The Alberta College of Paramedics

Alberta Occupational Competency Profile (AOCP)
Upgrade "Gap" Training Program

Emergency Medical Responder (EMR)

Pharmacology Module

Study Guide

Table of Contents

Acknowledgements & General Information i

Training Program 1
AOCP's 2
Introduction, Objectives and Learning Activities 6
Medication Routes Sources and Packaging 8
Pharmacokinetics and Pharmacodynamics 13
Safe Medication Administration 23
Drug Reference Materials 33
Glucometric Testing 36
Summary 39
Exam 40
Glossary of Terms 44
References 46
Lab Skill Checklists 48

INTRODUCTION

The overall goal of this program is to provide standardized upgrade "gap" education to ensure that all regulated practitioners of the Alberta College of Paramedics (College) meet the *Health Professions Act,* Paramedic Regulation and the scope of practice as defined by the Alberta Occupational Competency Profiles (AOCP) for the profession.

The Alberta Occupational Competency Profiles (AOCP) were developed through the facilitation of Dr. Bill DuPerron of Alberta Health and Wellness. Many College regulated practitioners were involved in compiling and organizing information about the roles and functions of paramedics, emergency medical technicians and emergency medical responders into the Profile.

The completion of the AOCP for the College is an important milestone for the profession. The document is a result of a collaborative partnership with the College and Alberta Health and Wellness plus the work and effort of members of the College.

The Competency Profile describes the vast expanse of competencies in Alberta at the present time as well as additional changes in scope of practice, which are identified in the Upgrade "Gap" Training Program. Each module in the "Gap" Training Program covers the additional competencies for a specific Competency Cluster as identified in the AOCP for each of the three disciplines regulated by the College. The Profile includes the knowledge, skills, attitudes, and judgments related to a variety of roles held by registered practitioners of the College.

BACKGROUND

The Health Professions Act (HPA) governs all regulated health professions in Alberta. The HPA was passed by the Alberta Legislature in May 1999 and in December 2001 the Order in Council proclaiming the Health Professions Act was signed by the Lieutenant Governor.

The HPA replaces a regulatory system (the *Health Disciplines Act*) that included multiple statutes that had different registration, continuing competence and investigation and disciplinary processes. Under the HPA, previous legislated exclusive scopes of practice will be eliminated and replaced with an "overlapping scope of practice" model based on restricted activities. Restricted activities are health services that only authorized persons may provide.

STRUCTURE OF THE HPA

The HPA will deal with processes such as registration, continuing competence, professional conduct, restricted activities, investigation and discipline that apply to all the professions. Each of the 28 professions will have their own regulation that will address in detail, profession specific areas such as required qualifications for entry into the profession. The Paramedic profession is expecting to be governed by the HPA in the near future.

ABOUT THE AOCP

Most of the competencies have been learned in basic education; other competencies have been acquired through advanced education, on the job training, and experience. All EMRs, EMTs and EMT-Ps have the basic competencies; however, competency on the job will vary depending on job requirements, and policy and procedure of the employing agency.

The Profile provides a cumulative view of the competencies within the Scope of Practice and within the general and specialized areas of that practice.

The College has developed the following educational module for upgrading the knowledge and skills of registered practitioners to meet the Alberta Occupational Competency Profiles (AOCP), the new Regulation and scope of practice.

HISTORY OF THE PROCESS

On March 4, 2000, the Paramedic Association of Canada adopted the National Occupational Competency Profile (NOCP), which included both a new classification and generic competencies for four professional designation levels of Paramedicine.

On March 22, 2000, the Alberta College of Paramedics' Council made the commitment that the Alberta College of Paramedics AOCP would meet or exceed the NOCP.

ACKNOWLEDGEMENTS

Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee Members:

Douglas Britton, MEM, EMT-P, Chair
Renee Linssen, EMR, Vice-Chair
William Coghill, MEM, EMT-P, CHCA
Ruth Farrow, EMT-P, MLT
Christine Patterson, MEM, EMT
Richard Poon, BSc., EMT-P, MEd
Marilyn Ringness, BSc., EMT-P
Barry Straub, EMT-P

Donna Lefurgey, CEO/Registrar
Laurie Mitchell, Registration Division Leader

Package Development and Design

Portage College Prehospital Care Programs
Lac La Biche, Alberta

In collaboration with…
Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee

Module Creation and Research

Portage College Prehospital Care Programs
Lac La Biche, Alberta

In collaboration with…
Alberta College of Paramedics
Continuing Competency Ad Hoc Education Committee

About the Authors (Portage College)

Portage College (formerly Alberta Vocational Center, Lac La Biche) was established in 1968. The College currently offers over 30 certificate and diploma programs in six areas of study: Business, Human Services, Native Cultural Arts, Trades and Technical, Health and Wellness and Academic Upgrading. Over 1800 students are served annually through campuses in 13 northern Alberta communities, with another 1,300 taking short term or customized training programs each year.

Portage College has been offering prehospital care training program since the mid 1980s. Portage College is currently approved by the Alberta College of Paramedics for the following Paramedicine programs:

Emergency Medical Responder (EMR)
Emergency Medical Technician (EMT)
Emergency Medical Technologist-Paramedic (EMT-P)

Disclaimer

Portage College and the Alberta College of Paramedics have attempted to ensure that the information is in context relevant to the practitioner and is as concise as possible. Portage College has used a variety of resource materials in order to provide a solid base of up-to-date information.

If any of the information contained within this module contradicts the direction you have received from your employer/medical director, the policy of your employer should take precedence over the information in this module.

As a regulated practitioner of the Alberta College of Paramedics, while under the *Health Disciplines Act*, you may only deliver health services which fall within your scope of practice and is in accordance with the provisions of the *Health Disciplines Act* or the *Health Professions Act* when the HPA is implemented.

Any content contained in this module that is beyond your scope or not within your current competence does not authorize you to deliver those health services. That is, if a given health service is not within your scope of practice and/or you have not yet attained the competency, you may not deliver that health service.

Alberta Occupational Competency Profile (AOCP)

Training Program

Learning Goal

This educational training is intended to review and upgrade the competencies of The Alberta College of Paramedics registered practitioners in order to meet the requirements of the new regulation under the Health Professions Act (2000) including the Alberta Occupational Competency Profile (AOCP) and scope of practice.

Program Objective

To provide standardized education to registered practitioners to ensure that all regulated members of the Alberta College of Paramedics meet the regulation and defined scope of practice for the profession.

Program Format

The Alberta Occupational Competency Profile (AOCP) training program will combine independent study modul*es* and scheduled lab skills assessment sessions. Certification will be granted on successful completion of all program requirements.

Independent Study Modules

There are three EMR – AOCP continuing education modules to be completed.

1. Pharmacology
2. Airway Management
3. Trauma & MCI

Lab Skill Assessment

All skills identified for each module will be assessed during the lab skills assessment for that module.

Exam

Mastery of the each module's content will be assessed through multiple-choice exams during the lab sessions. These exams are open book and can be found in each module following the module summary.

EMR – Pharmacology Competencies

This module meets the following competencies of the Alberta Occupational Competency Profile (AOCP).

A-4 Knowledge of Pharmacology

A-4-1 Differentiate trade and generic names.

A-4-2 Distinguish among drug preparations.

A-4-3 Explain the meaning of drug terms necessary to safely interpret information in drug-reference sources:

- Half-life
- Therapeutic index
- Peak level
- Lethal Dose
- Onset of action, duration, agonist, antagonist

A-4-4 Discuss factors that influence drug absorption, metabolism, distribution, and elimination:

- Age of patient, body mass, physical condition, drug action and interaction

A-4-5 Demonstrate a working knowledge of major effects and side effects of medications and drug families including, but not limited to:

- Bronchodilators
- Salbutamol
- Ipratropium Bromide
- Adrenergic agonists
- Epinephrine
- Platelet Inhibitors
- Acetylsalicylic acid
- Anti-hypoglycemic agents
- Oral glucose gel

A-4-6 Describe how drugs react with receptors to produce the desired effects.

A-4-7 Calculate and correctly measure or infuse the correct volume of drug to be administered for a given situation (specific to EMR medications).

A-4-8 Demonstrate a working knowledge of the "Compendium of Pharmaceuticals and Specialties" and other drug reference material.

B-8 Apply Infection Control Precautions

B-8-1 Demonstrate knowledge and ability to use aseptic technique.

B-8-2 Demonstrate knowledge of elements of infection control:

- The infection agent – pathogen
- Reservoir - pathogen environment
- Exit from reservoir – vector
- Transportation (exudate, feces, and needle)
- Entrance (skin, mucous lining or mouth)
- Host (human or animal)

B-8-3 Demonstrate ability to establish isolation / reverse isolation procedures:

- Appropriate protection of self / patient
- Disposal of utensils, supplies and waste
- Proper handling of equipment
- Explanation to patients

G-1 Medication Administration

G-1-1 Demonstrate the ability to prepare medication for administration:

- Verify local protocol/physician order
- Assess appropriateness of medication for the condition
- Contraindications, age, weight, allergies, clinical condition, concurrent medication

G-1-2 Demonstrate the ability to apply guidelines for medication administration:

- Right medication
- Right dosage
- Right route
- Right time
- Right patient
- Right documentation
- Expiry date
- Packaging integrity
- Absence of precipitate
- Clarity

G-1-3 Demonstrate knowledge to follow specific legislation and local protocol.

G-1-4 Demonstrate knowledge and ability to provide proper documentation:

- Document administration of medication immediately after dispensing
- Time
- Dose
- Route
- Effect

G-1-5 Provide patient information regarding medication:
- Indications
- Effects
- Side effects

G-1-6 Demonstrate knowledge to evaluate patient for changes following administration:
- Action of the medication
- Side effects
- Adverse effects

G-2 Administration via Oral Route

G-2-1 Demonstrate knowledge of oral route for Acute Coronary Syndrome and Hypoglycemia:
- Rate of absorption
- Patient clinical condition – consciousness
- Properties of medication

G-2-2 Confirm findings, history and indications for the use of the medication for**:**
- Acute Coronary Syndrome (ACS)
- Hypoglycemia

G-2-3 Select the supply of the prescribed medication:
- Acetylsalicylic Acid (ASA)
- Oral glucose

G-2-4 Confirm correct medication.

G-2-5 Administer medication:
- The pill, tablet, capsule or gel should be placed in the patient's mouth
- Swallow with enough fluid to ensure medication reaches the stomach

G-2-6 Monitor patient:
- Document effect

G-3 Patient Assist Administration via Inhalation

G-3-1 Demonstrate knowledge of inhalation route:
- Rate of absorption
- Patient clinical condition
- Properties of medication

G-3-2 Confirm findings, history and indications for the use of the medication for:
- Asthma
- COPD

G-3-3 Select the supply of the prescribed medication:
- Salbutamol
- Ipratropium Bromide

G-3-4 Confirm correct medication.

G-3-5 Prepare delivery equipment.

G-3-6 Administer medication:
- Self administration
- Assisted administration

G-3-7 Monitor patient:
- Document effect

G-4 Patient Assist Administration via Intramuscular Route

G-4-1 Demonstrate knowledge for reasons for intramuscular injection based on:
- Rate of absorption
- Volume to be administered
- Patient clinical condition
- Properties of medication

G-4-2 Confirm findings, history and indications for the use of the medication for:
- Anaphylaxis
- Special circumstance medications as introduced by Emergency Preparedness Canada

G-4-3 Select the supply of the prescribed medication:
- Epinephrine (pre-filled, pre-measured)
- Special circumstance medications as introduced by Emergency Preparedness Canada

G-4-4 Confirm correct medication.

