



Test Results Management

By Tracking Your Lab Reqs and Results
with EMR Queries

By Ian Pun, MD



Disclosure of Conflict of Interests & Commercial Support

Dr. Ian Pun's Relationship with Commercial Interests:

- Previous speaker honoraria Merck, Pfizer, Gilead, Amgen, B.I., AstraZeneca, GSK for the approved usage of their pharmaceutical products
- Research stipend: Gilead, Amgen
- No financial compensation for this current talk and I am not talking about brand name pharmaceutical products today
- No financial relationship or affiliation with EMR products

Mitigating Potential Bias

- Use evidence-based practice guidelines from Canadian and foreign sources.
- Practice guidelines from CPSO, CMPA, Canada Infoway, Diabetes Canada etc.
- Materials and Advice from online physicians OSCAR EMR user forums.
- Viewpoint from an OSCAR EMR user, so the usage of other EMRs may vary

Faculty/Presenter Disclosures

- Faculty: Dr. Ian Pun
- Family physician in Scarborough, OSCAR EMR user and contributor since 2010; background in IT
- Presents quarterly OSCAR EMR user meetings at Don Mills Public Library, Toronto (not affiliated)
- Online Google classroom for OSCAR EMR (not affiliated)
- Find me on the OSCAR EMR user forum [oscarmcmaster-bc-users](#)
- Contact me if you want open-source EMR advice

Agenda: Tracking Lab and Imaging Results

- Requirements for Lab Result Tracking
- Use custom queries to search for labs not back
example case of NO LAB RESULT
- Use custom queries to search for abnormal lab results
example case of ABNORMAL LAB RESULT
- User custom query to search for imaging results



Physicians receive hundreds of written requests and reports every day.

Blood, Pathology, Imaging, Rx renewals, Insurance requests, Referrals, Consults

Consequences of Missing Abnormal Lab Results

Disease progression

Leads to

Complications, Morbidity and
Mortality

May lead to

Medico-legal consequences



Missed PSA Result Case from CMPA

Ineffective office system to monitor test results

- A 58-year-old male has a PSA ordered by his family physician and it measures at 11, but the patient is not notified. He comes back 8 years later. His PSA level is now at 40, but the result is filed and neither the physician nor the patient is notified.
- One year later, the patient returns. The physician notes the abnormal result from the second test and orders a repeat PSA which comes back at 70. This time the patient is promptly referred to urology and is diagnosed with a locally advanced prostate cancer.
- A College complaint results in a caution to the physician. This is followed by a threat of a legal action. An early settlement is paid by the CMPA on behalf of the physician when expert support cannot be obtained, as the physician did not have a system in place to flag abnormal results and relied only on patients showing up for their appointments.

CPMA PSA Cases

- **PSA Test** The CMPA conducted a review of 69 medico-legal cases that closed between 2008 and 2012 and involved prostate cancer (CMPA website)
- Of the 69 cases, 49 were mostly related to the diagnosis or, in a few instances, the medical treatment of prostate cancer
 - Most men with an elevated PSA level turn out not to have prostate cancer; only about 25% of men who have a prostate biopsy due to an elevated PSA level actually are found to have prostate cancer when a biopsy is done.
 - A false-negative test result occurs when a man's PSA level is low even though he actually has prostate cancer. False-negative test results may give a man, his family, and his doctor false assurance that he does not have cancer, when he may in fact have a cancer that requires treatment.
- **Prostate Cancer Death: Elevated PSA Test Result Withheld for 16 Months Diagnosis Delay Settles for \$2 Million**
 - *2011 Medical Malpractice Trial Report (Boston, MASS)*

IGNORED TESTS!

Most CMPA lawsuits of prostate cancer were from ignored PSA results not from actual treatment!

CPSO Guidelines 2011 Test Result Management

Any electronic or paper-based system used to manage test results must enable physicians to:

Record all tests they order;

Record that all test results they receive have been reviewed;

Identify high risk patients and clinically significant test results;

Record that a patient has been informed of any clinically significant result and that appropriate follow-up has occurred.



