



# MAINTENANCE MANAGEMENT OF BLOOD GAS ANALYZERS

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## Abstract:

**Introduction:** Blood gas analyzers or Arterial Blood Gas Analyzers (ABGs) are one of the most important equipment in laboratories and points of care (POCs). ABG measures the level of gases and pH in the blood to take critical procedures on patients who are in bad status.

**Method:** a retrospective study was performed on 4 blood gas analyzers in 4 different locations in the Royal Medical Services Hospitals in Jordan during the period between 2012 and 2016. All maintenance reports were gathered and examined to specify the components that repeatedly deteriorate. Moreover, the advantages of maintaining blood gas analyzer on a regular schedule and according to the manufacturer recommendations were investigated.

**Results:** During the 5 years period, 52 maintenance reports was identified as the reports where the maintaining of the device needed a replacement part. The frequency of failure due to the following parts: electrodes, tube set, and pumps tube were 25, 18, and 17 respectively.

**Conclusion:** The breakdown period of the blood gas analyzer were reduced significantly due to following the manufacturer guidelines in performing the planned preventive maintenance. The replacement parts needed repeatedly for fixing the devices such as pump tube, electrodes, tube sets and others should be kept in the hospital inventory to reduce the downtime of the equipment.

**Keywords:** Blood gas analyzer, Replacement parts, Breakdown, Planned preventive maintenance.

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## Introduction:

Blood gas analyzer is an analytical medical device used to measure the partial pressure of different gasses such as O<sub>2</sub>, CO<sub>2</sub> and others in an arterial blood sample. This device can be found in different health care department including respiratory therapy departments, operating theatres clinical laboratories, ICU, and physician offices to monitor the exchange of breathing gases in lung, and the balance of acids and bases in blood. The value of arterial PO<sub>2</sub> below 80 mm Hg may indicate improper pulmonary respiration which can be due to increased O<sub>2</sub> demand, low inspired O<sub>2</sub>, or decreased cardiac output. Arterial PCO<sub>2</sub> normal range is from 35 to 45 mm Hg. Measured values beyond this range is an indicator of hypocapnia or hypercapnia and tell the health professional about the ventilation status (1).

Biomedical equipment maintenance department in any hospital is responsible for keeping this equipment and others in proper condition to ensure that the device is working properly avoiding long periods of downtime and that the readings measured by the device is accurate and precise and reflect the actual values in patients' blood sample. In order to achieve this task, planned preventive maintenance according to manufacturer's recommendations is required at fixed intervals. It is reported that improper performing of inspection and preventive maintenance is responsible for sudden failure of medical devices.

In this paper, the advantages of maintaining blood gas analyzer on a regular schedule and according to the manufacturer recommendations are investigated. Furthermore, the frequent failures of this device during a 4 years period between 2012 and 2016 were analyzed to identify the components of the device that frequently deteriorate.

## Methods:

a retrospective study was performed on 4 blood gas analyzers in 4 different locations in the Royal Medical Services Hospitals in Jordan during the period between 2012 and 2016. The first step was to collect all maintenance reports written after performing inspection and maintenance of blood gas analyzer in these four hospitals, and then classify them into two parts; planned preventive maintenance reports and breakdown maintenance reports (2). Secondly, it is investigated if the preventive maintenance was performed correctly at fixed intervals as the manufacturer recommends. Moreover, the consequences of maintaining the equipment regularly is investigated to find out if this procedure improved the performance of the devices and reduced overall downtime of the equipment. Afterward, the breakdown



maintenance reports were analyzed to identify the equipment parts needed during this period to maintain these devices and correct its performance. The components responsible for the longest period of downtime and breakdown frequently were specified to try to keep them in the inventory or to make the procedure of purchasing them easier and quicker. This is important to repair the failed units quickly without that long period of downtime which affects the performance of the device and could exaggerate the problem.

### Results and Discussion:

It is recommended by the manufacturer to perform the preventive maintenance every 4 months. This study shows that this was done perfectly. Table 1 shows the frequency of PPM during the last 5 years period on 4 blood gas analyzers in different locations. Analyzing the figures reveals that the PPM was conducted at least 3 times in each year which means that the PPM was done nearly every 4 months.

