Cortisol Test

Lateral Flow Immunoassay for the quantitative measurement of salivary Cortisol in combination with IPRO LFD Reader.

English test instructions and information.

Test for research or investigative purposes.
Not an in vitro diagnostic test.
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</table>
Lateral-Flow assays represent a well established proven technology for a variety of point-of-care and field use applications. Although these simple diagnostic tests are established in many routine applications, this technology has not been widely applied when very sensitive, highly reproducible, quantitative results or electronic data documentation are required. The IPRO Lateral Flow Device (LFD) Reader now makes this possible, by combining the major advantages of traditional lateral flow assay with modern technologies to fulfill the requirements for new quantitative tests. The component parts required for a test are an IPRO LFD Reader, an IPRO Oral Fluid Collector (OFC) swab, IPRO OFC Buffer and an IPRO LFD cassette, in this case Cortisol.

**IPRO LFD Reader Safety Precautions:**

- **Operating location:** The location of the reader should be preferably on a desk or stable surface with enough surrounding space in order to easily insert the cassettes or unplug the device. In case of emergency or under abnormal operating conditions the location should provide, at any time, enough space to allow the easy disconnection of the device.

- **Battery power:** The IPRO LFD Reader can be powered by batteries without external power supply. The batteries must periodically be recharged by connecting the external power supply for at least 4 hours (the complete charging time is 14 hours). It is important to charge the reader for 24 Hours before first use. *Remember: The reader must be switched on to enable charging.*

- **Ambient temperature:** The use of the IPRO LFD Reader in environments prone to large changes in temperature can cause measurement values to deviate from real values. Please take the environmental conditions into account when trouble shooting.

- **Ambient light:** The IPRO LFD Reader is a highly sensitive and precise optical device. The device has internal correction for normal levels of ambient light, but highly intense light falling into the test strip insertion port can cause serious interference with the measurement and must be avoided.

- **Vibration:** The IPRO LFD Reader is a highly sensitive and precise optical device. The result can be influenced by vibrations e.g. if the device is used close to vibrating machines. The device must be used on a stable and level surface.

- **Dirty environment:** If you plan to use the IPRO LFD Reader in a working environment prone to dirt build-up, you will need to clean the device regularly. For cleaning, use a damp cloth. For more persistent stains, it is also possible to clean the surface with a cloth dipped in pure alcohol (isopropanol or ethanol). Avoid the use of aggressive solvents such as acetone.
2.0 Materials supplied, Storage and Stability

Table One: Materials supplied, storage and stability

<table>
<thead>
<tr>
<th>Component</th>
<th>Cat. No.</th>
<th>Content</th>
<th>Storage at</th>
<th>Shelf Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPRO LFD READER</td>
<td>IPRO LFD RDR</td>
<td>1</td>
<td>4˚C to 40˚C</td>
<td>N/A</td>
</tr>
<tr>
<td>IPRO OFC SWAB</td>
<td>IPRO OFC</td>
<td>100</td>
<td>4˚C to 37˚C</td>
<td>24 months</td>
</tr>
<tr>
<td>IPRO OFC BUFFER</td>
<td>IPRO OFC</td>
<td>100</td>
<td>4˚C to 37˚C</td>
<td>18 months</td>
</tr>
<tr>
<td>IPRO Cortisol LFD</td>
<td>IPRO LFD-C</td>
<td>100</td>
<td>4˚C to 37˚C</td>
<td>12 months</td>
</tr>
</tbody>
</table>

3.0 Specimen Collection and Preparation

The determination of cortisol levels in human oral fluid requires the collection of Oral Fluid using the IPRO OFC (Oral Fluid Collector) Swab and Buffer. The swab will collect 0.5 mL of oral fluid and is then placed in the IPRO Buffer. However the cortisol concentration value given on the reader will be the actual value of cortisol in the saliva sample.

4.0 Warnings and Precautions

All reagents within IPRO test kits are strictly intended for in vitro use only. It is intended that the kits be used by staff who are informed and trained to carry out such tests. Please adhere strictly to the stated protocols in this document for safety and to ensure the gathering of effective information.

*Timings are important and deviation from the stated protocol will increase the variability of the data gained.*

Samples should be stored securely or disposed of responsibly upon test completion. It is usual to gain informed consent from humans before the commencement of testing procedures. Guidance on ethics and informed consent can be found on this WHO website:

http://www.who.int/rpc/research_ethics/informed_consent/en/
**5.0 Methodology and Test Principle**

Most rapid diagnostic tests work by capturing analytes on a solid surface and then attaching molecules to them that allow detection by the naked eye. IPRO's test is based on the principle of Lateral flow, also called immunochromatographic strip (ICS) tests or simply strip-tests. The LFD consists of 7 components (shown in figure one) making the strip in addition to the housing plastic cassette.