MISSING LAB RESULT

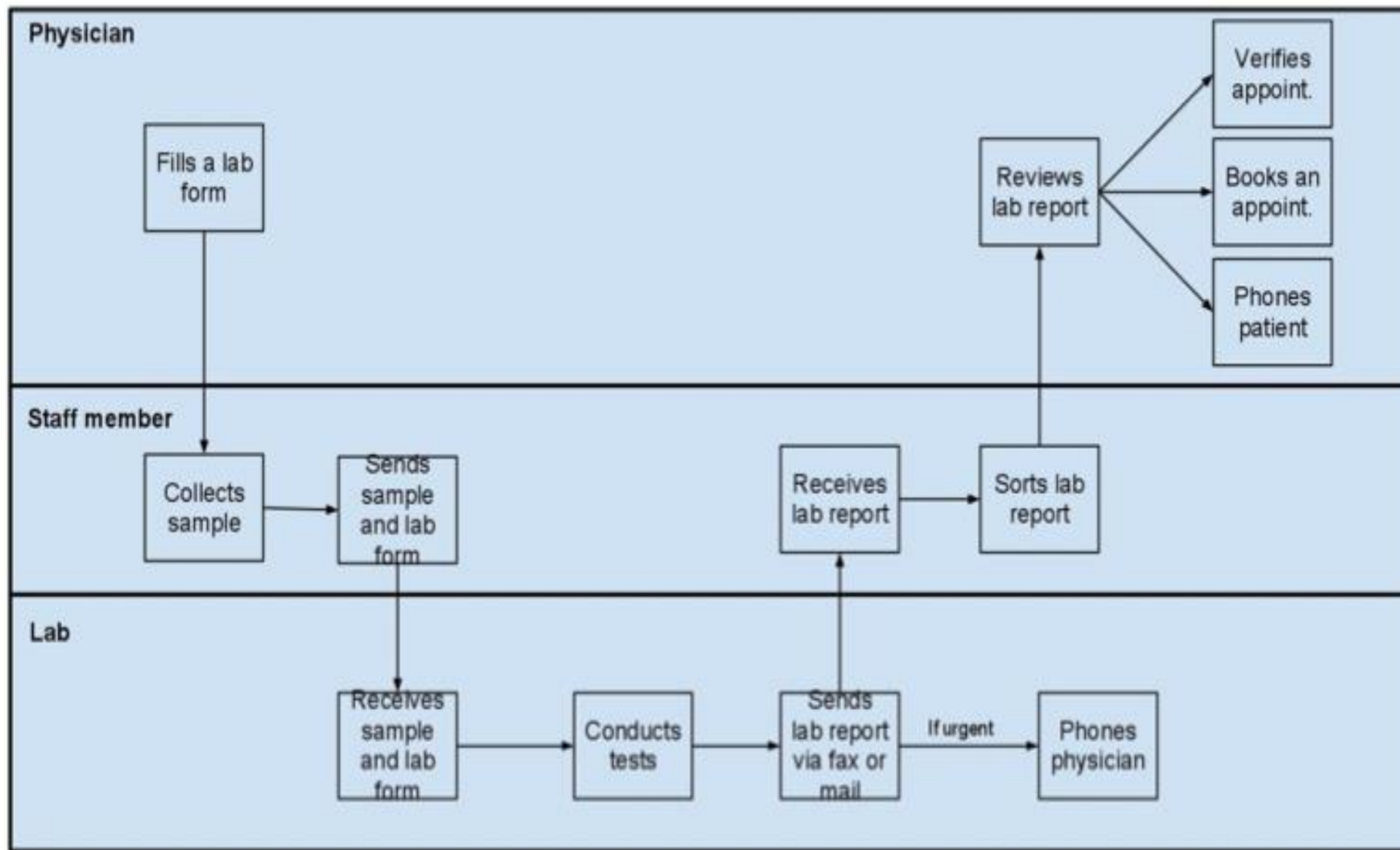
HOW DO YOU KNOW IF A LAB YOU ORDERED IS MISSING?

Do you just rely on the patient just to come back and remind you?

