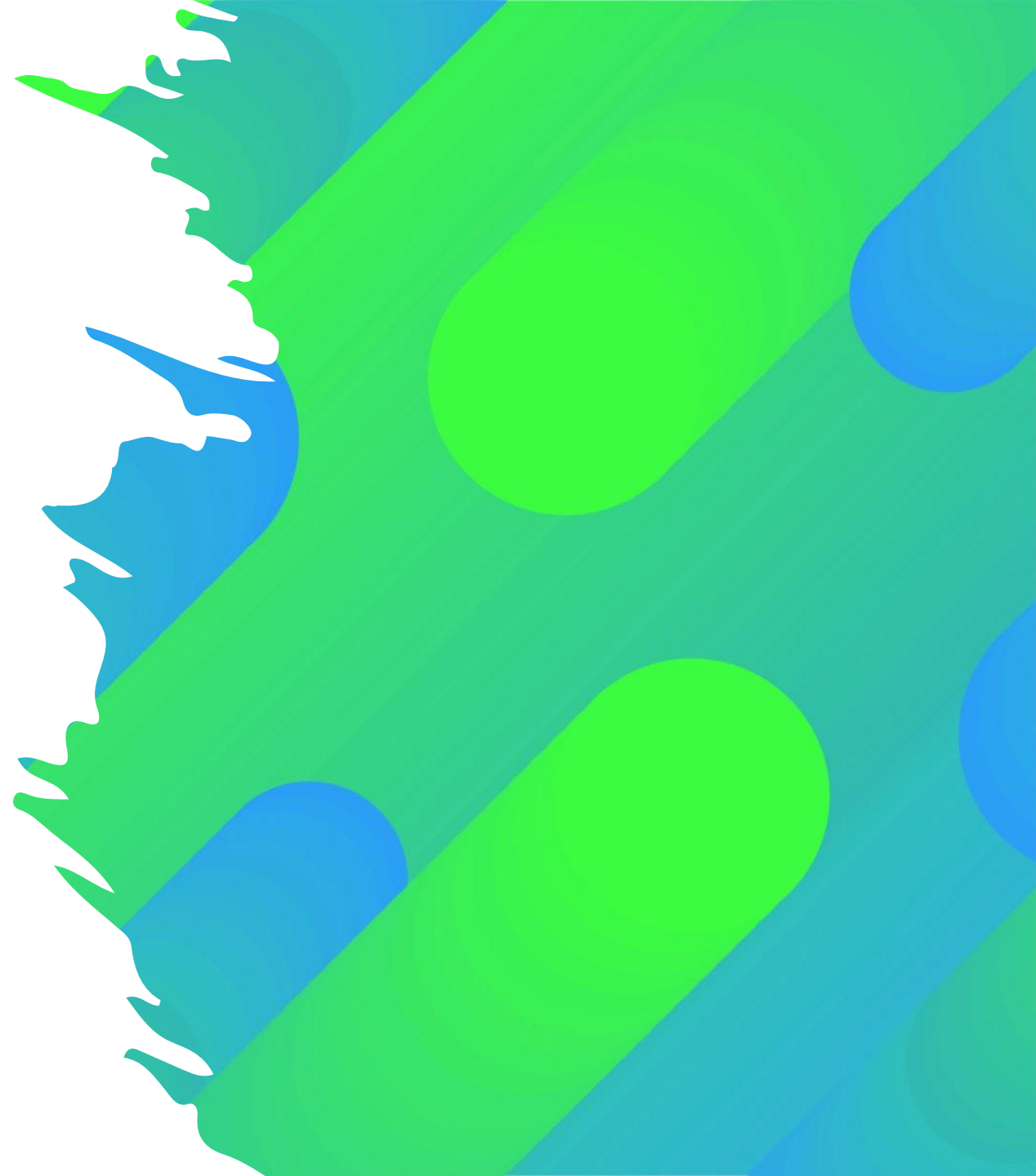



The project of calibration of blood pressure measuring devices in Egypt

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Results of a project to calibrate mercury sphygmomanometer blood pressure-measuring devices in Egypt