G-4-5 Prepare site:
- Cleanse the site

G-4-6 Administer medication:
- Insert needle into intramuscular tissue
- Inject medication
- Remove the needle
- Dispose of needle in supplied sharps container
- Cover the puncture site
- Massage gently to facilitate absorption

G-4-7 Monitor patient:
- Document effect

Pharmacology Module Overview

Introduction

As the EMS profession matures so do the roles and responsibilities of its practitioners. One such change is the scope of practice, which now encompasses a greater role in pre-hospital medication administration. The following module is an introduction to medication administration. In no way is this module to be considered the only education the EMR requires to remain competent in medication administration. Ongoing research and continuing education must be sought out to ensure the EMR is always aware of changes with regard to in scope medication. This ongoing education provides protection for the EMR, the profession and most importantly the patient.

Learning Objectives

Upon completion of this module the EMR will be able to:

1. Identify medication sources, routes and packaging.
2. Define the pharmaceutical, pharmacokinetic and pharmacodynamic phases.
3. Discuss and perform safe medication administration.
4. Interpret drug reference materials.
5. Demonstrate the knowledge and the correct procedure for glucometric testing.

Learning Activities

Recommended Resources

Each module identifies specific content students must cover to meet the module learning objectives.

Key Terms

Students are to define the *Key Terms* identified for each learning objective.

Exam

Mastery of the module content will be assessed through a multiple-choice exam during the lab sessions. This exam is open book and can be found in this module following the module summary.

Lab Skills Practice

Students are to review the skills identified in the *Lab Skills Checklist* provided in Appendix A. Review of these checklists is essential preparation for the lab skill assessments, which are mandatory for successful completion of this module.

Objective 1

Identify Medication Sources, Routes and Packaging

The history on medication administration dates back thousands of years to the Neolithic period making pharmacology one of the oldest branches in medicine. During Egyptian times wounds were treated with moldy bread (antibiotic properties) and willow bark (original source of Aspirin). Discoveries have found a medicinal scroll listing hundreds of herbal formulations for a wide variety of illness. Some medications discovered 13^{th} – 18^{th} century are still in use today, such as opium, digoxin and atropine. It was during the 19^{th} century that a distinction between physician and pharmacist was widely accepted with the pharmacist preparing, dispensing and selling the drugs. Pharmacology is the study of drugs and their actions on living organisms. The suffix–ology meaning "*the study of*" and the root word pharma meaning "*medicine*".

The EMR must have knowledge of medications in order to fully understand the need for assisting a patient with administration of their prescribed medications. The medications that the EMR is able to assist with are: MDI–Ventolin/Atrovent and pre-measured epinephrine for adults and pediatrics. The medications the EMR is able to carry and administer are ASA and oral glucose.

As an EMR working in the field, there will be exposure to numerous types of medications. This module will cover knowledge on pharmacology to ensure the practitioner has a clear understanding of the topic.

Today many drugs, once available and prepared by pharmacists, are now prepared and distributed by large corporations.

Presently drugs are derived from five major sources:

- Plants eg: Atropine is derived from the Atropa belladonna plant *(Deadly Nightshade)*
- Animals eg: Insulin is derived from the bovine and porcine sources
- Minerals eg: Potassium is derived from sylvite
- Synthetic eg: Fentanyl is derived from the lab
- Microorganisms eg: Penicillin is derived from mold

Drugs have many uses both medical and non medical including the following:

- Preventative
- Diagnostic
- Substitutive
- Restorative
- Therapeutic
- Palliative
- Curative
- Recreational
- Supportive

Drug Routes

There are various routes of medication administration. Some drugs are approved for administration by one or more routes but will typically be in a different form or concentration to achieve the desired effect. The route of administration will have an impact on the drug's absorption and distribution. The two classifications of drug routes are *Enteral* and *Parenteral*.

Enteral administration is the introduction of medication into the body via the gastrointestinal tract (GI Tract). This may be by oral, per ora (PO), sublingual (SL), buccal and rectal, per rectum (PR). Enteral administration is the most variable as the environment in the GI tract changes constantly and differs from one person to another. Enteral administration has a slower rate of absorption compared to parenteral routes and should not be considered for patients with altered LOC, in patients who have difficulty swallowing or airway comprise. Some medications cannot be taken orally as the stomach acid or digestive enzymes would render them useless.

- ***Oral route***: This is the easiest, safest, and most common form of medication administration with the majority of prescription and over the counter (OTC) medications supplied in this form. Solid drugs administered enterally must first dissolve prior to absorption (dissolution), whereas liquid drugs are administered dissolved.

- ***Sublingual route (transmucosal)***: Medications are administered under the tongue and are rapidly absorbed into the rich supply of blood vessels, unlike other oral medications that are absorbed in the stomach or small intestines. This is not to be swallowed. (Note: This route is not in the EMR scope of practice.)

- ***Buccal****:* Medications are administered in the mouth with the drug placed between the cheek and gum. The drug is absorbed across the mucous membrane. Not a common route in the prehospital setting, however, common with OTC medications such as cough drops (not to be swallowed).

- ***Rectal****:* Not a common route in the prehospital setting however can be beneficial in some circumstances such as vomiting or a seizing patient or situations where you are unable to administer a drug by another route. Suppositories are usually solid at room temperature and dissolve due to the higher body temperature. (Note: This route is not in the EMR scope of practice.)

Parenteral administration is the introduction of medications by means other than the GI tract. Medications administered through these routes have a quicker onset of action. These routes include ***intravenous (IV), endotracheal (ET), intramuscular (IM), subcutaneous (SQ, SC),*** transdermal, inhalation and umbilical. Medications administered parentally are not affected by the stomach pH, food consumption, and bowel motility, which result in a more predictable therapeutic effect. Parenteral administration is very effective in the prehospital or emergent setting.

Practitioners must realize that once the drug is administered via these routes, there is no way to retrieve the drug.

- ***IV***: Drugs are administered directly in the vein. Common in the prehospital setting, however it requires a patent IV line prior to administration. Attention to aseptic technique is a must because the drug is directly administered into the central circulation. (Note: This route is not in the EMR scope of practice.)

- ***ET****:* Can be common in the prehospital setting for some medications if the patient is intubated. A limited amount of drugs can be administered directly into the lungs. (Note: This route is not in the EMR scope of practice.)

- ***IM****:* Again a good choice for rapid absorption as muscle tissue is usually rich in blood supply. Drugs administered IM require aseptic technique and may cause pain or discomfort to the patient. The amount injected for a male should not exceed 5 ml and for a female or child you should not exceed 3 ml in the gluteus medius (dorsogluteal), gluteus minimus (ventrogluteal), and vastus lateralis (anterolateral midthigh). The total amount injected in the deltoid muscle (upper arm below the shoulder) should not exceed 1 ml in women or small children and 2 ml in men. If the amount to be injected exceeds this, you should consider giving two injections at different sites.

- ***SQ/SC****:* Whereas IM is administered into muscle tissue SQ/SC is administered above the muscle tissue into the subcutaneous tissue. This route is not as quick acting as an IM, however some medications can only be administered by this route due to patient condition or formulation. The amount injected should not exceed 1 ml.

Transdermal: A good choice for constant supply of a drug. Not a popular choice in the emergent setting due to slow absorption rate. Many patients encountered may be prescribed a transdermal patch for a variety of circumstances such as a nicotine patch to stop smoking or a nitroglycerin patch to prevent an angina attack. (Note: This route is not in the EMR scope of practice.)

Inhalation: Common choice in the prehospital setting with a rapid onset. Drugs are inhaled into the lungs and passed into general circulation.

Umbilical*:* A choice only with neonates as an alternate route by administering medications directly into circulation by cannulation of the umbilical vein.
(Note: This route is not in the EMR scope of practice.)

Table P-1 Comparison Of Drug Administration By Various Routes

Route	Absorption Rate	Route	Absorption Rate
Oral	*Slow*	Transdermal	*Slow*
Sublingual	*Moderate*	Intravenous	*Rapid*
Inhalation (gas)	*Rapid*	Subcutaneous	*Slow*
Intramuscular	*Moderate*	Aerosol	*Rapid*

Packaging and Storage

During the industrial revolution it became easier for companies to prepare, package and distribute medications. Today drugs come in a variety of forms and are packaged accordingly with many developed for use in the emergency setting. Table P-2 lists the medication packaging and the drugs the EMR should be familiar with.

Storing some medications are cause for concern as some are light sensitive (such as nitroglycerin and epinephrine), while others would be vulnerable to temperature fluctuations (such as Entonox). Other considerations of drug storage are shelf life, moisture and security.

Table P-2 Drug Packaging

Types of Packaging	Examples of Medications
Ampule/ amp	Epinephrine
Vial (single dose and multidose)	Epinephrine
Tablet	Aspirin, Nitroglycerin
Transdermal Patch	Nitroglycerin
Paste	Nitroglycerine
Gas	Oxygen, Entonox
Aerosols/ Sprays	Nitroglycerin
Metered Dose Inhaler (MDI)	Ventolin, Atrovent, Combivent
Nebulizer	Ventolin, Atrovent, Combivent
Prefilled Syringe	Dextrose ($D_{50}W$)
Autoinjector	Epinephrine
Gel	Oral Glucose

Objective 1: Key Terms

- Drug Routes
- Enteral
- Parenteral
- Oral
- Intramuscular
- Inhalation
- Tablets
- Autoinjectors
- Paste
- Metered Dose Inhaler (MDI)

Objective 2

Define the Pharmaceutical, Pharmacokinetic and Pharmacodynamic Phases of Medication Administration

A drug is a substance taken into the body to prevent, diagnose or treat an illness. A drug when taken into the body will not result in a new function; it will only modify existing tissue or organ functions. Because a drug will typically affect more than one system or organ at a time, the practitioner must consider all actions and effects of the drug prior to administration. For a drug to reach its site of action and achieve its desired effect it must first go through the following three phases:

- Pharmaceutical phase
- Pharmacokinetic phase
- Pharmacodynamic phase

PHARMACEUTICAL PHASE

The ***pharmaceutical phase*** has an impact on the pharmacokinetic and pharmacodynamic phase in that it refers to the form in which the drug is supplied such as a solid, liquid or gas. For example, once solid medication enters the body it must first be transformed into a solution before it can have any effect. This is referred to as ***dissolution***. The faster the dissolution, the faster the drug will cross the cell membrane and be absorbed. Since liquid medications are already in solution form, they have a much faster absorption rate.

Drug Forms

Drugs are available in a variety of forms, which will have a direct result on the method of administration, storage and packaging. The three forms are:

- Solids
- Liquids
- Gaseous

Solids

Typically solids will be administered via the GI tract and come in a variety of forms such as pills, tablets, capsules, suppositories and powders.

Figure P1

Liquids
Drugs in liquid form can be administered both enterally and parentally. They are available in a variety of preparations including solutions, suspensions, emulsions, elixirs, syrups and tinctures.

Figure P 2

Gas
Oxygen being the most commonly used medication in the prehospital setting comes in the gaseous form as does Entonox. Oxygen is often not thought of as a medication as it is in the air we breathe, however in the concentrated form found in oxygen tanks is classified as a medication.