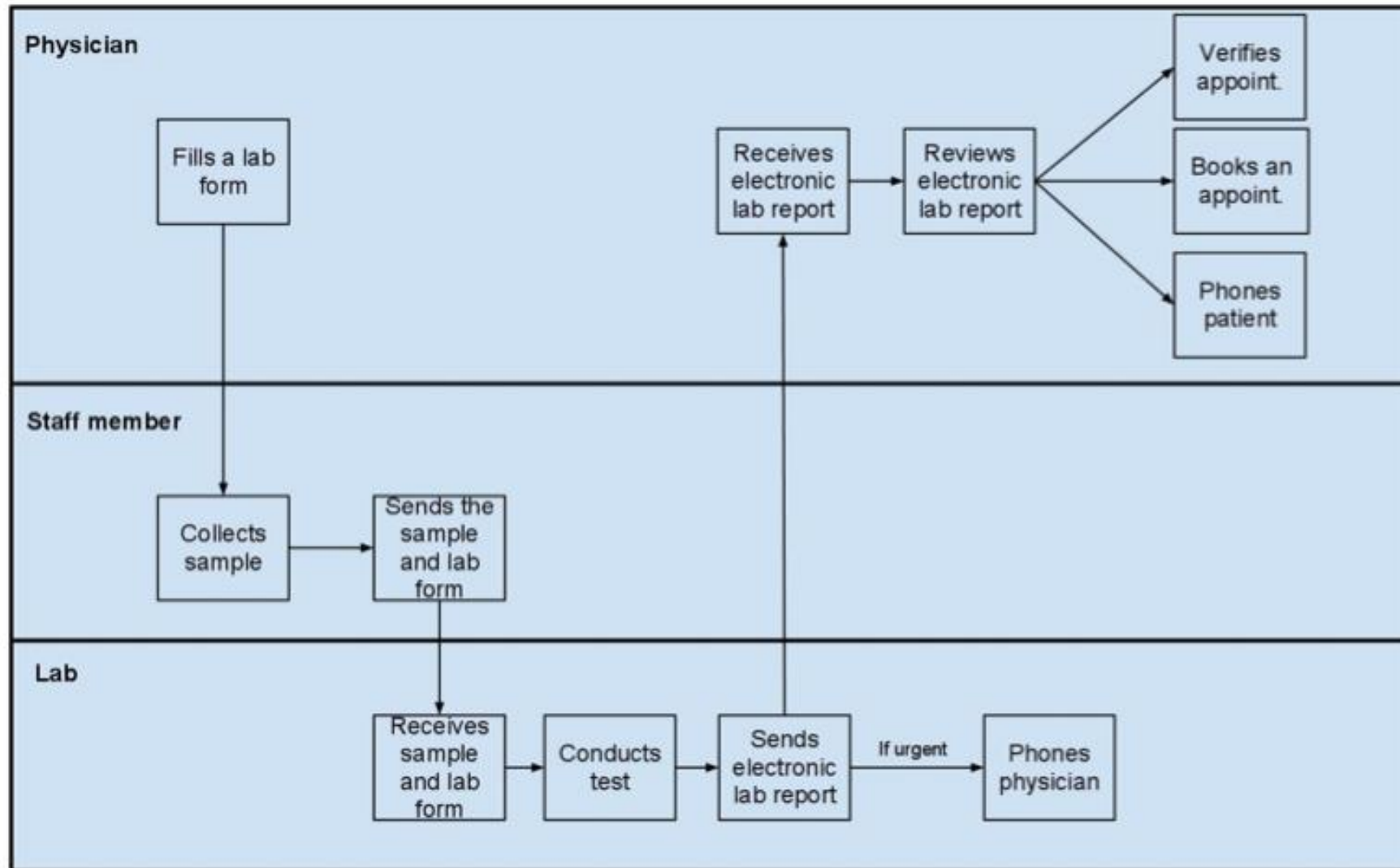
WHERE DOES THE WORKFLOW FAIL?

Automated way of searching tests?

Lab Result Workflow - Paper



Lab Result Workflow - Electronic



Why Don't Some Results Come Back?