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Abstract

Hypertension (HTN) is a common health problem and a major cardiovascular risk factor. Accurate measurement of blood pressure (BP) is mandatory for proper diagnosis and follow-up. The aim of this study was to evaluate the accuracy of mercury sphygmomanometer BP-measuring devices in public hospitals in Cairo, Egypt. Fifty public hospitals were included, and 10% of all mercury sphygmomanometer devices in each hospital were tested. Assessment included physical condition (e.g., mercury status, lid of the device, state of the rubber tubes), leakage rate, and calibration accuracy (as compared with a reference device). Devices were approved as accurate when they could successfully pass all three assessment tests. The total number of sphygmomanometer devices was 465. The overall pass rate was 1.3% (six devices). Twenty-five (5.2%) devices passed all of the physical tests, 50 (10.8%) passed the leakage test, and 50 (16.5%) passed the calibration accuracy test.

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Introduction



World Health
Organization
Egypt



Egypt National STEPwise Survey For Noncommunicable Diseases Risk Factors Report 2017

Raised Blood Pressure:

About 29.5% of the surveyed population has a *raised blood pressure* (defined as systolic and/or diastolic blood pressure $\geq 140/90$ mmHg) and this includes both sexes and those who are currently on medication. Surprisingly, 71% of the respondents with raised BP were not taking any medication and their BP was not controlled.

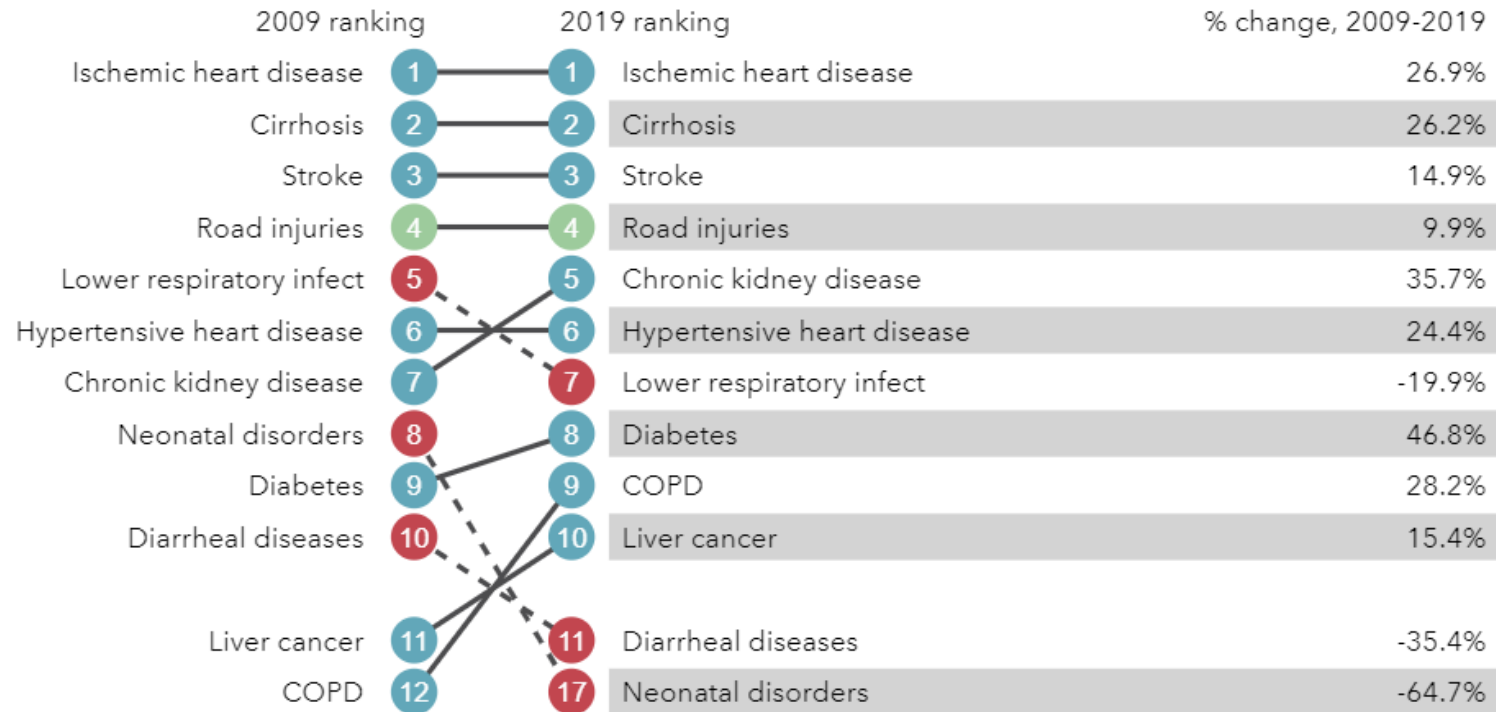




Egypt

What causes the most deaths?