Figure P 3

PHARMACOKINETIC PHASE

The ***pharmacokinetic phase*** (motion of the drug), put simply, is the study of how a drug enters the body, how it is distributed to its site of action, how it is broken down and then eliminated from the body. All phases of pharmacokinetics involve drug movement. The phases of pharmacokinetics are:

- Absorption
- Distribution
- Biotransformation or metabolism
- Elimination

Absorption

Absorption is the movement of a drug from its site of administration to the circulatory system. The mode of administration will have a direct impact on absorption rates. The rate of absorption directly affects how quickly a drug becomes available to exert its action. The greater the blood flow to the site of administration the greater the rate of absorption.

There are five factors that affect drug absorption:

- Dissolution
- Solubility
- pH
- Blood flow
- Surface area

Dissolution

Before a drug can be absorbed, it must first dissolve. Drugs in a liquid form will allow rapid dissolution, while solids will need to be broken down. Hence, drugs in formulation for rapid dissolution will have faster onset than drugs formulated for slow dissolution.

Solubility

As a general rule, lipid soluble drugs can readily and easily cross the membranes that separate them from the blood. As a result, they will have a faster onset of action.

pH

The term pH is an abbreviation for "potential of hydrogen". It is a measure of the degree to which a solution is acidic or alkaline (basic). An acid is a substance that can give up a hydrogen atom (H^+) and a base is a substance that can accept a hydrogen atom (H^+). The more acidic a solution, the greater the hydrogen ion concentration and the lower the pH. The human body strives to maintain ***homeostasis***. In order to achieve this goal, it must maintain a state where it is neither acidic or alkali. Body pH is maintained at a level of 7.35-7.45, which is a normal acid-base balance. Depending on the type of medication, pH will have an effect on the rate of absorption. For example, acidic drugs are better absorbed in acidic conditions, such as ASA in the stomach.

Blood flow

Absorption of drugs will be enhanced when the site of administration is highly vascular. The more blood flow the more absorption of the drug.

Surface area

The larger the area available for absorption, the faster absorption will be.

Distribution

This is the transport of a drug from the site of absorption to the site or sites of action. Drug distribution is determined by three factors; blood flow to tissue, ability to exit the vascular system and ability to enter the cell.

Blood flow to tissue

The rate at which drugs will be delivered to a particular tissue will be directly related to the blood flow it receives.

Exiting the vascular system

Most drugs must be delivered to a cell outside of the circulatory system before it can have its action. Circulating drugs form a bond with blood proteins while traveling in the circulatory system. The most important of these proteins is plasma albumin. While these bonds facilitate distribution, the drug bound to the protein will not be able to leave the bloodstream until the ***affinity*** for the drug and the protein has been broken. In addition, drugs will need to travel past natural barriers, meant to protect us, such as the blood brain or placental barriers before they can cross into the capillary beds to finally reach the target cell.

Entering the cell

While most drugs bind to receptors found on the outside cell membrane, some drugs need to enter the cell to reach their site of action.

Biotransformation or metabolism

Drug biotransformation, also called metabolism, is defined as the enzyme breakdown of drug structure. Most drug metabolism takes place in the liver but can also occur in the kidneys, lungs, intestines and plasma. The purpose of metabolism is to breakdown the drug so it becomes less active and converting it to a metabolite ready for excretion.

Elimination

Elimination of metabolites from the body is primarily carried out by the kidneys and excreted through urine. However, drugs can also be eliminated through respiration, sweat, mammary glands and the body's solid waste.

Special Considerations

Several factors can influence the pharmacokinetic phases. A patient's age, pregnancy, body mass, race and gender as well as drug interactions and predisposition to the administration must be considered by practitioners who possess the ability to administer any medication.

The Very Young

As discussed previously, pharmacokinetic factors determine the concentration of the drug at its site of action and hence determine the intensity and duration of responses. Because the organ systems are not fully developed, these patients are at risk for both prolonged and intense drug action. Poor gastric emptying and low acidity impede drug absorption. Poor protein binding and immature blood-brain-barrier alters distribution. Immature liver and kidney systems lead to slow metabolism and excretion.

The Elderly

As a result of the aging process the elderly will have decreased liver and kidney function and reduced cardiac output. This can result in slower metabolism and excretion leading to higher levels of drug in circulation. ***Polypharmacy*** is common among the elderly in that the patient is often on several medications. A thorough history is extremely important for all prescription, over-the-counter medications (OTC) and home remedies to minimize and adverse reactions.

Pregnancy

Women who are pregnant are another high-risk group as the fetus may be exposed to medications the mother receives. The U.S Food and Drug administration (FDA) have five safety categories for medication administration for a pregnant patient. (See Table P-3)

Table P-3 Pregnancy Categories

Category A	No risk to fetus
Category B	*Animal studies show no risk to fetus
Category C	*Animal studies show there may be a risk
Category D	Studies show a risk to fetus
Category X	Positive risk to fetus, do not use

** Category B and C lack human evidence and the benefits of drug administration may outweigh the risks.*

Body Mass and Gender

This is another consideration as the larger the mass the greater the fluid to dilute the drug. It is common to see drug administration based on a patient's weight. Male and females have different amounts and distribution of body fat, which can affect the amount of drug available in circulation.

Other considerations include genetic factors such as a lack of enzymes affecting metabolism. Side effects can be common in some populations of Natives, Asians, African descendants and similar populations of non-whites.

Drug Interaction

Receiving multiple therapies has the potential of altering all phases of pharmacokinetics. Interactive compounds may find themselves competing for absorption sites, distribution pathways, metabolism structures and excretion routes. Drug interactions can either facilitate or impede theses phases and can therefore alter the intensity and duration of action.

Predisposition

A patient's presentation and his/her predisposition prior to the medication administration will greatly affect all the phases. Factors such as liver disease, impaired cardiac function, and/or kidney disease can alter the efficiency of drug processing.

PHARMACODYNAMIC PHASE

The ***pharmacodynamic phase*** is the study of drugs and their effect on living tissues. By understanding pharmacodynamics the practitioner can understand why a drug is given and how it works. As explained earlier drugs do not impart a new function, they only modify existing functions of the cells or organs.

In order to participate rationally in drug therapeutics, prehospital personnel need a basic understanding of pharmacodynamics. It is important to know about drug actions in order to educate your patient about their medications, administration decisions and evaluate your patient for drug responses while being able to identify harmful effects. Having a sound grasp of pharmacodynamics will enable you to support your reasoning for medication therapies.

With most drugs, the mechanism of action and desired effect is obtained as the drug (THE KEY) binds to its specific cellular receptor site (THE LOCK). Receptor sites are different molecules on the surface of the cell that can bond to different chemicals. Most commonly referred to as the LOCK AND KEY mechanism, it best explains how a drug can produce a biological response with the drug being the key and the receptor site the lock.

Many of the medications used in the prehospital setting both directly and indirectly affect the nervous system in some way. It is for this reason that a basic understanding of the nervous system is essential for prehospital drug therapy.

Nervous System

Although the nervous system tissue accounts for only 3% of total body weight, it functions to activate, control and integrate all of the systems in the body. It receives information regarding changes in the internal and external environment and initiates and regulates the appropriate response to the stimulus. Thus the nervous system plays an important role in maintaining homeostasis.

Although it is important for all prehospital personnel to understand the anatomy and physiology of the entire nervous system, symptomatic medication administration will require you to focus on the autonomic branch of the peripheral nervous system.

Autonomic Nervous System

There are many tissues and organs in our body that we cannot consciously and voluntarily control. Such activities as heart contraction, digestive processes, dilation and constriction of blood vessels and pupils are all involuntary and automatic. The innervation of these muscles and glands is carried out by the autonomic nervous system.

In general, the sympathetic and parasympathetic divisions of the autonomic nervous system have opposing actions. For example, stimulation of the heart by the sympathetic division will increase the heart rate, while stimulation by the parasympathetic division will slow it down.

The sympathetic nervous system prepares the body for stressful situations and emergencies requiring fast action and great exertion. It increases the heart rate and respiration, dilates the pupil and curtails digestion. An important function of the sympathetic nervous system is to control blood vessels. In order to provide more bloodflow under stressful situations, the coronary and skeletal muscles are dilated. By controlling peripheral blood vessel diameter, the sympathetic system is capable of regulating both cardiac output and arterial pressure.

The parasympathetic system restores the body to normal conditions when the emergency has diminished. The system promotes digestion, slows down the heart rate, returns the breathing to normal and causes the pupils to return to normal size.

The autonomic nervous system uses both neurotransmitters (cellular chemical messengers) and receptor sites to impart its actions on all the body systems.

It is important for EMR's to understand these principles, as the inner functioning of the sympathetic system, which also function on the principle of the lock and key mechanism, will be directly affected during symptom relief medication administration.

To illicit its action, the sympathetic system uses a variety of neurotransmitters such as epinephrine, norepinephrine and dopamine to affect the target receptor sites Alpha-1 (α1), Beta-1 (β1) and Beta-2 (β2). Binding of the neurotransmitter epinephrine to any of these sites will result in a specific sympathetic action or effect. (See Table P-4)

Table P-4 Sympathetic Nervous System Receptors and Actions

Example: EPINEPHRINE	
Receptor Site	**Action of Binding**
Alpha- 1 (α1)	Vascular constriction (vasoconstriction)
Beta- 1 (β1)	Increased heart rate (positive chronotropic) Increased cardiac force of contraction (positive inotropic)
Beta 2- (β2)	Bronchodilation and decreased lung secretions

By now, you should see the importance and direct link between anatomy, physiology and the pharmacodynamics. To achieve competency, a practitioner must demonstrate that he/she has the knowledge required to enable them to evaluate the safety, determine the need and evaluate the response of medication administration in emergent situations.

Mechanism of Action

The following are brief explanations of the mechanism of action of the drugs soon to be included in the new EMR scope of practice.

- ***Epinephrine (Adrenalin):*** *E*pinephrine will bind to the Alpha-1 (α1) and Beta-1 (β1) and Beta-2 (β2) receptors of the sympathetic system, resulting in bronchodilation, drying of the bronchial mucus membranes. Activation of both alpha and beta receptors also explains the associated increased heart rate and blood pressure.

- ***Salbutamol (Ventolin, Albuterol):*** Salbutamol imparts its effect by binding to Beta-2 (β2) receptor sites and promoting bronchodilation. Salbutamol also activates cardiac receptors, (Beta-1 (β1), which explains the increase in heart rate and blood pressure effects of this drug.

- ***Ipratropium bromide (Atrovent):*** Ipratropium bromide inhibits parasympathetic bronchoconstriction, resulting in more open lower airways and bronchodilation

- ***Acetylsalicylic acid (ASA, Aspirin):*** Acetylsalicylic acid has multiple effects; it blocks pain impulses in the CNS, dilates peripheral vessels and decreases blood platelet aggregation. In large part, it is used prehospitally to prevent blood and vascular fluid from clotting.

Interactions

As you are preparing to administer medications in the field, you will find that you will have to pay attention and start evaluating the consequences of administering symptom relief medication in conjunction with physician prescribed medications, OTC medications or street drugs. As explained earlier in this section, drug interactions have the potential of affecting the mechanism of action of the medication that you are to administer, which could endanger your patient.

Knowledge of the following drug response terms is necessary to understand medication therapy and safely interpret information in drug-reference sources.

