Utility of calcium, magnesium and phosphate testing in the emergency department

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Austin Health

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Background

Calcium, Magnesium and Phosphate:

- Commonly ordered in the ED
- Only one study has assessed the usefulness
  - 20 years old
  - limited usefulness
- ‘Choosing Wisely’ campaign:
  - to reduce unnecessary investigations and management
  - where they bring no benefit to patient outcomes
- Current ordering trends and results are unknown

Aims

Primary aim:

- Frequently of Ca, Mg and PO4 testing
- Yield of abnormal tests

Secondary aims:

- Changes in patient management in the ED
- Cost
- Factors associated with abnormal results

Methods

- Retrospective study of e-Medical Records
- Austin Hospital ED, Melbourne
  - tertiary, metropolitan centre
  - mixed annual census ~90,000
- January 1 and June 30, 2017
- Inclusion criteria:
  - adult patients (≥18 years)
  - calcium, magnesium or phosphate ordered
  - results returned during the ED stay

Methods

Data extracted:

- Demographics
- Symptoms
- Past medical history
- Medications
- Ca, Mg, PO4 results
- Management changes in ED

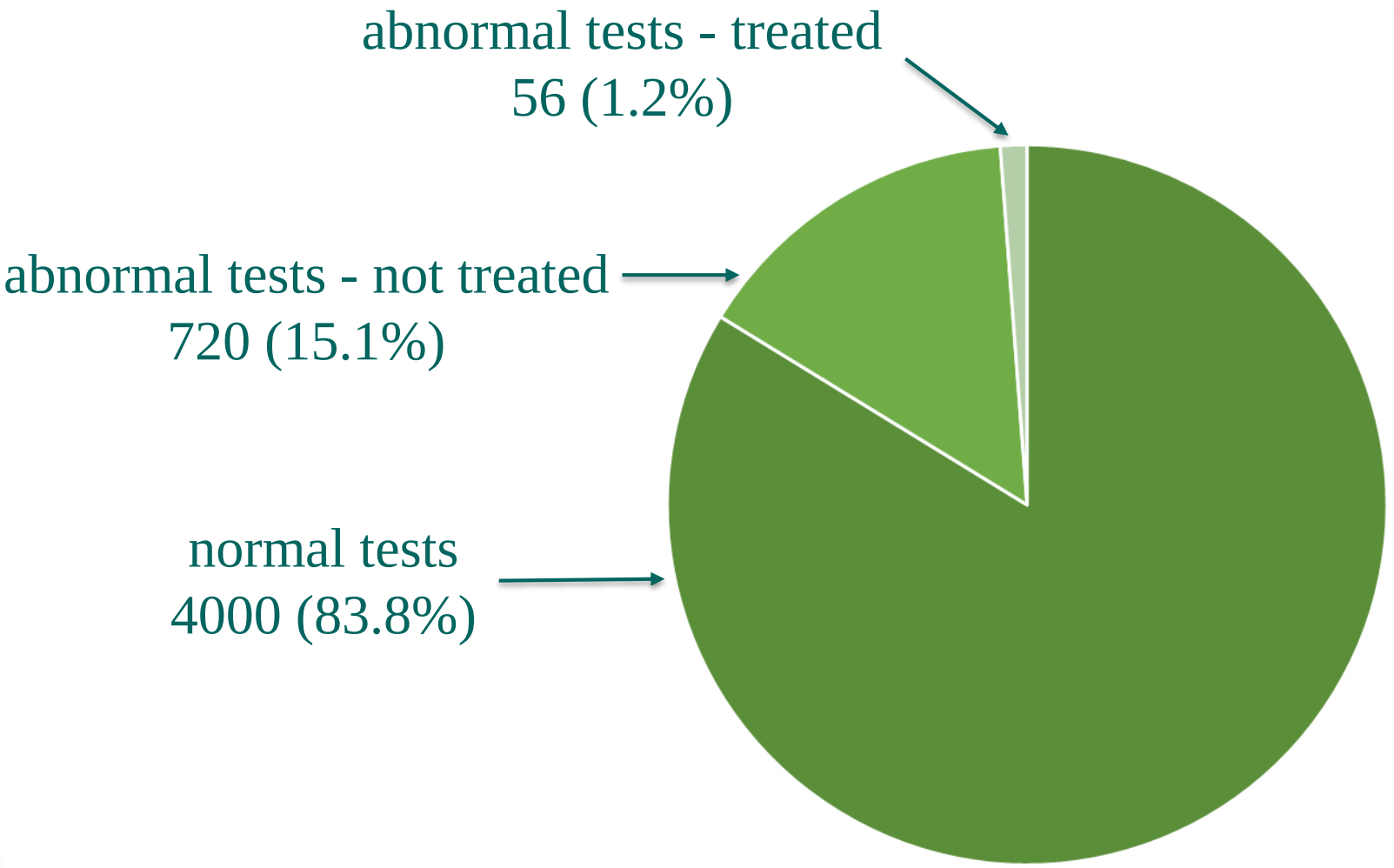
Data analysis:

- Descriptive: n (%, 95%CI)
- Logistic regression - 6 models
  - high/low x Ca/Mg/PO4
  - variables with $p<0.10$ on univariate

Results

- 33,120 adult patients presented
- 1,716 (5.2%) had ≥1 Ca, Mg or PO4 test completed
- 4,776 individual Ca, Mg or PO4 tests completed
  - 776 (16.2%, 95%CI 15.2-17.3) tests were abnormal
  - 56 (1.2%, 95%CI 0.9-1.6) tests changed management

Results



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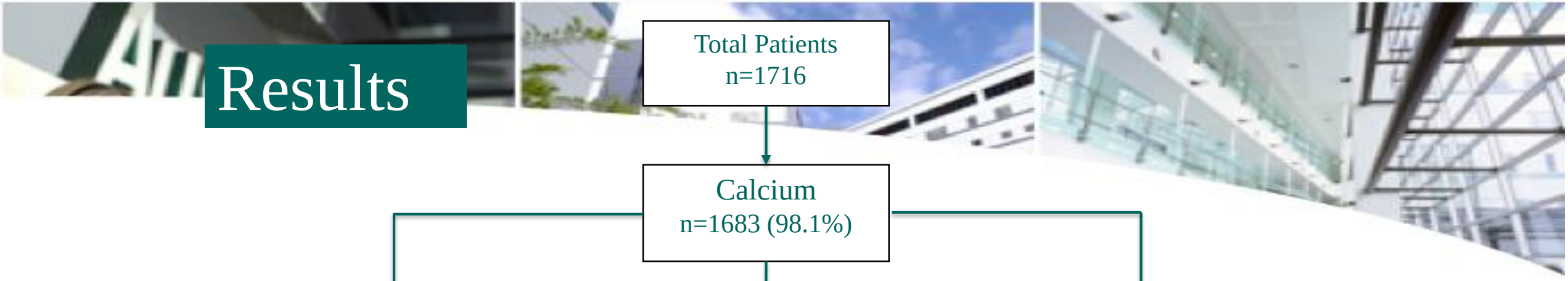
Results



Total Patients
n=1716

Calcium
n=1683 (98.1%)

Low Calcium
n=26 (1.5%)

2.0-2.14 mmol/L n=11
1.5-1.99 mmol/L n=13
<1.5 mmol/L n=2

Normal Calcium
n=1454 (86.4%)

2.15-2.55 mmol/L

High Calcium
n=203 (12.1%)

2.56-2.99 mmol/L n=191
3.0-3.99 mmol/L n=9
≥4.0 mmol/L n=3

Treatment (n=6)

Oral calcium n=3 (11.5%)
IV calcium n=6 (23.1%)

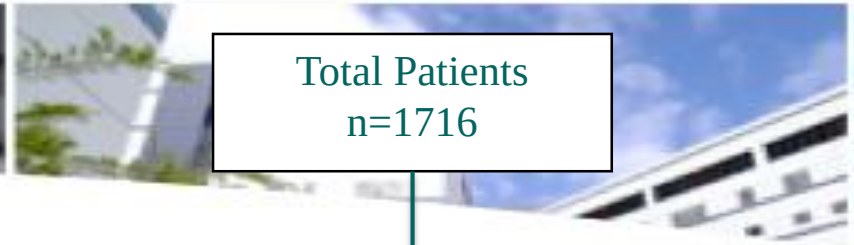
Treatment (n=1)

IV calcium n=1 (0.1%)

Treatment (n=10)

IV fluids n=9 (4.4%)
furosemide n=2 (1.0%)
bisphosphonate n=4 (2.0%)
calcitonin n=1 (0.5%)

Results



Total Patients
n=1716

Magnesium
n=1579 (92.0%)

Low Magnesium
n=128 (8.1%)

0.65-0.50 mmol/L n=117
0.40-0.49 mmol/L n=7
<40 mmol/L n=4

Normal Magnesium
n=1421 (90.0%)

0.66-1.07 mmol/L

High Magnesium
n=30 (1.9%)

1.08-1.29 mmol/L n=22
1.30-1.39 mmol/L n=3
≥1.4 mmol/L n=5

Treatment (n=33)

Oral magnesium n=9 (7.0%)
IV magnesium n=24 (18.8%)