- Communicable, maternal, neonatal, and nutritional diseases
- Non-communicable diseases
- Injuries




The Egyptian health map: a guide for evidence-based decision-making

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Table 3. Deaths / 100 000 Population from key noncommunicable diseases by governorates, 2014

Governorates	Cancer	Chronic respiratory diseases	Ischemic heart diseases	Hypertensive diseases	Cerebro-vascular diseases	Liver cirrhosis	Road accidents
Cairo	83.0	42.4	44.0	70.2	51.0	22.0	17.0
Alexandria	107.0	26.5	51.0	114.4	55.0	17.0	18.0
Port-Said	77.0	48.3	19.0	9.0	70.0	8.0	5.0
Suez	42.0	4.7	12.0	149.0	38.0	24.0	48.0
Ismailia	41.0	17.7	15.0	31.1	17.0	16.0	37.0
Damietta	75.0	2.6	6.0	145.6	51.0	69.0	12.0
Dakahlia	37.0	10.5	20.0	40.7	46.0	49.0	12.0
Sharkia	16.0	5.0	10.0	35.5	51.0	33.0	10.0
Kalyoubia	22.0	14.5	39.0	19.7	39.0	43.0	5.0
Kafr-ElSheikh	25.0	36.3	16.0	39.0	28.0	65.0	7.0
Gharbia	24.0	70.1	14.0	40.3	46.0	41.0	4.0
Menoufia	18.0	25.7	27.0	30.9	46.0	23.0	9.0
Behera	33.0	11.9	17.0	14.5	37.0	25.0	15.0
Giza	41.0	26.1	17.0	19.4	45.0	20.0	14.0
Beni-Suef	19.0	17.9	39.0	5.9	85.0	48.0	11.0
Fayoum	19.0	30.2	10.0	20.8	31.0	15.0	4.0
Menia	26.0	24.2	61.0	18.7	53.0	41.0	12.0
Asyout	30.0	40.9	14.0	12.0	47.0	31.0	17.0
Suhag	21.0	25.5	29.0	14.6	48.0	29.0	10.0
Qena	13.0	11.7	10.0	22.1	52.0	18.0	6.0
Aswan	19.0	33.3	8.0	22.1	33.0	15.0	19.0