Table P-5 Drug Response Terms

Addiction	Strong dependence on a drug, may be physiological, psychological or both that may be due to decreased response to a drug with repeated use
Agonist	A drug that combines with a receptor to stimulate a response
Antagonist	Drugs that combine with a receptor site to prevent a response
Duration	Length of time the drug exerts its actions
Half-Life	The time it takes to remove 50% of the drug from the body
Homeostasis	The natural tendency of the body to maintain a steady and normal internal environment
Lethal dose	Amount of drug which may be fatal
Peak Level	Peak level is the highest concentration produced by a specific dose
Potentiation	One drug enhancing the effects of another drug
Onset of Action	The time between the administration of a drug to the first sign of its effect. The onset of action is influenced by physical and chemical properties of the drug and by the route of administration
Side effect	Undesired effect of a drug
Synergism	Two drugs having a greater effect than each drug individually
Therapeutic index	A drugs lethal dose compared to its effective dose for 50% of the population, to determine the safety of the drug

Objective 2: Key Terms

- Dissolution
- Pharmacodynamic phase
- Pharmaceutical phase
- Pharmacokinetic phase
- Affinity
- Polypharmacy
- Absorption
- Distribution
- Biotransformation
- Elimination

Objective 3

Discuss and Perform Safe Medication Administration

The first and foremost rule in medication administration is to “do no harm”. In order to ensure you do no harm the provider must consider patient consent and risk versus benefit.

When considering medication administration there are six rights the practitioner must ensure each time a drug is administered:

1. Right patient
2. Right drug
3. Right time
4. Right dose
5. Right route
6. Right documentation

When considering the six rights of medications, they must be looked at individually as follows:

Right patient

Patient confusion is not usually a common problem in the prehospital setting as typically there is only one patient at a time. If drug orders are given by a physician during field administration, ensure you receive the order prior to giving the medication. Second or third hand information can lead to mistakes and regardless of who errs you are the responsible party if you give the drug.

Right drug

Prior to administering any drug you must first look at and read the label at least three times. First when the drug is removed from the sealed package, second when preparing the drug and again prior to administration. In addition to checking to ensure you have the right drug, you need to check the expiration date, concentration and recommended route of administration.

Right time

Prehospital drug therapy is often required in a timely manner. “Time” refers to not only the time of day but also timing with regard to presenting symptoms and the dosage intervals required to appropriately treat the condition. Do not delay transport to administer a drug if the delay is not in the patient’s best interest.

Right dose

Accuracy is paramount in medication administration. It is good to memorize the dosages in your scope of practice however mistakes can be made. Always calculate the dose prior to preparing the medication and have it double-checked by your partner. Another resource for ensuring proper dosage is to have access to a pocket reference guide for medications.

Right route

A drug administered by the incorrect route may cause complications and be fatal to the patient or not be absorbed at the proper rate. For example a drug given SQ will be slower acting than a drug administered IM and could make a difference in patient outcome. Follow your medication protocols and know the routes for proper medication administration.

Right documentation

Proper documentation includes drug, time, route, concentration, dose, person who administered the drug and how the patient responded to it. Any medication errors must also be documented and reported to the receiving facility immediately. Remember if it wasn't documented it wasn't done.

Color, Clarity, Concentration & Expiry Date

(Three C's & E)

As discussed above, a drug should be examined at least three times prior to administration. Initially when removing the drug from the sealed package, then before preparation and lastly prior to administration. While examining the drug also check for color, clarity, concentration, absence of precipitate, and expiration date.

At the end of this module, there is a formulary for the drugs that will be in the EMR scope of practice. Refer to the formulary for specific indications, pharmacology, and doses. For the procedure/skill to administer a medication refer to the skills assessment section.

AN OVERVIEW ON MEDICATION ADMINISTRATION

Prior to any drug administration, a patient assessment must be completed with the EMR taking all appropriate personal protection precautions. After the assessment is complete and a baseline set of vitals is obtained the practitioner must weigh the ***risk versus benefit factor*** and make the decision whether to administer the medication. Drug administration carries a great deal of responsibility and a thorough understanding of all drugs in scope is necessary so they can be safely administered.

When to administer a drug is a question that will offer the practitioner many challenges. No two patients are alike as no two situations are alike. With the introduction of symptom relief medication the EMR must exercise critical thinking at all times. For the patient to benefit from symptom relief medications it is important for the responding personnel to work as a team so the appropriate patient assessment, history and vitals can be completed in a timely manner.

TECHNIQUES OF ADMINISTRATION

As with all medication administration aseptic technique is a must. In the prehospital setting it is impossible to have a sterile environment but care must be taken to reduce the incidence of contamination. Personal protective precautions must be used regardless of the route of administration.

Oral Administration (ASA, Oral Glucose)

To administer a drug orally, ***per ora*** **(PO)**, the patient must be conscious and able to swallow. When administering ASA tap out the required dose into the lid of the bottle or patients hand. Any spilled medication is considered contaminated and must be discarded immediately.

ASA tablets must be chewed to facilitate absorption. Oral glucose can only be administered to a conscious patient, as there is a need to actively swallow to prevent aspiration. The tip of the tube twists off and the patient then squeezes the liquid glucose into their mouth and swallows it. Oral glucose is absorbed in the gastrointestinal (GI) tract.

Inhalation Administration (Ventolin, Atrovent)

For medications to be administered through inhalation the patient must be conscious and able to follow directions. To properly use a MDI refer to the following table.

Table P-6 Metered Dose Inhaler (MDI)

Shake canister for 30-60 seconds to mix medication with propellant
Get patient to exhale
Place the MDI mouthpiece in the patient's mouth and tell the patient to inhale deeply while delivering the metered dose of medication
Instruct patient to hold breath for up to 10 seconds
Exhale slowly
Repeat steps for further dosing
Reassess patient

(Refer to lab skill guideline Appendix B)

Injection (Epi-Pen™, Epi-Pen Jr.™)

Some drugs are supplied in metered doses such as Epi-Pen™. To reduce the risk of injury, never recap needles and place in a sharps container as soon as medication is administered.

Prior to injection the procedure should be explained to the patient. The ***intramuscular (IM)*** site needs to be identified and stabilized. With the Epi-Pen™, the practitioner will place it on the appropriate site and apply pressure. The needle is spring-loaded and will enter into the site through clothing if necessary. Once pressure has been applied, the practitioner will hold the Epi-Pen™ in place at a 90° angle for 10 seconds. Discard sharps in appropriate container and reassess patient.

DRUG DOSAGES

When dealing with medications the weight of the drug is measured in grams or units thereof, while volume is measured in liters or units thereof. Table P-7 below will demonstrate the applicable volume and weight comparisons.

Table P-7 For Volume and Weight Comparisons

Volume Equivalents	Weight Equivalents
1 liter = 1000 milliliters	1 kilogram = 1000 grams
1 milliliter = 1/1000 of a liter	1 milligram = 1/1000 of a gram
1 milliliter = 1 cubic centimeter	1 microgram = 1/1000 of a milligram
	1kilogram = 2.2 pounds

Table P-8 For Commonly Used Abbreviations

DD = desired dose	cc = cubic centimeter	mcg/ µg = microgram
C = concentration	l = liter	mEq - milliequiviliant
IV= intravenous	ml = milliliter	lb = pound
IVP = IV push	g = gram	min = minute
gtt = drop	kg = kilogram	tab = tablet
po = per ora	mg = milligram	

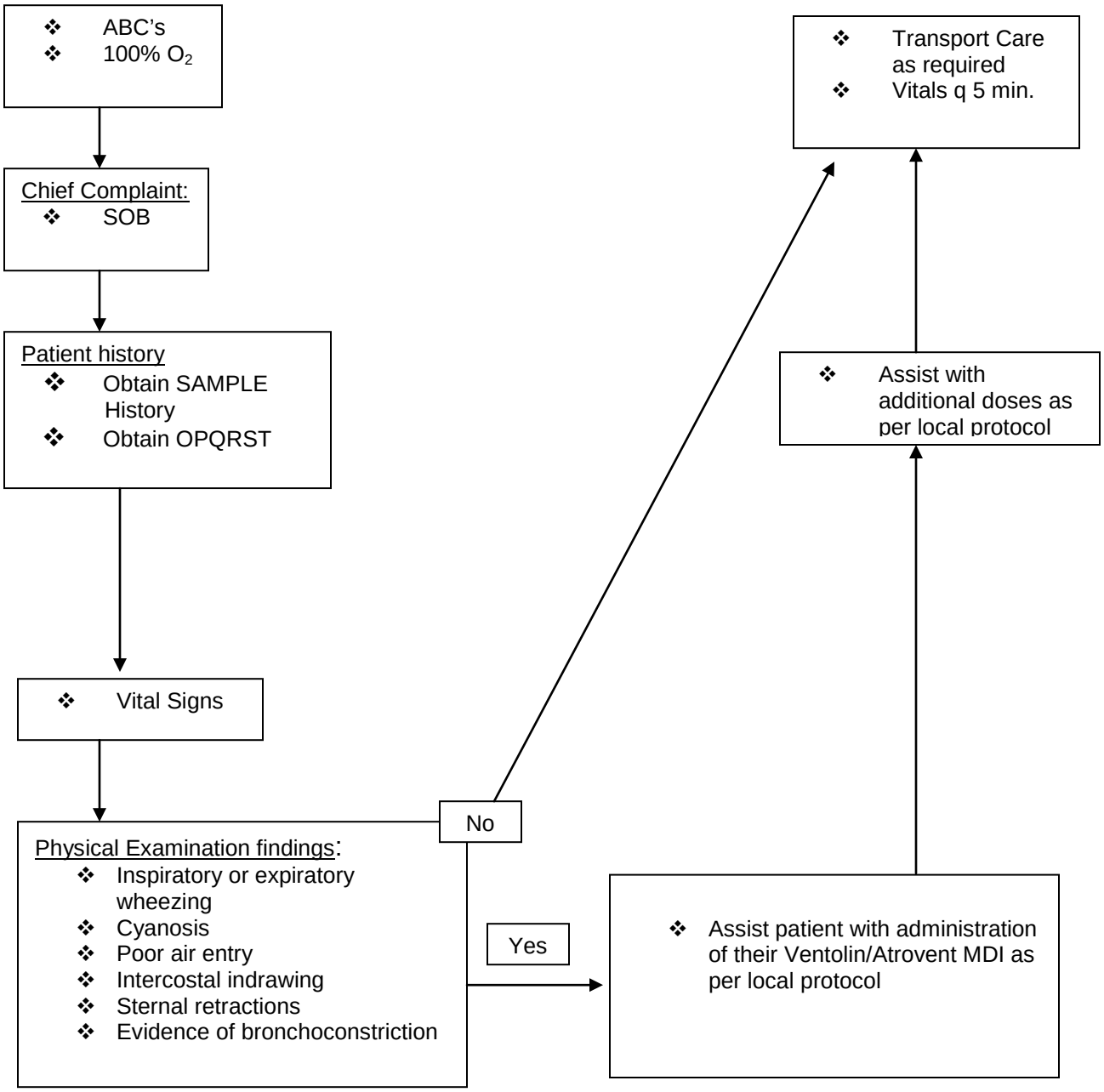
Table P-9 For Medications In The EMR Scope Of Practice

Drug	Route	Sample Dosages
Oral Glucose	Oral	25 g
ASA	Oral	160 – 325 mg
Epi-Pen	IM	0.3 mg
Epi-Pen Jr.	IM	0.15 mg
Ventolin	MDI	100 mcg/spray
Atrovent	MDI	20 mcg/spray

On the following pages are flow charts for the conditions and medications discussed in this module. The EMR will need to ensure that he/she is thoroughly familiar with all of the aspects of these flow charts in order to safely administer any medication. Lab evaluations will be based on the processes found within these charts.