Treatment (n=49)

Oral magnesium n=7 (0.5%)
IV magnesium n=42 (3.0%)

Treatment (n=0)

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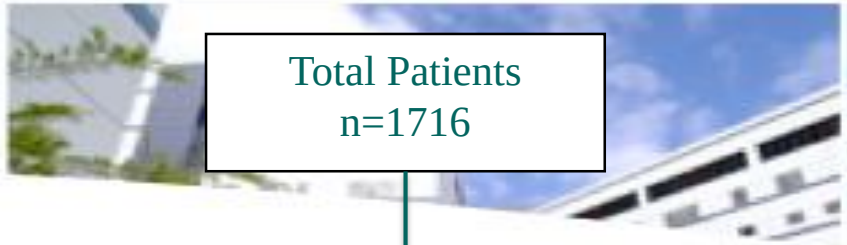
Results



Total Patients
n=1716

Phosphate
n=1514 (82.2%)

Low Phosphate
n=225 (14.9%)

0.70-0.86 mmol/L n=153
0.50-0.69 mmol/L n=59
<0.50 mmol/L n=13

Normal Phosphate
n=1125 (74.3%)

0.87-1.45 mmol/L

High Phosphate
n=164 (10.8%)

1.46-1.99 mmol/L n=125
2.0-2.99 mmol/L n=32
≥3.0 mmol/L n=7

Treatment (n=6)

Oral phosphate n=5 (2.2%)
IV phosphate n=1 (0.4%)

Treatment (n=0)

Treatment (n=1)

IV fluids n=1 (0.6%)

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Results: Cost

Using the Medicare Benefits Schedule:

- $22,687.45 = total cost of all tests
- $22,181.05 = saving if tests not changing management were not ordered

Results: Calcium Regression

Variables associated with *low Ca*	OR	(95%CI)	p
Phosphate supplements	17.3	(2.0-153.2)	0.01
Perioral numbness	17.1	(1.3-217.9)	0.03
Hand or foot spasm	11.7	(1.2-116.8)	0.04
Cancer treatment	5.9	(1.2-27.6)	0.03
Vomiting	4.3	(1.7-10.9)	<0.01
Calcium supplements	3.0	(1.1-8.3)	0.03

Results: Calcium Regression

Variables associated with *high Ca*	OR	(95%CI)	p
Polyuria	9.7	(2.1-44.0)	<0.01
Hyperparathyroidism	4.3	(1.3-15.1)	0.02
Type 1 diabetes	3.6	(1.1-11.9)	0.04
Confusion	2.3	(1.4-3.6)	<0.01
Cancer	1.7	(1.2-2.4)	<0.01
Vomiting	1.7	(1.1-2.6)	0.02
Female gender	1.6	(1.1-2.3)	<0.01
Hypothyroidism	0.4	(0.1-0.96)	0.04

Results: Magnesium Regression

Variables associated with *low Mg*	OR	(95%CI)	p
Tacrolimus	13.1	(4.1-41.3)	<0.001
Alcohol abuse	9.3	(4.6-19.1)	<0.001
Type 2 diabetes	2.9	(1.9-4.7)	<0.001
Proton pump inhibitor	2.2	(1.4-3.3)	<0.001
Female gender	1.9	(1.3-3.0)	<0.01

Results: Magnesium Regression

Variables associated with *high Mg*	OR	(95%CI)	p
Chronic renal disease	4.5	1.7-12.1	<0.01
Thiazide diuretic	4.5	1.1-18.4	0.03
Lethargy	4.3	1.7-10.7	<0.01
Female gender	0.4	0.2-0.97	0.04

Results: Phosphate Regression

Variables associated with *low PO_4*	OR	(95%CI)	p
Seizure	2.1	(1.2-3.8)	0.01
Glucocorticoids	1.7	(1.1-2.7)	0.02
Nausea	1.7	(1.1-2.6)	<0.01
Female gender	0.7	(0.5-0.9)	0.02
Diuretics	0.6	(0.4-0.9)	0.01

Results: Phosphate Regression

Variables associated with *high PO_4*	OR	(95%CI)	p
Polyuria	5.0	1.1-23.6	0.04
Chronic renal disease	3.5	2.2-5.4	<0.001
Diuretics	1.9	1.2-3.0	<0.01
Palpitations	0.4	0.2-0.9	0.03

Summary

- 5.2% of ED patients were investigated
- 16.2% tests were abnormal
- 1.2% patients treated because of abnormal test
- 2.9% patients treated although test was normal
  - 1 Ca, 49 Mg
- Substantial costs savings possible
- Regression identifies those at risk of abnormal levels
  - Will inform investigation guideline development