- There is no result found in the chart and physician had given lab req to patient
- Patient didn't go to the lab for various reasons: No time; didn't think test was necessary; fear of the test; didn't want to pay for the test; lost the req, etc.
- Lab factors: lab missed doing the test; lab did the test and didn't report it back (failure in transport – mail, fax, HL7); lab sent result to wrong physician (similar name)
- Office factors: staff misfiled result (paper or fax only)



NO LAB RESULT – WATCH DOG SOLUTION

EMR TECHNOLOGY

(SQL DATABASE SEARCHING)

TO

**SEARCH FOR UNRECONCILED LAB
REQs**



Solution SQL QUERY: Search Results for PSAs Not Back

Search lab result not back

Search Lab req for LAB TYPE request
but LAB results was not back -in the time interval by Ian Pun MD

Step 1: Lab Type search for:	<input type="text" value="PSA"/>
Step 2: NUMBER of MONTHS going back:	<input type="text" value="3 months"/>
Step 3: Generate Query	<input type="button" value="Run Query"/>

[Show/Hide Options](#)

```
select
substring(f1.b_dateSigned,1,10) as date,
CONCAT( "<a target=new href=../../demographic/demographiccontrol.jsp?demograph
concat(d.last_name, ", ", d.first_name) as name
from
formLabReq07 f1 , demographic d
where
d.demographic_no = f1.demographic_no AND
( f1.h_cbc = 1 and {choice} = 1 or
psa_total = 1 and {choice} = 2 or
b_hba1c = 1 and {choice} = 3 or
b_alt = 1 and {choice} = 4
)
and
f1.b_dateSigned > DATE_SUB(curdate(),INTERVAL {intev} MONTH) AND f1.demograph
```

NOT IN

Report by Template

Search lab result not back

Search Lab req for LAB TYPE request
but LAB results was not back -in the time interval by Ian Pun MD 2018
[Hide/Show Query](#)

date	demo	name
2018-05-23	38	IM
2018-05-23	28	
2018-05-28	23	3
2018-05-29	22	
2018-05-30	24	
2018-06-06	34	
2018-06-18	36	i
2018-06-18	99	LOK
2018-06-20	26	!IN
2018-06-27	18	3
2018-07-11	27	
2018-07-30	28	
2018-08-08	17	UNG
2018-09-01	27	UNG

HOW IT WORKS

Matches the most recent LAB TEST ORDER in EMR eForm to the most recent LAB RESULT in the DATABASE.

Flags the patient if NOT FOUND.

Your workflow MUST BE 100% electronic for this to work!

Case : Lab Missed Doing PSA

- 69 year old healthy male (hx osteoporosis on denosumab) physical mid-June 2018
- Routine blood came back normal, PSA missing, so I wait
- Searching in July for missing PSAs ordered, flagged his name
- Call lab for result. Lab said PSA order was not checked off and was not done (but my eForm OHIP req showed it was)
- Patient recalled in August , did PSA again -> result 5.60, DRE ok
- PSA was 3.36 last year so I send him to urologist, pending now



ABNORMAL RESULTS

HOW ABOUT OVERLOOKED ABNORMAL RESULTS?

ABNORMAL RESULTS that were in the chart and IGNORED?



Why Are Abnormal Results Not Acted On?

- This is an ABNORMAL RESULT is in the chart like the high PSA in CMPA case.
- Physician factors: abnormal lab result overlooked - felt unimportant OR missed because WE ARE SIMPLY OVERWORKED!
- Office factors: staff missed acting on abnormal result so patient not informed by staff
- Patient informed, but did not go for further testing or recall for consultation: they feel it was not necessary, fear, etc.

SOLUTION: SQL QUERY for Most Recent Abnormal Lab Result (written by Dr. Ian Pun)

Latest lab result <=> ?

Dr. Pun Searches for patients by recent LAB result A1C ,

Step 1:	Lab Test type	<input type="text" value="PSA"/>
Step 2:	LAB test value >=<	<input type="text" value="> 4.5"/>
Step 3:	Generate Query	<input type="button" value="Run Query"/>

[Show/Hide Options](#)

GET MOST RECENT ABNORMAL LAB RESULTS

Latest lab result <=> ?