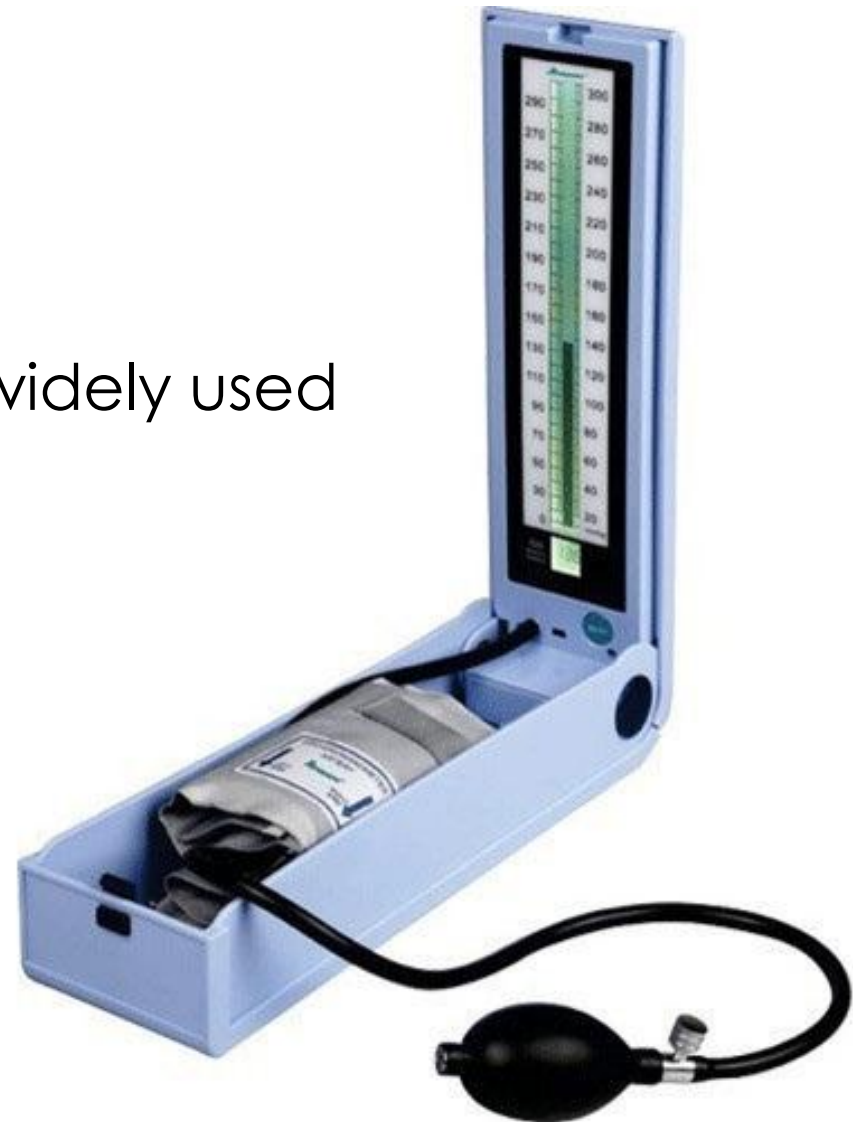
- 
- HTN **diagnosis** starts with correct BP measurement
 - HTN **management** needs correct BP measurement
 - HTN **follow up** needs correct BP measurement

Well trained personnel

Proper measuring technique

Validated devices

Sphygmomanometers are still the most widely used devices in Egypt



Maintenance of mercury devices

Which?

All devices should be maintained

How?

Using the 3 steps evaluation

When?

Physical (6 months)

calibration (12 ms/portable devices and
36 ms/immobile devices)

Where?

National Institution of Standards
Certified calibration centers

Who?

2 trained technicians



A light blue brushstroke background shape, resembling a paintbrush stroke, centered on a white background. The stroke is wider at the top and bottom and tapers slightly towards the middle, with a rough, feathered edge on the right side.

Methods

Study design

- A cross-sectional
- Multi-centers
- August 2016- April 2019

- 50 Public hospitals, Cairo
- 10% of devices in each hospital were randomly selected
- Devices were tested onsite



Physical assessment



Air leakage



Calibration accuracy



Physical assessment

Table. 1 Physical assessment tests for mercury sphygmomanometer BP-measuring devices.

<i>Status item</i>	<i>Device was considered defective if any of the following was present</i>
The Mercury	<ul style="list-style-type: none"> —Black discoloration or air bubbles of the mercury. —Mercury was not sufficient to be at the zero mark on the tube (when zero pressure applied with an open system and a vertical sphygmomanometer.
The lid of the device	<ul style="list-style-type: none"> —Not secure in its position. —Not effectively closed.
Indicators and displays (Scale and glass tube clarity)	<ul style="list-style-type: none"> —Not clear or not easy to be read. —Glass tube discoloration or contamination.
The leather washer (The leather disc) or filters	<ul style="list-style-type: none"> —Mercury loss test is positive. After stopping pumping, mercury continues to rise and does not stop. The dropping speed time from 200 mmHg to 0 mmHg is more than 1 s. —The rapid exhaust test from 200 mmHg to 40 mmHg is more than 1.5 s
Zero Reading	<ul style="list-style-type: none"> —Deviated reading by $>\pm 2$ mmHg.
Health and safety	<ul style="list-style-type: none"> —Absence of the cuff correct positioning indicator over the artery. —Absence of the cuff limb circumference indicator for which it is appropriate. —Absence of instructions regarding its use, maintenance, and safety.
The cuffs	<ul style="list-style-type: none"> —Rips, tears or inability to be fastened and to stay fastened on inflation.
The bladder	<ul style="list-style-type: none"> —Worn, torn or prolapsed out of the cuff.
The inflation bulb	<ul style="list-style-type: none"> —Cracks, leaking air on pumping.
The rubber tubing	<ul style="list-style-type: none"> —Holes, leaks, cracks, or excessive wear.
Connectors	<ul style="list-style-type: none"> —Loose connections.