In the next section of this module, you will learn how to use drug reference material to review common prescription drugs and the interactions related to administering symptom relief medication.

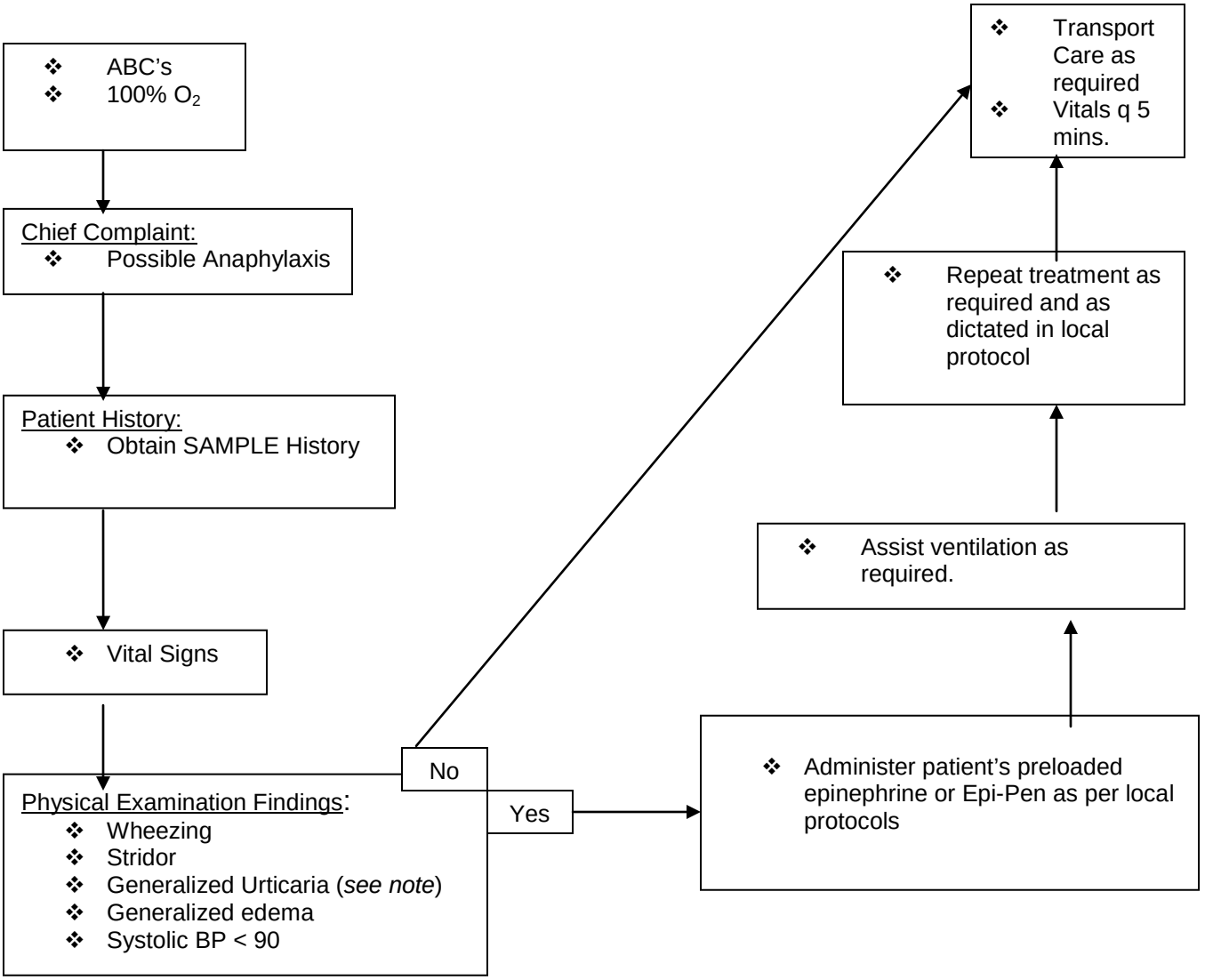
FLOW CHART FOR SHORTNESS OF BREATH



NOTE :

- Beware of the SILENT CHEST as severe bronchospasm may be present with absent air entry and no evidence of wheezing, but with other indications of shortness of breath.

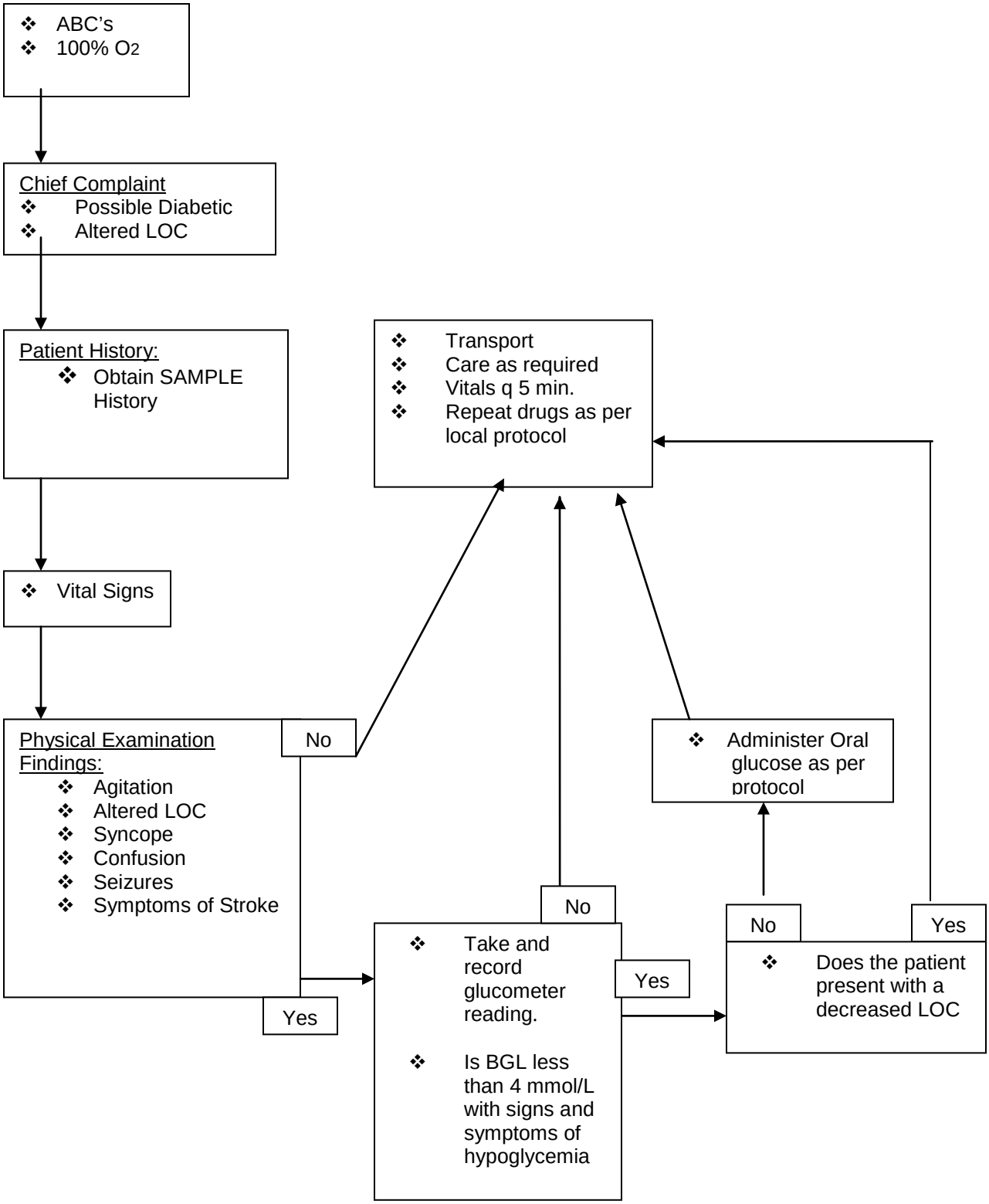
FLOW CHART FOR ANAPHYLAXIS



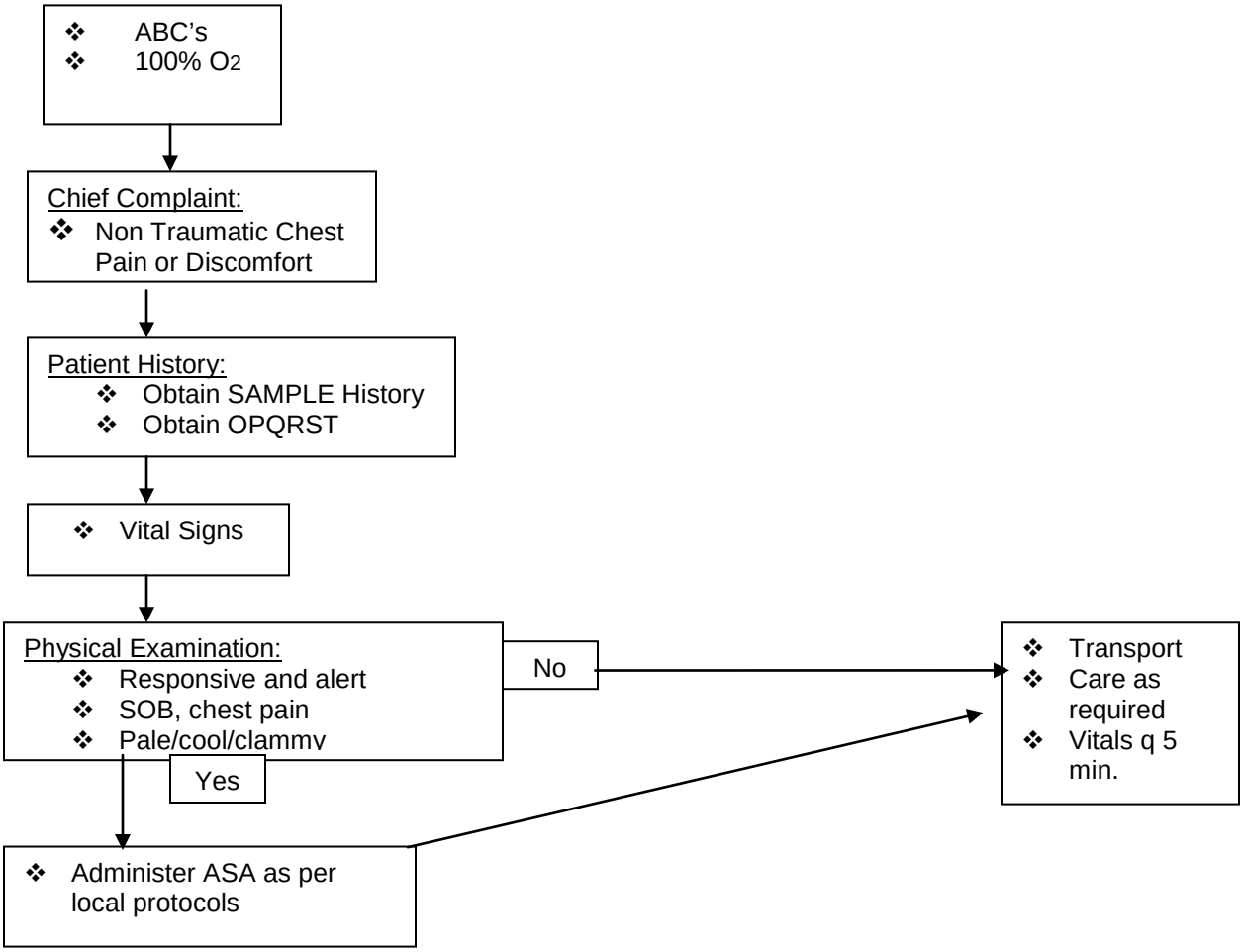
NOTE:

- Practitioners must be able to differentiate between local and systemic signs and symptoms
- Urticaria on its own is usually not an indication for administering Epinephrine.