Dr. Pun Searches for patients by recent LAB result A1C , ie HB, PSA .CALC > 6.0 , use % for wildcard or and dataField for range

demographicNo	Dem	dateObserved	age	last_name	first_name	type	dataField
99:	99	2018-08-:	69	C		PSA	5.60
20:	20	2018-08-:	83	Z		PSA	6.19
24:	24	2018-07-:	76	N		PSA	4.78
20:	20	2018-06-:	85	LI		PSA	15.22
32:	32	2018-05-:	72	G		PSA	6.3 In
39:	39	2018-04-:	79	P		PSA	8.7
32:	32	2018-04-:	73	S		PSA	5.49
13:	13	2018-04-:	71	T		PSA	5.20 f/t
37:	37	2018-03-:	73	S		PSA	4.97
36:	36	2018-02-:	78	FI		[SK PSA	11.40
25:	25	2018-01-:	67	W		PSA	4.91
40:	40	2018-01-:	65	T		PSA	4.67
20:	20	2017-12-:	53	P		PSA	5.0
19:	19	2017-11-:	76	FI		PSA	10.32
14:	14	2017-11-:	64	LI		PSA	10.23
27:	27	2017-09-:	64	D		PSA	6.91
33:	33	2017-09-:	79	C		PSA	4.80
27:	27	2017-06-:	50	T		PSA	10.02 f/t
56:	56	2017-05-:	70	C		PSA	5.2 f/T
38:	38	2017-05-:	80	Z		PSA	8.8
39:	39	2017-04-:	70	M		PSA	6.74



GET MOST RECENT ABNORMAL LAB RESULTS

- Search for lab results that are above an abnormal limit
e.g. PSA > 4.5

Get the list of patients and follow up on them

I found 2 prostate cancers (and one pending) in 2017 by finding slightly abnormal PSAs

Results of PSA Searching

From: Dr. Jonathan Chan <dr.jonxxxxx@xxxx.com>
Subject: Re: PSA searching template is saving lives!
Date: January 19, 2018 7:52:30 PM EST
To: Ian Pun <ianpun@gmail.com>

Hi Ian -

- I saw PATIENT A on 12/15/17 and will arrange for rebiopsy in 3 months.
- I just saw PATIENT B today and he signed consent for radical prostatectomy
- PATIENT C - radical prostatectomy discharged POD 2 uneventfully; booked to see me 1/15/18 to review pathology which is Gleason 7 (negative lymph nodes; negative margins)

- **Your PSA searching template is saving lives!** You should implement with other GPs to flag their high risk patients.

Dr. Jonathan Chan, urologist

Examples of Abnormal Values I Can Search

A1C – Hemoglobin A1C > 0.07 (CDA = 0.065)

ACR – albumin creatinine ratio

AFP – alpha fetoprotein > 8

ALT – liver ALT

BHCG – serum beta HCG

PLTS – platelets

HB – hemoglobin

LDL – cholesterol for FH

There is a measurement table in the database.

Cases: Search Abnormal Results

- Search LDL > 5 Possible FH for high LDL
- Search LDL < 2 for the well-controlled LDL
- Search A1C > 0.10 really out of control diabetics
- Search Hb < 90 for the anemia
- Search PLTS < 100 for platelets liver disease, ITP, leukemia
- Search ALT > 50 for liver disease
- Search BHCG > 5 for all the pregnant women you have
- Search CALC < 2.15 for low calcium (due to meds)

To Recap: How Are You Ordering Your Blood Lab Tests?