Leather washer
- Mercury loss

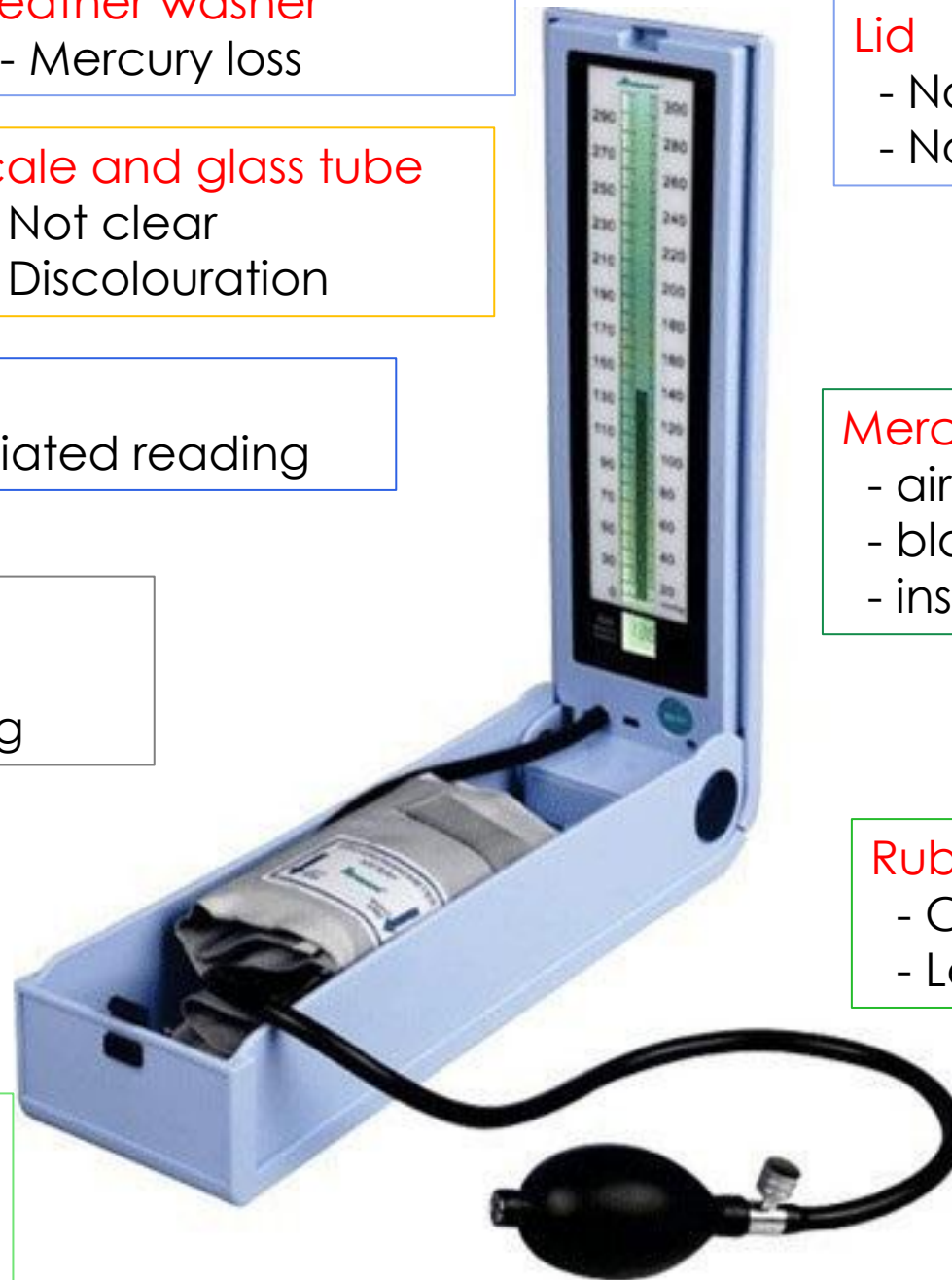
Scale and glass tube
- Not clear
- Discolouration

