What is a Clinical Pharmacist?

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How to Benefit Most from your Clinical Pharmacist
How Does Clinical Pharmacy Differ From Pharmacy?

• The discipline of pharmacy embraces the knowledge on synthesis, chemistry and preparation of drugs

• Clinical pharmacy is more oriented to the analysis of population needs with regards to medicines, ways of administration, patterns of use and drugs effects on the patients.

• The focus of attention moves from the drug to the single patient or population receiving drugs.
### “traditional” vs. “clinical pharmacy”

<table>
<thead>
<tr>
<th>Traditional pharmacy services</th>
<th>Clinical pharmacy services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesis and chemistry of medication</td>
<td>Individualized medication monitoring and evaluation</td>
</tr>
<tr>
<td>Preparation of drugs</td>
<td>Patient-centered care</td>
</tr>
<tr>
<td>Dispensing medication services</td>
<td>Integrated healthcare team in which the pharmacist is directly involved in patient care</td>
</tr>
<tr>
<td><strong>PRODUCT</strong> focus</td>
<td><strong>PATIENT</strong> focus</td>
</tr>
</tbody>
</table>
Pharmacy Education

• 1821-1940’s
  • Graduate in Pharmacy (Ph. G.) 2 year
  • Pharmaceutical Chemist (Ph.C.) extra year
  • Doctor of Pharmacy (Phar. D.) required “further study”

• 1940’s-1990’s
  • B.S. Pharm. 5 years

• Pharm.D 1950
  • Three year post-B.S. Pharm. program 1950’s – 1990’s
  • 1970’s PGY, Fellowship

• Since mid 1990’s all pharmacy degrees are Pharm. D.
  • Six year program
  • PGY 1, 2 year. Fellowship

A mixture of Pharm.D.s are currently in practice
Thanks to PENICILLIN

...He Will Come Home!
Explosion in Drug Development
BCPS
Board Certified Pharmacotherapy Specialist

- Nuclear Pharmacy
- Pediatric
- Cardiology
- Pharmacotherapy
- Ambulatory Care
- Nutrition Support
- Oncology
- Critical Care
- Psychiatric
- Infectious Disease
Pharmacogenomics (PGx)

Image accessed from: http://mytorontocanadambastudentexperience.blogspot.com/2012/10/personalized-medicine-or-p4-medicine.html
Will Pharmacogenomic Testing Replace Clinical Pharmacy?

Factors That Influence Drug Response

Ambulatory Care

• Veterans Administration, public health services have been the model adopted by most US hospitals / clinics.

• Lipid, CHF, asthma, HTN, diabetes clinics have been advocated and are in place especially in underserved areas.

• Warfarin Clinic
  • Most established pharmacist run ambulatory program
  • Well validated studies supporting improved time in therapeutic range compared to provider run programs.

• Billing remains a stumbling block in many states.
Nutrition support

• Integrated team
  • MD, RD, Pharm.D.

• MD initiates order for PN
  • Discussion with Dietary
  • If PN continues, MD is responsible for deciding on fluid volume / day. The rest is up to Dietician and Pharmacy.
Parenteral Nutrition, Days Therapy, Patient #s

PN Service initiated

Days of therapy
Number of Patients
Oncology

• Expertise in dosing.
  • Renal or myelosuppressive issues modifying dose
• Counseling patients on ADE, compliance, herbals
Critical Care

• Complex patients
• Drug interactions,
• Sedation protocols
  • Assisting nurses with selection of drug choice, dose
• Delirium assessment
  • CAM-ICU scoring, daily wake up trials
• TDM
Therapeutic Drug Monitoring (TDM) refers to analysis and subsequent interpretation of drug concentrations in biological fluids.
PLACE

TDM should be used to
maximise efficacy
minimise toxicity

To personalise dosing for high probability of therapeutic success, prevent development of resistance, provide low probability of toxicity
AMINOGLYCOSIDES AND GLYCOPROTEOPEPTIDES

Assays developed for side-effect profiles
Large market to prevent toxicity
Rapid turnaround, easy to use immunoassays
TDM should be used to

maximise efficacy

minimize toxicity
BETA-LACTAMS

Safe drugs
Large therapeutic range

TDM should be used to
maximise efficacy
minimise toxicity
Pathophysiologic Factors Affecting Drug Concentration

- Decreased GFR
  - Est CLcr works when you don’t need it
- Augmented Renal Clearance (GFR > 130ml/min)
  - Sepsis, Vasopressors, Trauma, TBI
- Decreased hepatic function
  - Hypoalbuminemia, hepatitis, enzyme inhibition
- Augmented hepatic function
  - Metabolic phenotype, enzyme induction
- Fluid resuscitation
  - Increased Vd, Cl.
- Sepsis, TBI, Burns, Trauma, Age, Pregnancy, ECMO, Dialysis
• **When Not to Use Creatinine-based Estimating Equations**
  
  Creatinine-based estimating equations may not be suitable for all populations. Creatinine-based estimates of kidney function are only useful when renal function is stable; serum creatinine values obtained while kidney function is changing will not provide accurate estimates of kidney function.