FLOW CHART FOR HYPOGLYCEMIA



FLOW CHART FOR CARDIAC CHEST PAIN



Objective 3: Key Terms

- Six rights
- Three C's & E
- Risk versus benefit

Objective 4

Interpret Drug Reference Materials

Health Canada holds the responsibility for administering the Food and Drug Act and the Controlled Drugs and Substances Act, the two federal acts that form our national drug laws. These acts and their accompanying regulations along with the appropriate provincial laws, determine the safety, distribution, and advertising of prescription or OTC drugs. These laws also dictate the importance of performing regular drug counts and the legislation associated with wastage of controlled substances or medications. As a professional practitioner, you will be required to follow your local and service protocols regarding inventory procedures, drug requisitions and controlled substance documentation.

It is imperative for the benefit of the practitioner to continue to expand their knowledge of the drugs not only in their scope of practice but also the various medications that are found during patient care. No one person can memorize all the medications on the market, however with continued research and study, the practitioner will not only become safer but also a more knowledgeable professional.

There are a variety of reference materials available to the EMS practitioner. Common sources of reference material include the Internet, EMS pocket guides, medication pamphlets, EMS textbooks, *Compendium of Pharmaceuticals and Specialties (CPS)* to name but a few. With all of the different sources available it can seem overwhelming and quite confusing.

Navigating the Compendium of Pharmaceuticals and Specialties (CPS)

One of the more popular reference books is the CPS, which is an important tool for safe practice and continued learning. The CPS is relatively simple and easy book to use. (See Figure P-10)

There are several color-coded sections each with a different focus. Each section will have instructions on how to use the CPS and more detailed information about what each section contains. The following is merely a quick overview.

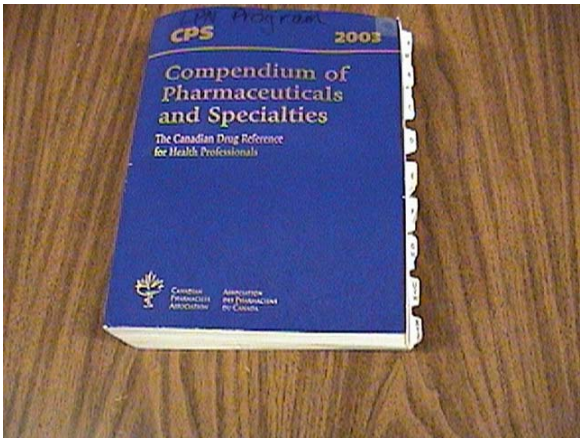


Figure P4

Table P-10 Sections Of CPS

Peach	Two sections, (1) Information on product news including information on new entries since last edition (2) Discontinued products.
Green	This section contains an alphabetical listing of brand and generic names of medication. Drug names in italics are generic names, while bold face names not underlined indicate a shortened ***monograph***. Underlining indicates detailed monograph availability.
Pink	This section lists drugs alphabetically and arranges them within *therapeutic* categories. All drugs in this section are listed by their generic name.
White	The first white section contains color pictures sent for inclusion by the various manufactures. Pictures may also include a DIN (drug identification number).
Yellow	The yellow section is further classed in three areas: (1) Poison Control Centers and including contact information in alphabetical order for across Canada (2) Health Organizations and contains a brief summary for across Canada (3) Pharmaceutical manufactures/distributors with contact information of Canadian manufactures and distributors.
Lilac	Called the Clin-Info section, provides a quick reference to practitioners for safe drug use and in a variety of circumstances such as cardiac arrest.
Blue	The blue section contains monographs to assist the health care professional to aid in patient education. The terms used in this section are in language that is easy to understand for the layperson. (Note: Not all drugs are found in this section.)
White	The second white section contains drug monographs in alphabetical order. The monographs contain detailed information on the drug such as pharmacology, indications, contraindications, precautions, adverse effects, overdose symptoms and care, dosage, and how supplied.

Drug Classifications and Families

Drugs are classified in a variety of ways. The most common classifications are the ***pharmacologic family,*** which is the drugs chemical structure and the ***therapeutic family,*** which is the mechanism of action and the resulting therapeutic effect is has on the body. (Refer to the pink section of the CPS).

Please note: A particular drug may produce multiple therapeutic effects and as a result be listed under multiple therapeutic families.

There is usually one drug within the family that will be considered the prototype and all other drugs within this family will be compared to it. For example, morphine (opium derivative) is the prototype; all other drugs in the opiate family will be compared to morphine.

Drug names

Drug names can be quite confusing, as there can be several names for one drug. A drug can only have one generic name but can have many trade names. For simplistic purposes drugs can have three different names:

- Chemical Name
- Trade Name (proprietary or brand name)
- Generic Name (nonproprietary name)

When a drug is first invented it will be given a ***chemical name*** based on the drug's molecular structure and chemical composition.

A ***trade name*** is the name that is always capitalized (a proper noun) and given to the drug by the manufacturer. A drug may have several trade names, depending on the number of companies producing it, but will have only one generic name.

The ***generic name*** is usually some abbreviated form of the chemical name and will not be capitalized.

Objective 4: Key Terms

- Compendium of Pharmaceuticals and Specialties (CPS)
- Monograph
- Pharmacologic family
- Therapeutic family
- Chemical name
- Trade name
- Generic name

Objective 5

Demonstrate Knowledge of and the Correct Procedure for Glucometric Testing

Theory Review

Glucose is required by the body to maintain normal functions. Glucose molecules cross the cell membranes by active transport. Insulin, which is produced by the pancreas, is necessary for this process to take place. In a normal person the body is able to balance the glucose levels. Diabetic patients do not inherently have the ability to balance the glucose and insulin levels due to a lack of adequate insulin secretion from the pancreas. The two types of Diabetes Mellitus will be discussed here.

Type I (often are insulin dependant) - is when the patient does not produce enough insulin and often becomes insulin dependent. This type develops in childhood and has been referred to as Juvenile Diabetes. Because of the long duration of the disease, organs such as the heart, kidney, eyes and nerves can be affected due to unstable and often excessive levels of sugar in the blood. This type of diabetes can also develop later in life.

Type II (often are non-insulin dependant) – is when the patient is not producing enough insulin automatically but can be controlled by either diet alone or medication and diet. This type appears later in life and the patient often takes medications to increase insulin release, reduce production of glucose in the liver, or increase the sensitivity of insulin receptor sites. The patient may be taking one or a combination of these medications to regulate their blood sugar.

It is important for the diabetic to balance their food intake with physical activity and to minimize illness or other stressors in order to manage the disease. Each of these factors can cause sharp fluctuations in blood sugar concentrations. They also need to be effective in insulin administration and rotation of injection sites if they are insulin dependant.

Diabetic emergencies are referred to as the following:

1. **Hypoglycemia** – abnormally low levels of sugar levels.
2. **Hyperglycemia** – abnormally high levels of sugar levels.
3. **Diabetic Coma/Ketoacidosis** (slow onset) – inadequate amounts of insulin in the body resulting in severe hyperglycemia and ketoacidosis, polyuria (excessive urination), polydipsia (excessive thirst), and polyphagia (excessive hunger).

4. **Insulin Shock** (rapid onset) – is a state of excessive levels of insulin in relation to the available sugar in the blood thereby causing a state of hypoglycemia. The excessive insulin causes the uptake of all available glucose into the cells. The resulting lack of available sugar deprives the brain of required energy and causes a release of epinephrine, which accounts for the shock-like symptoms of this imbalance. If the glucose levels remain low for any amount of time, permanent brain damage may occur. Symptoms include sweating, tremors, palpitations, bizarre behavior, and eventually coma if left untreated.

Do not confuse a diabetic emergency with a drunken state; the signs can be very similar.

Normal Values

Blood glucose levels (BGL) should be obtained on all patients with an altered level of consciousness.

Normal BGL is 3.8 mmol/L to 7.0 mmol/L. It is important to evaluate your patient not just the BGL monitor as some people can be outside of these "normal" readings and be asymptomatic. The normal values are given as a guideline only as some individual "normals" may be outside of these values.

BGL above 8 mmol/L may result in the following signs & symptoms – extreme thirst, weakness, fatigue, weight loss, blurred vision, frequent urination and altered LOC.

BGL below 3.8 mmol/L may result in the following signs & symptoms – hunger, nausea, weakness, headache, sweating, irritability, shaking, confusion and altered LOC.

Both conditions can be life threatening if they are left untreated.

Blood Glucose Monitors

There are a variety of BGL monitors on the market. Knowing the manufacturers procedures when operating them will ensure that the practitioner will obtain accurate results. As with any procedure, PPE precautions need to be implemented with this procedure.

When preparing the patient for a blood glucose test, the practitioner must fully inform him/her of the expected sensation and reason for doing the testing thus obtaining consent. The practitioner must also ensure he/she has the following equipment ready and within reach.

1. Blood glucose monitor – ensure it is on and reagent strip is inserted if required by the particular model.
2. Alcohol swab
3. 2x2 gauze
4. Bandaid
5. Lancet
6. BGL (reagent) strips (check expiry date and monitor settings if applicable)

The site that the practitioner will use is generally the middle or index finger. Preference is given to the outside of the finger tip as opposed to the pad as it is less painful and is not used to the same extent on a daily basis. Massage the finger to bring blood to the area to be prepped. The site is prepared by rubbing an alcohol swab in a circular motion moving from the inside to the outside to move bacteria away from the site. Hold the finger firmly to ensure minimal movement and gently pierce the finger. The lancet used most commonly today is the Safe-T-Pro™, Roche™, which comes with a holder to reduce the chance of needlestick injury and cross transmission of blood borne pathogens from reusable activators. The lancet should be held firmly but gently against the site and the lancet activated by pushing the blue bar on top of the lancet. Wipe away the first drop of blood and massage the finger for more blood. Being careful not to touch the reagent strip, drop a full drop of blood over the reagent area and await the reading. Cover the site with a bandage to keep the site clean.

As there are many different types of monitors, it is important that the EMR become familiar with the operation of the monitor used in their service.

Documentation

Once the reading has been obtained, it must be recorded on the Patient Care Report (PCR), including the time it was taken. Ensure you document the current patient condition including any symptoms the patient is having that relate to the BGL measurement. Also be sure to record the time the measurement was taken and any treatment administered as a result of the reading.