- I manually fill out a photocopied OHIP requisition
- Not a good way, must manually track
- I fill out the OHIP eForm by checking the boxes
- The preferred way as the orders are stored and can be tracked electronically

Lab Requisition Ministry Health Long Term Care

Ontario Ministry of Health and Long-Term Care
Laboratory Requisition Requisitioning Clinician / Practitioner

Name: **Pun, Ian Y H**
Address: _____
Ontario

Clinician/Practitioner Number: _____ CPSO / Registration No. _____
Health Number: **9876543217** Version: **HJ** Sex: M F Date of Birth: **1959/01/11**
Province: _____ Other Provincial Registration Number: _____ Patient's Telephone Contact Number: **416-999-0231**

Check (✓) one: OHIP/Insured Third Party / Uninsured WSIB

Additional Clinical Information (e.g. diagnosis):
CHF

Copy to: Clinician/Practitioner
Last Name: _____ First Name: _____

Patient's Last Name (as per OHIP Card): **FAKE**
Patient's First & Middle Names (as per OHIP Card): **JACKY**
Patient's Address (including Postal Code):
**123 Fake street
Scarborough
ON m3f 3g5**

INSTRUCTIONS: Nothing to eat or drink, except for water, for 10 hours prior to the test.

CONDITIONS:
THIS IS MEDICAL HISTORY OF FAKE.JAKEY

CURRENT MEDS:
atorvastatin 10 mg 1 OD

INSTRUCTIONS:
 Copy to Patient
 Fasting Instructions

THERAPEUTIC MONITORING
CHF:
 Baseline Follow-up
 Standing Order Q3M
CKD Stage 3:
 Annual eGFR/ACR Q6M

DM:
 Annual A1C Q3M

DYSLIPIDEMIA:
 Screening On Statin

HYPERTENSION:
 Annual

OTHERS:
 Autoimmune ANA, RF
 CBC
 Celiac disease ~\$120
 Bariatric
 CTD Workup
 Dementia
 Eating disorder workup
 Fatigue
 Gyne Cancer
 Hep B (Chronic) follow-up
 Infertility Female Male

Note: Separate requisitions are required for cytology, histology / pathology and tests performed by Public Health Laboratory

x	Biochemistry	x	Hematology	x	Viral Hepatitis (check one only)
<input checked="" type="checkbox"/>	Glucose <input type="checkbox"/> Random <input checked="" type="checkbox"/> Fasting	<input checked="" type="checkbox"/>	CBC	<input type="checkbox"/>	Acute Hepatitis
<input type="checkbox"/>	HbA1C	<input type="checkbox"/>	Prothrombin Time (INR)	<input type="checkbox"/>	Chronic Hepatitis
<input checked="" type="checkbox"/>	Creatinine (eGFR)	<input type="checkbox"/>	Immunology	<input type="checkbox"/>	Immune Status / Previous Exposure
<input type="checkbox"/>	Uric Acid	<input type="checkbox"/>	Pregnancy Test (Urine)	Specify: <input type="checkbox"/> Hepatitis A	
<input checked="" type="checkbox"/>	Sodium	<input type="checkbox"/>	Mononucleosis Screen	<input type="checkbox"/> Hepatitis B	
<input checked="" type="checkbox"/>	Potassium	<input type="checkbox"/>	Rubella	<input type="checkbox"/> Hepatitis C	
<input checked="" type="checkbox"/>	Chloride	<input type="checkbox"/>	Prenatal: ABO, RhD, Antibody Screen (titre and ident. if positive)	or order individual hepatitis tests in the "Other Tests" section below	
<input type="checkbox"/>	CK	<input type="checkbox"/>		Prostate Specific Antigen (PSA)	

Name
Pun, Ian Y H

Address

Ontario

Clinician/Practitioner's Contact Number for Urgent Results

416-

Service Date

yyyy mm dd

Clinician/Practitioner Number

CPSO / Registration No.

Health Number

9876543217

Version

HJ

Sex

M F

Date of Birth

1959/01/11

Check (✓) one:

OHIP/Insured

Third Party / Uninsured

WSIB

Province

Other Provincial Registration Number

Patient's Telephone Contact Number

416-999-0231

Additional Clinical Information (e.g. diagnosis)

CHF

Patient's Last Name (as per OHIP Card)

FAKE

Patient's First & Middle Names (as per OHIP Card)

JACKY

Copy to: Clinician/Practitioner

Last Name

First Name

Patient's Address (including Postal Code)

123 Fake street

Scarborough

ON

m3f 3g5

INSTRUCTIONS: Nothing to eat or drink, except for water, for 10 hours prior to the test.