• Creatinine-based estimating equations are not recommended for use with:

  • Individuals with unstable creatinine concentrations. This includes pregnant women; patients with serious co-morbid conditions; and hospitalized patients, particularly those with acute renal failure. Creatinine-based estimating equations should be used only for patients with stable creatinine concentrations.

Clcr Pitfalls
(when used as a tool for Drug monitoring)

Clcr 100ml/min

90ml/min filtered
10ml/min secreted

Clcr 50ml/min

40ml/min filtered
10ml/min secreted

Clcr 25ml/min

15ml/min filtered
10ml/min secreted
Augmented Renal Clearance

Younger patients (<50 yrs old) with “normal” renal function and some type of inflammatory response
Especially with fluid loads or pressors
Augmented Renal Clearance

Augmented Renal Clearance
Cr Cl > 130ml/min

Creatinine clearance

Lipman et al Anesth Analg 2003
Cefoteline  × Cefpirome
Augmented Renal Clearance in the ICU: Results of a Multicenter Observational Study of Renal Function in Critically Ill Patients With Normal Plasma Creatinine Concentrations

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UDY et al Critical Care Medicine March 2014: 42 : 520-527
Decreased Hepatic Function

• Hypoalbuminemia
  • Increased volume distribution $\rightarrow$ lower drug concentration
  • Changes in protein binding (increased free fraction) effecting clearance of some drugs
• Enzyme inhibition
  • Occurs quickly, substrate drug accumulation occurs rapidly (based on $t\frac{1}{2}$ of drug)
Augmented Hepatic Function

• Enzyme induction
  • Phenytoin, carbamazepine, rifampin among many others can double or triple the metabolic transformation of substrate drugs.
  • Unlike hepatic inhibition, induction takes time to be clinically seen (10-14 days).
Fluid Resuscitation

For drugs that are primarily distributed in the vascular and extravascular space.

Many antibiotics, water soluble compounds

~15 liters

5 liters of IV fluid can as much as halve the peak drug concentration.
ERTAPENEM 1GM/DAY (??!!)

Level ‘therapeutic’ target = 100% $f_{T>MIC}$

DOSE INCR 1GM TDS
AS EXTENDED INFUSION

and only then did we get adequate levels!
FDA Labeled Dose

• Average Dose
• Average Patient
• Average Disease State
IF YOU DON’T LOOK PROPERLY
YOU WON’T SEE IT.
To Protocol or not to Protocol?
Collaborative Practice Agreements

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Creates “comfort level” between provider and pharmacist</td>
<td>• Requires updating</td>
</tr>
<tr>
<td>• Standardized process</td>
<td>• Deviations from protocol need to be documented / notification to provider</td>
</tr>
<tr>
<td>• Creates consistency within the pharmacy service</td>
<td>• Tend to limit flexibility of dosing</td>
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</tbody>
</table>
# DVT/PE/A-FIB

## SYSTEMATIC WARFARIN DOSING GUIDE

### THERAPEUTIC GOAL

**INR 2.0-3.0**

<table>
<thead>
<tr>
<th>Day</th>
<th>Description</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patient work-up unremarkable</td>
<td>5.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient at risk of hemorrhage</td>
<td>5.0 mg</td>
</tr>
<tr>
<td>2</td>
<td>No change in PTs</td>
<td>same dose day 1</td>
</tr>
<tr>
<td></td>
<td>Patient subtherapeutic</td>
<td>7.5 mg</td>
</tr>
<tr>
<td></td>
<td>Patient therapeutic</td>
<td>5.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic</td>
<td>hold</td>
</tr>
<tr>
<td>3</td>
<td>No change in PTs</td>
<td>10.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient subtherapeutic</td>
<td>7.5 mg</td>
</tr>
<tr>
<td></td>
<td>Patient therapeutic</td>
<td>5.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic</td>
<td>hold</td>
</tr>
<tr>
<td></td>
<td>Dose held previous day</td>
<td>1.0 mg</td>
</tr>
<tr>
<td>4</td>
<td>Patient subtherapeutic</td>
<td>7.5 mg</td>
</tr>
<tr>
<td></td>
<td>Patient therapeutic</td>
<td>5.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic (INR&lt;3.3)</td>
<td>1.0 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic (INR&gt;3.3)</td>
<td>hold</td>
</tr>
<tr>
<td></td>
<td>Dose held previous day</td>
<td>1.0 mg</td>
</tr>
<tr>
<td>≥5</td>
<td>Patient subtherapeutic</td>
<td>↑ by 2.5 mg</td>
</tr>
<tr>
<td></td>
<td>Patient therapeutic</td>
<td>Same Dose</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic (INR&lt;3.3)</td>
<td>↓ by 1.25 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic (INR&lt;3.5)</td>
<td>↓ by 2.5 mg</td>
</tr>
<tr>
<td></td>
<td>Patient supratherapeutic (INR&gt;3.5)</td>
<td>hold</td>
</tr>
<tr>
<td></td>
<td>Dose held previous day</td>
<td>1.0 mg</td>
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Conclusions

• The “explosion” of drugs post-WWII created a need for pharmacist with more training in personalized pharmacy care from a dosing perspective.
• Keep in mind that there are Pharm.Ds out there with significant differences in training.
• Large subsets of patients often require substantially different doses of drug.
• Drug dose protocols are mostly beneficial but can be constraining.