Objective 5: Key Terms

- Hypoglycemia
- Hyperglycemia
- Diabetic Coma
- Insulin Shock
- Polyuria
- Polydipsia
- Polyphagia
- Ketoacidosis
- BGL

Summary

This module has addressed various medications and the administration methods that will be utilized by the EMR when the new scope of practice is approved. As you have read, the administration of medication comes with a great deal of responsibility and risk. This area of your practice requires ongoing study to ensure you are always up to date with the latest research and that you are immediately aware of any changes to the risks associated with any of the medications. This includes any interactions with other new or current medications on the market. Once the pharmacology covered in this module is approved, you will need to ensure that your medical director approves the implementation of this in your service. Until that time, study and practice to prepare for it. When working with your patients, consider everything you have learned that applies to the patient presentation so you will begin to mentally implement the application of pharmacology. The ultimate responsibility lies with the practitioner to ensure ongoing competence.

Exam

1. Drugs administered orally and absorbed in the gastrointestinal tract are classified as:
   a. Enteral
   b. Parenteral
   c. Pulmonary
   d. Internal

2. A SQ injection is introduced:
   a. Beneath the skin and above the dermal layer at a 45-degree angle
   b. Beneath the skin and below the dermal layer at a 45-degree angle
   c. Beneath the skin and below the dermal layer at a 35-degree angle
   d. Beneath the connective tissue and into the muscle at a 90-degree angle

3. An IM injection is:
   a. Better than IV as they are as quick and less invasive
   b. Absorbed quicker than a subcutaneous injection
   c. Absorption rates similar to an intravenous injection
   d. Has a similar rate of absorption to a subcutaneous injection

4. The maximum amount of fluid to be injected IM into the deltoid muscle in a adult male is:
   a. ½ ml
   b. 1 ml
   c. 2 ½ ml
   d. 2 ml

5. Medications that are administered SL absorb at a _____rate.
   a. Slow
   b. Rapid
   c. Moderate
   d. Same as Oral

6. The components of pharmacokinetics are:
   a. Absorption, distribution, diffusion and radiation
   b. Conduction, convection, and radiation
   c. Absorption, perfusion, biotransformation, and excretion
   d. Absorption, distribution, biotransformation, and elimination

7. The term “half life” means:
   a. The shelf life of the drug
   b. The time the body takes to eliminate half the drug
   c. Taking half of the recommended dose
   d. None of the above

8. Define pharmacology:
    a. The study of drugs and their actions on living organisms
    b. The study of metabolic rates of the body
    c. The study of medication dispensing
    d. The study of drug allergies

9. The five factors that affect drug absorption are:
    a. Absorption, distribution, biotransformation, metabolism, and elimination
    b. Dissolution, solubility, pH, blood flow, and surface area
    c. Distribution, dissolution, solubility, metabolism, and blood flow
    d. Distribution, biotransformation, pH, blood flow and metabolism

10. Drug biotransformation is defined as:
    a. The elimination of the drug
    b. The time it takes to eliminate the drug
    c. The enzymatic alteration of drug structure
    d. The transport of a drug from the site of absorption

11. The first name given to a drug when it is first developed is:
    a. Generic Name
    b. Chemical Name
    c. Official Name
    d. Trade Name

12. CPS stands for:
    a. Compendium of Pharmaceuticals and Specialties
    b. Complete Pharmaceutical System
    c. Compendium of Pharmaceutical System
    d. Categorized Pharmaceutical System

13. Epinephrine is a:
    a. Chemical Name
    b. Trade Name
    c. Universal Name
    d. Generic Name

14. What two federal acts form the national drug laws?
    a. Controlled Drugs and Substances Act & Over the Counter and Prescription Drug Act
    b. Food and Drug Act & Controlled Drugs and Substances Act
    c. The National Controlled Substances Act & Food and Prescribed Drugs Act
    d. Food and Drug Act & the Over the Counter and Prescription Drug Act

15. ASA is a:
    a. Trade Name
    b. Chemical Name
    c. Generic Name
    d. None of the Above

16. When documenting the administration of medication it is important to document:
    a. The 3 C's and an E
    b. The drug administered, time, route, concentration, dose, person who administered the drug and how the patient responded to it
    c. The drug administered and how the patient responded
    d. Documentation is only required when an error has been made

17. How many times should a drug be examined prior to administration?
    a. 1 time
    b. 2 times
    c. 3 times
    d. 4 times

18. When referring to the 3 C's, what do they represent?
    a. Clarity, checking & consistency
    b. Color, consistency & concentration
    c. Color, clarity & concentration
    d. Color, concentration and check

19. The 6 rights when administering medications are:
    a. Right patient, drug, time, dose, route, and documentation
    b. Right drug, time, dose, route, documentation and concentration
    c. Right color, clarity, concentration, consistency, route, and drug
    d. Right patient, drug, concentration, color, route, and clarity

20. The proper angle for an IM injection of an Epi-Pen is:
    a. 35°
    b. 45°
    c. 60°
    d. 90°

21. Epi-Pen dosage for the Adult & Jr. are:
    a. 0.45 mg & 0.35 mg
    b. 0.75 mg & 0.60 mg
    c. 0.30 mg & 0.15 mg
    d. 0.25 mg & 0.10 mg

22. When the Epi-Pen has been administered, how long does the practitioner hold it in place?
    a. 5 seconds
    b. 10 seconds
    c. 15 seconds
    d. 30 seconds

23. When a patient has a BGL of 2.2 mmol/litre, what are they suffering from?
    a. Hyperglycemia
    b. Hypoglycemia
    c. Diabetic coma
    d. Ketoacidosis

24. A patient presenting with insulin shock will have:
    a. Rapid onset with excessive levels of insulin in relation to blood sugar
    b. Slow onset with inadequate amounts of insulin resulting in severe hyperglycemia
    c. Rapid onset with inadequate amounts of insulin resulting in sever hyperglycemia
    d. Slow onset with excess levels of insulin in relation to blood sugar

25. The normal BGL is:
    a. 5.8 mmol/L – 8.0 mmol/L
    b. 4.8 mmol/L – 10 mmol/L
    c. 3.8 mmol/L – 7.0 mmol/L
    d. 2.8 mmol/L – 8.0 mmol/L

Glossary of Terms

Objective 1: Key Terms

Drug Routes – The means by which the drug is introduced into the body
Enteral – is the introduction of medication into the body via the gastrointestinal tract
Parenteral – Not through the alimentary canal, eg…by subcutaneous, intramuscular, intrasternal, or intravenous injection.
Oral(PO) – Pertaining to the mouth; taken through or applied in the mouth, as an oral medication or an oral thermometer
Intramuscular (IM) – Within the muscle
Inhalation – The drawing of air or other substances into the lungs
Tablets – a solid dosage form containing a medicinal substance with or without a suitable diluent
Autoinjector – a hypodermic syringe used to inject yourself with a liquid
Paste – a mixture of a soft and malleable consistency
Metered-dose inhaler (MDI) – a device for administering medications by inhalation

Objective 2: Key Terms

Dissolution – The process in which one substance is dissolved in another
Pharmacodynamic phase - The study of drugs and their effect on living tissues
Pharmaceutical phase - The form of how a drug is prepared such as a solid, liquid or gas
Pharmacokinetic phase - The study of how a drug enters the body, its site of action and the drugs elimination from the body
Affinity – attraction; tendency to seek out or unite with another object or substance
Polypharmacy - is common among the elderly in that the patient is often on several medications
Absorption – The act of taking up or in by specific chemical or molecular action; especially the passage of liquids or other substances through a surface of the body into body fluids and tissues, as in the absorption of the end products of digestion into the villi that line the intestine
Distribution – This is the transport of a drug from the site of absorption to the site or sites of action
Biotransformation – The series of chemical alterations of a compound occurring within the body, as by enzymatic activity
Elimination – Elimination of metabolites from the body is primarily carried out by the kidneys and excreted through urine

Objective 3: Key Terms

Six rights – Right patient, right time, fight route, right drug, right dose, right documentation
Three C's & E – Color, clarity, concentration and expiration
Risk versus benefit – Does the benefit of administering a drug outweigh the risks

Objective 4: Key Terms

CPS - Compendium of Pharmaceuticals and Specialties
Monograph - Contain detailed information on the drug such as pharmacology, indications, contraindications, precautions, adverse effects, overdose symptoms and care, dosage, and how supplied
Pharmacologic family – The drugs chemical structure
Therapeutic family – The mechanism of action and the resulting therapeutic effect it has on the body
Chemical name – The first name given to a drug
Trade name - The name that is always capitalized and given to drug by the manufacturer (proper noun)
Generic name - Usually some form of abbreviated name of the chemical name and will not be capitalized

Objective 5: Key Terms

Hypoglycemia – An abnormally low level of sugar in the blood
Hyperglycemia – An abnormally high level of sugar in the blood
Diabetic Coma - Inadequate amounts of insulin in the body resulting in severe hyperglycemia and Ketoacidosis, Polyuria, Polydipsia, and Polyphagia
Insulin Shock - Excessive levels of insulin in relation to the available sugar in the blood thereby causing a state of hypoglycemia
Polyuria – Excessive urination
Polydipsia – Excessive thirst
Polyphagia – Excessive hunger
Ketoacidosis – The accumulation of ketone bodies in the blood, which results in metabolic acidosis
BGL – Blood glucose level

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Appendix A

Generic Name: Medical oxygen

Trade Name:

Classification: Medicinal gas

Supplied: compressed gas cylinder

Characteristics

- Colorless, odorless, tasteless gas essential to respiration
- At sea level, oxygen makes up approximately 10% - 16% of venous blood and 17% - 21% of arterial blood

Actions (Pharmacodynamics):

- Transported from the lungs to the body's tissues attached to hemoglobin in the red blood cells
- Inhalation/administration will increase oxygen concentration

Indications:

- Hypoxia from any cause
- Chest pain due to cardiac ischemia
- Altered level of consciousness

Dosage: Nasal Cannula: @ 1-6 L/min (24% - 40% O_2 concentration)
Simple & Pocket Mask: @ 6 – 10 L/min (40% - 60% O_2 concentration)
Partial/ Non-Rebreather (NRB): @ 10 – 15 L/min (up to 98% O_2 concentration)
Bag-Valve Mask (BVM): @ 10 – 15 L/min (up to 100% O_2 concentration)
Venturi Masks: @ 4 L/min (24% - 28% O_2 concentration)
@ 8 L/min (35% - 40% O_2 concentration)
Note: liter flow is dependent on the Venturi mask used

Route: Inhalation

Contraindications:

- None for emergency use

Precautions:

- *Respiratory:* In some cases of COPD, oxygen administration may reduce the patient's respiratory drive
  Note: This is not a reason to withhold oxygen, but be prepared to assist ventilations
- Oxygen that is not humidified may dry out or be irritating to mucous membranes

Generic Name: Glucose (oral)
Trade Name: Insta-glucose, Monogel
Classification: glucose
Supplied: 25 g/tube or 15 g/tablet
Actions (Pharmacodynamics): • A monosaccharide that is given orally and is readily absorbed in the intestine
Indications: • Hypoglycemia in patients who are alert, are able to follow commands & can swallow
Dosage: Adult – 25 g orally (may repeat in 10 minutes if necessary) (Administer the entire contents of tube (25 g) slowly and intermittently while patient swallows)
Route: Oral
Contraindications: • Any patient who is not alert • Any patient unable to follow commands • Any patient who lacks a gag reflex • Hyperglycemia
Precautions: • May cause nausea or the patient may gag when administered
Note: • Oral glucose is not absorbed sublingually or buccally