Zero
- Deviated reading

Cuff
- Tears
- Failed fastening

Cuff bladder
- Worn
- Prolapsed

Inflation bulb
- Cracks
- Leaking air



Lid
- Not secured
- Not closing

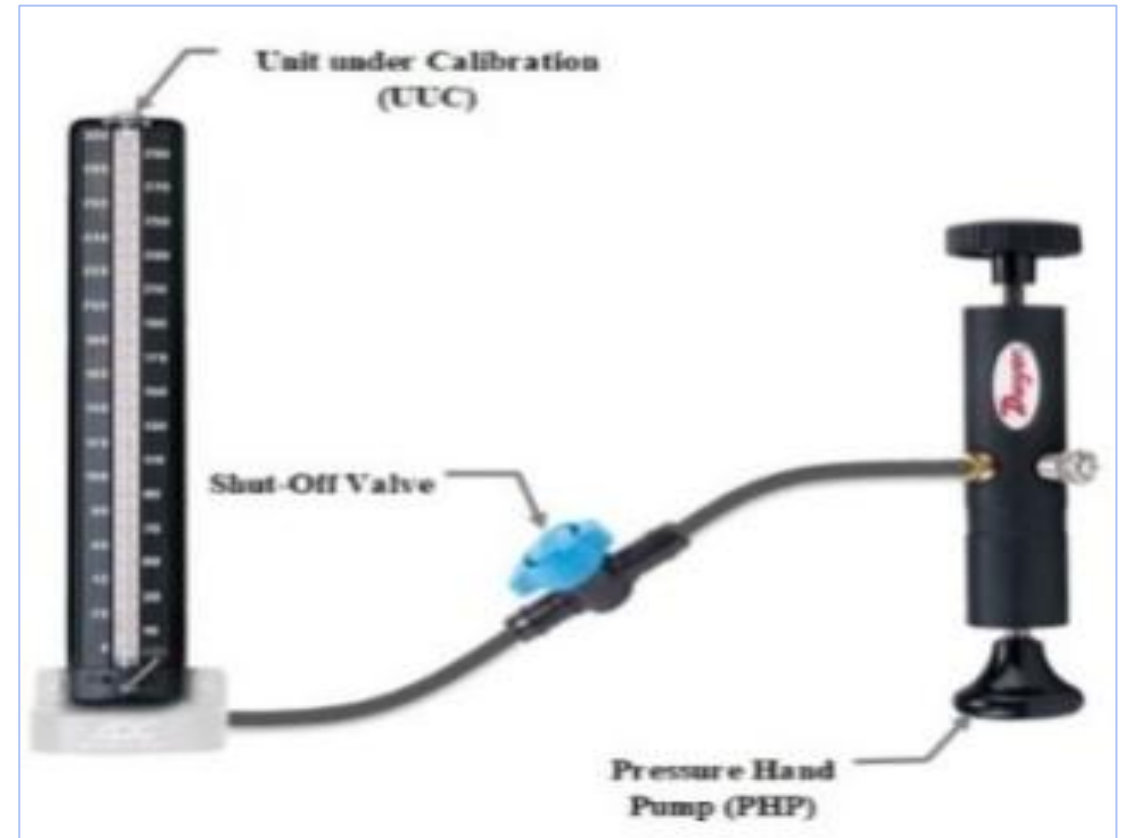
Mercury
- air bubbles
- black discolouration
- insufficient mercury