Year \ Equipment	2012	2013	2014	2015	2016
Equipment 1	4	3	3	4	3
Equipment 2	4	3	4	4	3
Equipment 3	3	4	4	3	3
Equipment 4	3	3	3	4	4

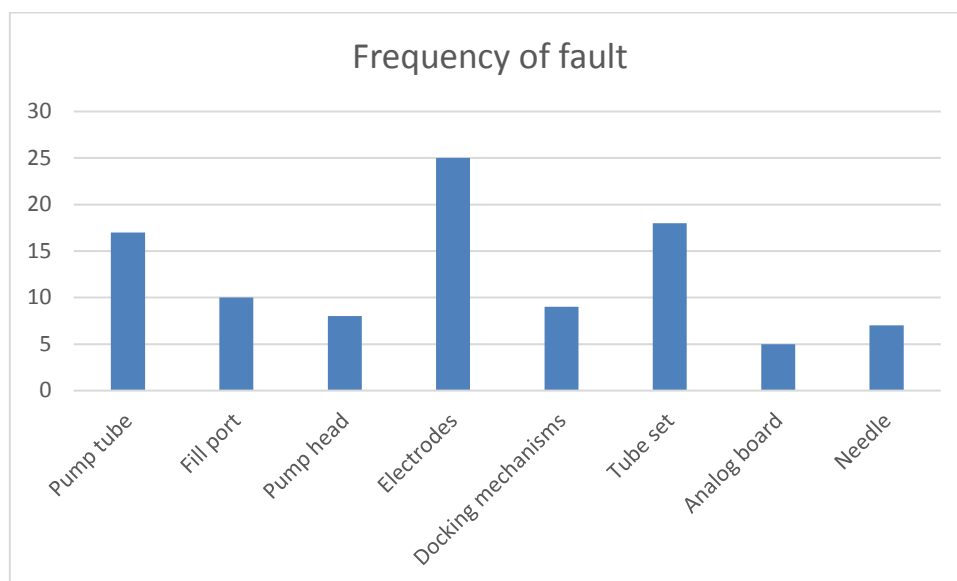
Table 1: the frequency of applying PPM for each blood gas analyzer in 4 locations in each year.

The PPM involves cleaning different components including Sample Measurement Chamber and Optics surfaces. In addition, calibrating several parts is needed every time the PPM is performed to guarantee that the device measures accurate values. Furthermore, some parts such as pump cartridge, gas I/O port are required to be replaced every year to avoid sudden failure. The unscheduled downtime of each equipment was 5 days per year on average. This figure is acceptable and indicates that the PPM is performed regularly and properly and as indicated by the manufacturer.

Table 2 and figure 1 show the main components of blood gas analyzer that collapse repeatedly during the period of study. Gas Electrodes were the most common cause of breakdown in the 4 locations. It failed 25 times, which require that this part should be purchased and kept in the inventory to avoid the long period of downtime while waiting the long procedure of purchasing the mentioned part. Pump tube and tube set should also be kept in the hospital as standby because the figures were 17, and 18 respectively.

	Faulty Part	Frequency of fault
1.	Pump tube	17
2.	Fill port	10
3.	Pump head	8
4.	Electrodes	25
5.	Docking mechanisms	9
6.	Tube set	18
7.	Analog board	5
8.	Needle	7

Table 2 shows the main components that collapse repeatedly during the period of study.



**Figure 1: the frequency of faults due to several device components.**

The other parts including fill port, pump head, docking mechanism, analog board, and needle failed frequently but not as frequent as the previous two components. The frequency of fault was less than 10 times during the whole period. In other words, less than twice a year. It is more convenient to also purchase these parts and use them when needed especially if the logistic system in the hospital is not quick enough to supply with the replacement part.

#### **Conclusion:**

The breakdown period of the blood gas analyzer were reduced significantly due to following the manufacturer guidelines in performing the planned preventive maintenance. The replacement parts needed repeatedly for fixing the devices such as pump tube, electrodes, tube sets and others should be kept in the hospital inventory to reduce the downtime of the equipment.

#### **References:**

1. Maintenance reports available at Al-Hussein Medical City.
2. Product comparison: Blood gas/PH analyzer, 2006, ECRI.