Note: Separate requisitions are required for cytology, histology / pathology and tests performed by Public Health Laboratory

x	Biochemistry	x	Hematology	x	Viral Hepatitis (check one only)
<input checked="" type="checkbox"/>	Glucose <input type="checkbox"/> Random <input checked="" type="checkbox"/> Fasting	<input checked="" type="checkbox"/>	CBC		Acute Hepatitis
	HbA1C		Prothrombin Time (INR)		Chronic Hepatitis
<input checked="" type="checkbox"/>	Creatinine (eGFR)		Immunology		Immune Status / Previous Exposure Specify: <input type="checkbox"/> Hepatitis A <input type="checkbox"/> Hepatitis B <input type="checkbox"/> Hepatitis C or order individual hepatitis tests in the "Other Tests" section below
	Uric Acid		Pregnancy Test (Urine)		
<input checked="" type="checkbox"/>	Sodium		Mononucleosis Screen		
<input checked="" type="checkbox"/>	Potassium		Rubella		
<input checked="" type="checkbox"/>	Chloride		Prenatal: ABO, RhD, Antibody Screen (titre and ident. if positive)		
	CK		Repeat Prenatal Antibodies	<input checked="" type="checkbox"/>	Prostate Specific Antigen (PSA)
<input checked="" type="checkbox"/>	ALT			<input type="checkbox"/>	Total PSA <input type="checkbox"/> Free PSA
	Alk. Phosphatase		Microbiology ID & Sensitivities (if warranted)		Specify one below: <input type="checkbox"/> Insured - Meets OHIP eligibility criteria <input checked="" type="checkbox"/> Uninsured - Screening: Patient responsible for payment
	Bilirubin		Cervical		
<input checked="" type="checkbox"/>	Albumin		Vaginal		Vitamin D (25-Hydroxy)
	Lipid Assessment (includes Cholesterol, HDL-C, Triglycerides, calculated LDL-C & Chol/HDL-C ratio: individual lipid tests may be ordered in the "Other Tests") ?		Vaginal / Rectal - Group B Strep		<input type="checkbox"/> Insured - Meets OHIP eligibility criteria: osteopenia; osteoporosis; rickets; renal disease; malabsorption syndromes; medications affecting vitamin D metabolism <input type="checkbox"/> Uninsured - Patient responsible for payment
	Albumin / Creatinine Ratio, Urine		Chlamydia (specify source):		
	Urinalysis (Chemical)		GC (specify source):		
	Neonatal Bilirubin:		Sputum		

CONDITIONS:

THIS IS MEDICAL HISTORY OF FAKE JAJKEY

CURRENT MEDS:

crestor 10 mg 1 OD

INSTRUCTIONS:

Copy to Patient

Fasting Instructions

THERAPEUTIC MONITORING

CHF:

Baseline Follow-up

Standing Order Q3M

CKD Stage 3:

Annual eGFR/ACR Q6M

DM:

Annual A1C Q3M

DYSLIPIDEMIA:

Screening On Statin

HYPERTENSION:

Annual

OTHERS:

Autoimmune ANA, RF

CBC

Celiac disease ~\$120

Bariatric

CTD Workup

Dementia

Eating disorder workup

Fatigue

Gyne Cancer

Hep B (Chronic) follow-up

Infertility Female Male

INR - Standing Order

LFTs

LFT Elevation Acute Chronic

Osteoporosis Female Male

PCOS workup

Prenatal:First visit labs

Prenatal:Gestational HTN

Renal Function

Conditions for Electronic Lab Result Tracking

- Must use OHIP lab eForm in EMR. An electronic version of the lab requests that stores the parameters of the request in the EMR database e.g. Hb request. Not a clickable PDF, etc.
- Lab results are sent via HL7 (an electronic transfer method from lab to your EMR). These are pulled into your EMR from the lab server or OLIS. Set up from vendor or lab is required.
- Lab results are parsed from the HL7 file and discretely populated into specific lab fields. e.g. Hb, PSA, A1C ,etc. called “measurements”.
- Lab results via fax or paper will not be populated into the EMR.

LAB INTEGRATION

MAKE SURE YOU GET YOUR LAB RESULTS into your EMR and populate the common LAB RESULTS into your database.

