, a geriatrics specific Capital Health, that lead to adverse drug events; risks, challenges and barriers experienced by GDH health care providers. Also, to validate the rules
PHASE 2: TOOL DESIGNING (DESIGN PHASE)				
1. Design a conceptual model for the medication risk assessment tool	AA	05/12/09	05/20/09	Provide express the meaning of terms and concepts used by domain experts to discuss the problem, and to find the correct relationships between different concepts
2. Design the graphic algorithms, and validate the algorithms	AA	06/04/09	06/12/09	Standardize and provide the best understanding of risk assessment tool
3. Validate the Algorithms	SB PM GP	06/12/09	06/18/09	Clinical point of view feedback + logic rules
4. Clinicians feedback	GDH	06/20/09	06/30/09	Geriatrician clinical feedback at GDH

Task	Respon-sible	Start Date	Target Date	Deliverable
5. Design the database and Entity relationships	AA GP	06/10/09	06/15/09	Provide a database format
6. Design the forms, interfaces, codes, and the reports format for the tool	AA TF	06/16/09	06/30/09	Prepare the tool for implementation
7. Test the tool	TF PM SB GP	07/01/09	07/08/09	Validate the tool
8. Users feedback	GDH	07/01/09	07/08/09	End users feedback
PHASE 3: TOOL IMPLEMENTATION (IMPLEMENTATION PHASE)				
9. Implement the tool	TF AA	07/09/09	07/23/09	Integrate the tool within the GDH system
10. Testing the tool and the major functions	TF AA	07/27/09	07/31/09	Test the designed flag system
11. Training model and user manual	AA	07/10/09	08/05/09	Provide a training plan and manual for end users
12. Presentations	AA	08/03/09	08/12/09	Prepare slides to be used as a training aid
13. Focus group, Feedback, and Evaluation	AA SB	08/03/09	08/17/09	Users feedback
14. Plan for evaluating the outcomes	AA SB PM	08/18/09	08/25/09	Identify the tool outcome measuring method (indicators)
15. Final report	AA	08/06/09	08/27/09	Write the final report
16. Presentation	AA	For the Fall Semester		Presentation to decision makers

Legend

AA	Almoeen, Abdulgader
SB	Bowles, Susan
TF	Fisher, Tracey
PM	Moorhouse, Paige
GP	Paterson, Grace
GDH	Geriatric Day Hospital Staff

Note: The training session will be in September 29th, 2009 at the Geriatric Day Hospital. At the same time, the user feedback survey will be conducted.