Rubber tubes
- Cracks
- Leaks

Connectors
- Loose

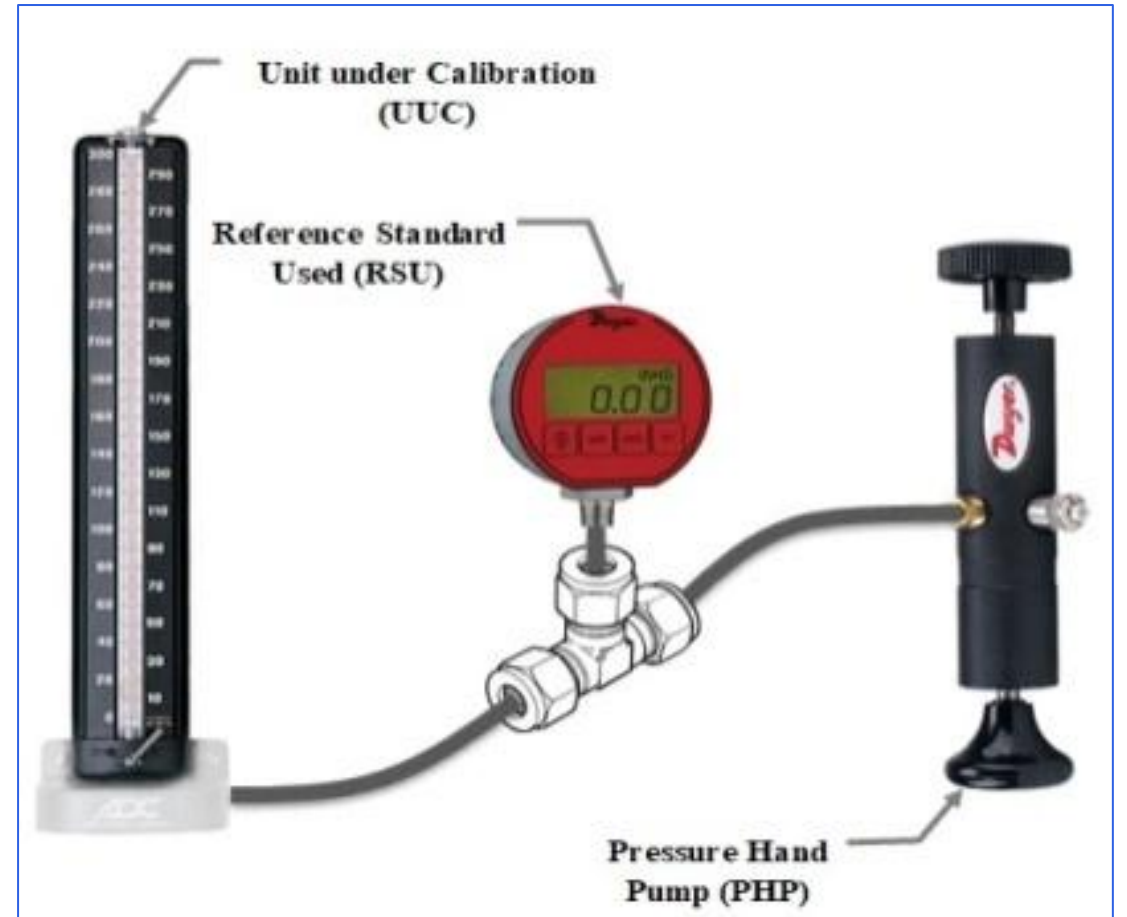
Leakage test

- Pressure variation in relation to time
- Increase the pressure to 260 mmHg pressure
- Shut off the valve
- Wait for 1 minute
- See the pressure
- Positive if pressure drops >4 mmHg after 1 minute
- Devices with leakage rate > 80 mmHg were exempted from the next step



Calibration

- RSU scale: 0 to 775 mmHg
- RSU accuracy: ± 0.25 mmHg
- Pressures are tested ascendingly and descending at 0, 50, 100, 150, 200 and 250 mmHg
- Max permissible error is ± 3 mmHg