GDMML – easy web service

Lifelabs – a web client

Proper connections of HL7, proper LOINC codes



Conditions for Electronic Lab Result Tracking

- EMR vendor needs to write you these search queries
- FEATURE may be built-into the EMR system
- Labs DO NOT USE a doctor generated “tracking number” for each lab order so there is no precise way of tracking all labs orders besides reconciliating the TEST ORDER to the TEST RESULT.
- Therefore, manual tracking is still used by most physicians because of the incomplete implementation of lab system and reporting (some results are not numeric, different standards)

Searching for Imaging Reports

- A little more tricky since results are NOT discrete numbers
- Imaging reports come in HRM or faxes (not searchable)
- Only to use tickler or other manual tracking system to reconcile. Or hashtag your orders e.g. #mammogram
- Script to reconcile CANCER CARE ONTARIO to match mammogram order
- Ultimate solution is machine learning for EMR

Search Quantum

Searches Quantum and SARCCO result

By Ian Pun MD 2016-01-21

[Hide/Show Query](#)

Dem#	fdid	eForm_name	Date	Provider	Last	First	G	DOB	m_desc	mammo_date	desc
27	1 13	.Quantum Imaging	2018-09-19	999998	W	Y,	F	1 1	Provider to review	02-Jun-2017	N/D: *** - Mammo - - Dx -
27	9 13	.Quantum Imaging	2018-09-17	999998	Hi	Y,	F	1 0	Overdue	07-Mar-2014	N/D: *** - Mammo - - Dx -
35	1 13	.Quantum Imaging	2018-09-15	999998	Hi	YI	F	1 0	Due in next 6mths	16-Nov-2016	Normal: *** - Return 2 Yr Mammo - - D
28	5 13	.Quantum Imaging	2018-09-15	999998	XI	H	F	1 0	Overdue	14-Mar-2016	N/D: *** - Mammo - - Dx -
21	5 13	/Quantum CHRISTINA	2018-09-12	010206	W	M S	F	1 0	Due in next 6mths	18-Jan-2018	Normal: *** - Return 1 Yr Mammo - - D
20	7 13	.Quantum Imaging	2018-09-10	999998	Cl	X	F	1 1	Due in next 6mths	05-Jan-2017	Normal: *** - Return 2 Yr Mammo Abnorm Ultrasound - 05-Jan-2017 Dx - Benign
28	1 13	.Quantum Imaging	2018-09-08	999998	Si	Y,	F	1 0	Overdue	29-Mar-2016	N/D: *** - Mammo - - Dx -
25	0 13	.Quantum Imaging	2018-09-05	999998	LI	JL	F	1 0	Normal screen	17-May-2018	Normal: *** - Return 1 Yr Mammo - - D
43	13	.Quantum Imaging	2018-08-29	999998	SI	H R	F	1 0	Overdue		: *** - Mammo - - Dx -
40	9 13	/Quantum CHRISTINA	2018-08-08	010206	L	W	F	1 0	Due in next 6mths	20-Sep-2016	Abnormal: *** - Return 2 Yr Mammo Abno Ultrasound - 23-Sep-2016 Dx - Benign
23	5 13	/Quantum CHRISTINA	2018-08-01	010206	IP	R	F	1 0	Due in next 6mths	30-Aug-2017	Normal: *** - Return Annually Mammo -
38	1 13	.Quantum Imaging	2018-08-01	999998	ZI	H	F	1 0	Overdue	06-Jun-2016	N/D: *** - Mammo - - Dx -
37	0 13	.Quantum Imaging	2018-08-01	999998	M.	Z	F	1 0	Overdue	20-Jun-2016	Normal: *** - Return 2 Yr Mammo - - D

Summary

Match lab req values to lab result values to search for missing results

Search for abnormal values by searching for last abnormal value

Need custom queries for this (vendor help)

Imaging result searching is more complicated



So Do Your Searching!

THANKS FOR COMING!

**My future talks will be about machine learning in
EMR.**

Dr. Ian Pun

Contact:

ianpun@gmail.com