Generic Name: Acetylsalicylic acid

Trade Name: Novasen (Canada), Aspirin, ASA, Bufferin

Classification: salicylate, antiplatelet, antipyretic, anti-inflammatory, non-opioid analgesic

Supplied: 80 or 81 mg, 325 mg, 500 mg, 650 mg tabs

Actions (Pharmacodynamics):

- *Anticoagulant:* at low doses, appears to impede clotting by blocking prostaglandin synthesis, which prevents formation of platelet-aggregating substance thromboxane A_2 (this is irreversible and can prolong bleeding time)
- *Analgesia/anti-inflammatory:* inhibits the synthesis of prostaglandin, preventing or reducing pain
- *Antipyretic:* acts on the hypothalamus to produce peripheral vasodilation causing sweating which leads to heat loss and cooling by evaporation

Indications: Acute coronary syndromes suggestive of an acute myocardial infarction

Dosage: Adult - 160-325 mg chewed as soon as possible

*__Note__: Give even if patient has taken ASA (doses higher than 1000 mg may limit beneficial effect)

Contraindications:

- Hypersensitivity: **SEVERE** allergy (known)
- Bleeding disorders (hemophilia, von Willebrand's disease)
- Unconsciousness

Precautions:

- Active ulcer disease, asthma
- Impaired renal and hepatic function
- May produce bronchoconstriction in asthmatics
- Children and adolescents with influenza or chickenpox infections (May increase the risk of Reye's syndrome)
- Reye's syndrome is a rare but serious illness in childhood that has a mortality rate of 20-30%. Symptoms are encephalopathy and fatty liver degeneration

Note:

- The effects of a single dose of aspirin persist for the life of the platelet (about 8 days)

Generic Name: Epinephrine

Trade Name: Adrenalin

Classification: adrenergic agonist (sympathomimetic)

Supplied: 1:1000 multidose vial 30 mg/30ml, 1:1000 ampule 1 mg/ml,
Epi Pen™ 0.3 mg, Epi Pen™ Jr 0.15 mg 1: 1000 (Autoinjector only for EMR administration)

Actions (Pharmacodynamics):

- Directly stimulates the alpha and beta-adrenergic receptors in the sympathetic nervous system.
- *Bronchodilation:* relaxes bronchial smooth muscle ($beta_2$ receptors) and inhibits histamine release.
- *CV and vasopressor:* produces positive chronotropic and inotropic effects ($beta_1$ receptors); increasing cardiac output, myocardial oxygen consumption and force of contraction. Vasodilation ($beta_2$ receptors) and vasoconstriction (alpha receptors).

Indications: Anaphylaxis

Dosage:

Adult - 0.3mg (1:1000) IM
Repeat q 5-10 minutes prn

Pediatric- 0.01 mg/kg IM/SQ (do not exceed 0.3 mg)

***Note**: Epinephrine dose is based on body weight. The EpiPen™ auto-injector (0.3 mg) is for patients weighing more than 66 lbs/30 kg while the EpiPen™ Jr (0.15 mg) is for patients weighing between 33 lbs/15 kg and 66 lbs/30 kg.

Route: subcutaneous or intramuscular (IM preferred)

Contraindications:

- None in the emergent setting

Precautions:

- Do not mix with alkaline solutions

Note:

- Messaging the site after an IM injection may hasten absorption.

Generic Name: Salbutamol (Canada), albuterol sulfate (US)

Trade Name: Ventolin

Classification: bronchodilator, $beta_2$-selective adrenergic agonist (sympathomimetic)

Supplied: 2.5 mL nebule (1mg/mL), MDI 100 mcg/spray, Combivent (Ventolin 2.5 mg/Atrovent 500 mcg)

Actions (Pharmacodynamics):

- Selectively stimulates beta-adrenergic receptors of the lungs, uterus, and vascular smooth muscle
- Brochodilation results from relaxation of the vascular smooth muscles, which relieves bronchospasm and reduces airway resistance
- Higher doses will drive serum potassium (K+) into the cells

Indications:

- Bronchospasm due to bronchial asthma, chronic bronchitis and other chronic bronchopulmonary disorders
- Respiratory distress with bronchospasm

Dosage:

Adult - 2.5 – 5.0 mg nebule – repeat q 10 minutes prn
MDI minimum 6 puffs max 20

Pediatric – 0.15 mg/kg diluted to 2.5 ml saline via nebulizer
or < 10 kg give 1.25 mg with NS to 2.5 ml
10-20 kg give 2.5 mg
> 20 kg give 2.5 – 5.0 mg
MDI pediatrics minimum 2 puff max 10

Route: Nebulizer or metered dose inhaler

Contraindications:

- Hypersensitivity

Precautions:

- Should not be used with patients presenting with acute heart failure Cardiovascular disease – cardiac dysrhythmias, hypertension
- Diabetes mellitus – risk of drug induced hyperglycemia
- Hypokalemia – risk further reducing serum potassium levels and possible adverse cardiovascular events

Generic Name: Ipratropium bromide

Trade Name: Atrovent

Classification: anti-cholinergic, bronchodilator

Supplied: 250 mcg, 500 mcg in 2.5 ml nebule, MDI 20 mcg/spray, Combivent (Ventolin 2.5 mg/Atrovent 500 mcg)

Actions (Pharmacodynamics):

- Inhibits cholinergic receptors in the bronchial smooth muscle, resulting in decreased concentrations of cyclic guanosine monophosphate (cyclic GMP). Decreased levels of cyclic GMP produce local, not systemic, bronchodilation

Indications: bronchospasm in asthma, chronic bronchitis and emphysema

Dosage: **Adult -** 250 –500 mcg via nebulizer with salbutamol (mixed) repeat up to two times if necessary

***Note:** Normally only 1-2 doses in other conditions (eg. emphysema, chronic bronchitis)

Combivent: 2.5 – 5.0 ml nebule – repeat q 10 minutes prn (not to exceed max dose for Atrovent)

MDI: minimum 1-4 puffs prn; max 10
(give after salbutamol; ipratropium has a much slower onset of action)

Pediatric (ages 5-11) – 25-250 mcg via nebulizer with salbutamol (mixed) repeat up to times two if necessary

MDI: minimum 2 puff prn; max 4 (give after salbutamol; ipratropium has a much slower onset of action)

***Note:** safety and efficacy in children under 12 years of age haven't been established

Contraindications:

- Hypersensitivity to drug or atropine or its derivatives

Precautions:

- Hypersensitivity to soy lecithin or related food products (soybeans, peanuts)
- Patients with narrow angle glaucoma
- Be careful to avoid accidental release into the eyes (use mouth piece neb if possible)

Appendix B

Lab Skills Checklist

ADMINISTRATION OF MEDICATION VIA INTRAMUSCULAR – (EPI-PEN)

- ❑ Apply PPE precautions
- ❑ Perform patient assessment
- ❑ Obtain history and baseline vital signs
- ❑ Determine treatment plan
- ❑ Select appropriate medication and route
- ❑ List indications and contraindications for medication and route
- ❑ Obtain consent and prepare patient for procedure
- ❑ Assemble equipment and supplies
- ❑ Confirm the medication is required (Adult: 0.3 mg, Pediatric: 0.15 mg of Epinephrine 1:1000)
- ❑ Apply the 6 Rights of medication administration
- ❑ Assess medication for color, clarity, concentration, and expiry date
- ❑ Remove the gray safety cap from the top end of the auto injector
- ❑ Clean and prep the injection site
- ❑ Pressing the black tip of the auto injector against the patient's outer thigh (*vastus lateralis muscle*) push hard until the needle enters the skin (hold in place for 10 seconds so the epinephrine can enter the muscle)
- ❑ Massage the site with a sterile gauze pad
- ❑ Reassess patient and vital signs
- ❑ Determine any adverse affects from medication
- ❑ Document PCR: medication, time, dose, route, vital signs, and effects of treatment

Comments:

Instructor Name &Initials: _____ *Date:* _____

Lab Skills Checklist

ADMINISTRATION OF MEDICATION VIA ORAL - (ASA, GLUCOSE GEL)

- ❑ Apply PPE precautions
- ❑ Perform patient assessment, ensure they can maintain their own airway
- ❑ Obtain SAMPLE history and baseline vital signs
- ❑ Determine treatment plan
- ❑ Select appropriate medication and route
- ❑ List indications and contraindications for medication and route
- ❑ Obtain consent and prepare patient for procedure
- ❑ Assemble equipment and supplies
- ❑ Confirm the medication is required
- ❑ Apply the 6 Rights of medication administration
- ❑ Assess medication for color, clarity, concentration, and expiry date
- ❑ Place medication in patient's mouth (ASA must be chewed prior to swallowing)
- ❑ Ensure medication is swallowed; water should be given as necessary
- ❑ Reassess patient and vital signs
- ❑ Determine any adverse affects from medication
- ❑ Document: medication, time, dose, route, v/s and effects of treatment
- ❑ Document PCR: medication, time, dose, route, vital signs, and effects of treatment

Comments:

Instructor Name &Initials: _____ *Date:* _____

Lab Skills Checklist

ADMINISTRATION OF MEDICATION MDI - (VENTOLIN, ATROVENT)

- ❑ Apply PPE precautions
- ❑ Perform patient assessment
- ❑ Obtain SAMPLE history and baseline vital signs
- ❑ Determine treatment plan
- ❑ Select appropriate medication and route
- ❑ List indications and contraindications for medication and route
- ❑ Obtain consent and prepare patient for procedure
- ❑ Assemble equipment and supplies
- ❑ Confirm the medication is required
- ❑ Apply the 6 Rights of medication administration
- ❑ Assess medication for concentration and expiry date
- ❑ Shake canister well for 30 – 60 seconds to mix medication and propellant
- ❑ Instruct the patient to take a slow deep breath as you depress the canister; which will deliver one dose through the spacer chamber used with MDI's. The patient should hold their breath for up to 10 seconds before exhaling (if they are able) immediately after inhaling the medication (repeat as per protocol)
- ❑ Resume oxygen treatment after administration of the medication
- ❑ Reassess patient and vital signs
- ❑ Determine any adverse affects from medication
- ❑ Document: medication, time, dose, route, v/s and effects of treatment

Comments:

Instructor Name &Initials: _____ *Date:* _____

Lab Skills Checklist

BLOOD GLUCOMETER TESTING

- ❑ Apply PPE precautions
- ❑ Perform patient assessment
- ❑ Obtain SAMPLE history and baseline vital signs
- ❑ Determine the need for a BGL
- ❑ Obtain consent and prepare patient for procedure
- ❑ Assemble equipment and supplies
- ❑ Explain the procedure to the patient
- ❑ Gently message the finger near the joint to increase blood flow
- ❑ Wipe the finger in a circular motion with an alcohol swab
- ❑ With a lancet pierce the skin
- ❑ Wipe away the first drops of blood and squeeze out more
- ❑ Apply adequate amount of blood to the test strip
- ❑ Document findings
- ❑ Apply a bandage to the site
- ❑ Dispose of materials in the sharps container / biohazard container

Comments:

Instructor Name &Initials: _____ *Date:* _____