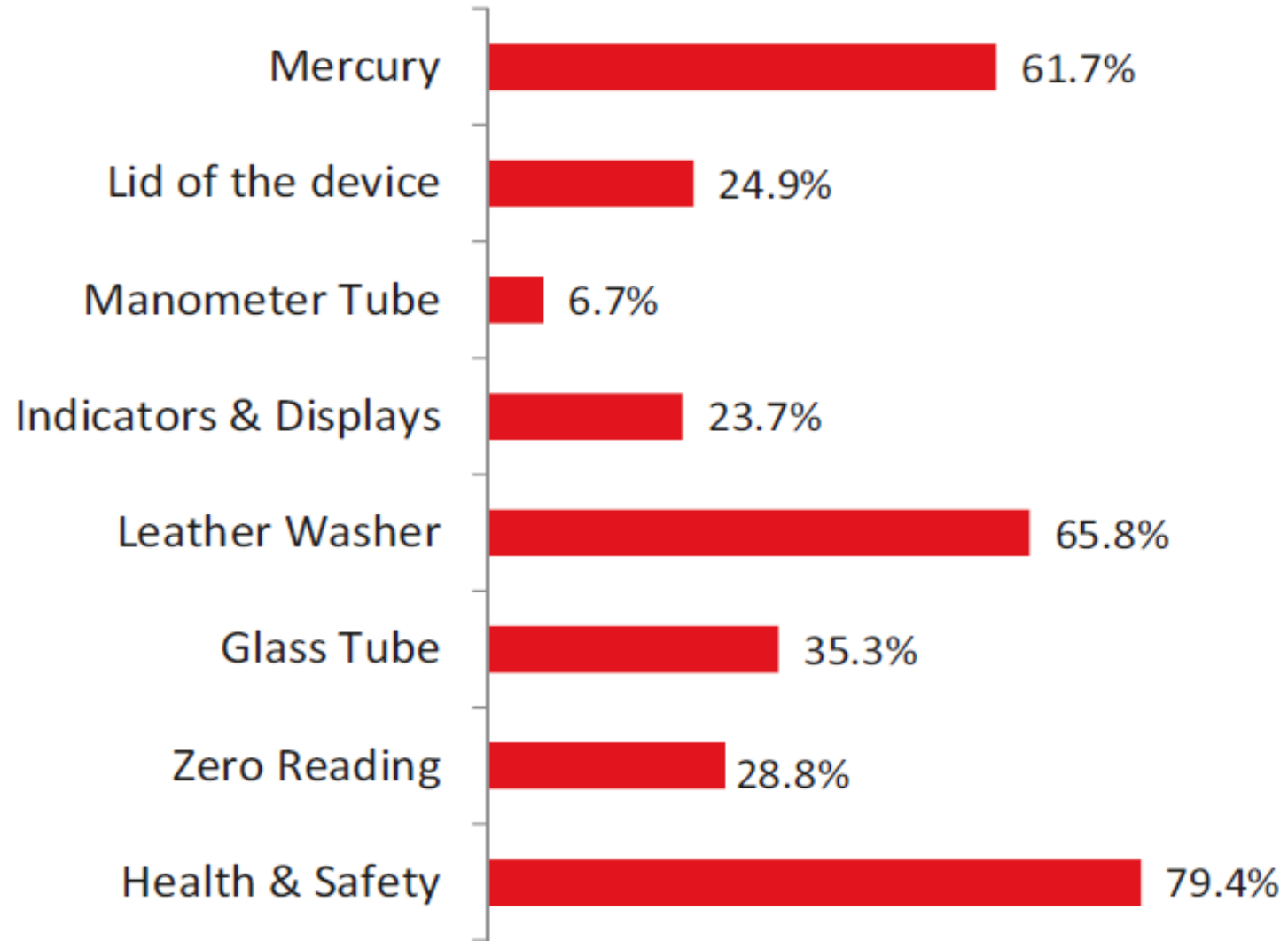
Digital Pressure Indicator



Results

Results

- 465 devices were tested
- Only 13 devices (2.8%) were previously tested, no records
- 162 devices (34.8%) were excluded from calibration



Failure rate at the different check points in the physical assessment of the devices.

Pass rates

25 devices (5.2%)
Passed physical assessment

50 devices (10.8%)
Passed leakage test

78 devices (16.5%)
Passed calibration test

6 devices (1.3%)
Passed all 3 tests

Conclusion

- Maintenance of BP measuring devices is essential
- Maintenance of BP devices has a cost-benefit
- Hospitals are usually unaware of the importance of maintaining BP mercury devices
- Almost all tested devices failed the 3 steps assessment protocol

Recommendations

- Gradually replace the mercury devices
- Regularly maintain the working ones

Acknowledgment

Dr. Hazem Abdel Meguid



Thank you