**Figure One: Components within the IPRO LFD**

1. Sample Pad
2. Conjugate Pad: The conjugate pad contains the dried detection reagent (conjugate).
3. Detection Conjugate: Gold-labelled anti-cortisol antibody
4. Solid-phase Nitrocellulose Membrane.
5. Test line: cortisol and control reagent line.
6. Absorbent Pad.
7. Plastic-adhesive backing card

The test is carried out by adding the sample (buffer/saliva mixture) onto the sample pad. The liquid will move by capillary action through the conjugate pad hydrating the dried conjugate. The whole mixture continues its flow through the nitrocellulose membrane towards the wicking/absorbent pad at the end of the strip. As the mixture flows across the membrane, the gold-labelled anti-cortisol will be captured by the cortisol test line resulting in the appearance of a red line. If cortisol is present in the sample, this will bind to the gold labelled anti-cortisol antibody, resulting in fewer gold particles being captured by the cortisol test line. It follows that the test line intensity is inversely proportional to the cortisol concentration in the sample. The IPRO LFD Reader measures the line intensity and converts this into the corresponding cortisol concentration in the saliva sample, expressed in ng/ml or nM, on the basis of a specific programmed standard curve specific to each Lot of cortisol test strips.
5.1 Test Procedure and Protocols

The stages are:

1. Sample collection using IPRO OFC swab
2. Placement of completed Swab into IPRO OFC Buffer
3. Addition of Buffer / Sample mix to LFD and incubation
4. Measurement of cortisol sample in the LFD
5. Interpretation of data

5.2 Sample Collection with IPRO OFC

5.21 IPRO OFC SWAB:
The oral fluid collector consists of a specially formulated synthetic polymer-based swab material attached to a plastic tube containing a volume adequacy indicator. The collector is designed to collect 0.5mL oral fluid.

5.22 IPRO OFC BUFFER BOTTLE:
The IPRO OFC buffer contains sodium phosphate, salts, detergents and preservatives. It has a number of key properties to make it an effective tool for user-friendly oral fluid collection in the field. Not only does it contain extraction agents to draw the target analytes from the swab into the buffer, it also contains preservatives to prevent growth of microorganisms. Once the swab is in the buffer it is stable at 37°C for three weeks. It is recommended that continued storage (weeks) be in a refrigerator or (months) in a freezer, where cortisol samples in the IPRO buffer are stable for at least 18 months.

IMPORTANT: DO NOT INGEST THE BUFFER.

5.23 Safety Notes:

- The oral fluid collector is designed for single use only.
- Do not chew or suck the oral fluid collection swab.
- Do not place the oral fluid collection swab in the mouth after it has been in the sample collection solution.
5.24 COLLECTION PROCEDURE:

1. Remove the IPRO OFC swab from the bag, by tearing the perforation.

2. Place the swab in the mouth, either on top of the tongue and close mouth, or actively swab the cheeks and gums. It does not matter which method is used, *as long as users are consistent on each occasion*, because oral fluid can come from different saliva glands and the location of the swab is thus important.

*Figure Two: OFC Collection Before*

3. Continue to collect until the volume adequacy indicator has turned royal BLUE in colour. This will typically take 20-50 seconds in most individuals, but can take several minutes if dehydrated, or flow rate is very low. In these rare instances be patient and await the colour change.

*Figure Three: OFC Collection After*
5.3 Placement of Swab into IPRO OFC Buffer

Once the oral fluid has been collected, it should be placed in the Buffer bottle, by holding the plastic tube and inserting the bud end of the swab into the Buffer, in the direction shown below.

Figure Four: Placement of Swab into the Buffer Bottle

Replace the top of the Buffer bottle tightly.

The bottle should then be mixed for a period of at two minutes. This should be done in a rhythmic up and down, or back and forth motion. The mixing is important to enable full extracting of the target analyte from the swab into the buffer. Do not be too vigorous in shaking.

5.4 Addition of Sample to LFD

Remove the IPRO Cortisol LFD from the foil pouch by tearing at the notches on either side.

As the LFD can be affected by humidity, it is important to check that there has been no colour change in the silica gel sachet that is also packed within each foil pouch with the LFD. If the silica gel has changed in colour (orange to green) then it is unlikely that the LFD is suitable for use and should be discarded.

Hold the buffer bottle perpendicular to the surface where the LFD is resting (for good repeatable performance, this should be a flat level surface). Put two drops of the Sample / Buffer mix into the round test window of the IPRO cortisol LFD.
Within 30 seconds a reddish liquid will start to appear in the rectangular test window and run across the whole strip. In the unlikely event that this has not happened within 90 seconds, add one more additional drop.

You should start to time the test from when the reddish colour first starts to appear in the rectangular test window. You will then scan your cortisol LFD on exactly 10 minutes from when the reddish colour first appears in the test window.

You will notice that within the test window there is the formation of two red lines, a (C) control and a (T) Test line.

Scanning the cortisol LFD either before or after 10 minutes will add to the variability of your readings, so it is important to be consistent and aim to read on 10 minutes on each occasion. (Refer to scan timings in Table Four on page 17 of this manual).

5.5 MEASUREMENT IN THE IPRO LFD READER

Figure Four: The IPRO LFD Reader

1. Display Window
2. ENTER and ON / OFF Button
3. BACK Button
4. FORWARD Button
5. UP Button
6. DOWN Button
7. Draw for IPRO Cortisol LFD
8. Battery Compartment
5.51 BASIC READER OPERATION

Full details of the operation and maintenance of the IPRO LFD Reader can be found in the separate manual documentation supplied on the memory stick with your IPRO LFD Reader (IPRO LFD RDR Manual). Basic instructions for general operation follow:

Press and hold the ON / OFF (2) button for two to three seconds. The IPRO LFD Reader will then start to boot up, while it displays a WELCOME message and go through a series of checks, which takes about two minutes.

Pull out the draw (7) and insert the Cortisol LFD cassette into the housing compartment, before closing the draw again. The reader will bleep if the cassette holder is not fully closed.

**Figure Five: Correct positioning of the LFD in Reader Drawer**

![Correct positioning of the LFD in Reader Drawer](image)

Control (C) Line  Test (T) Line  Sample window

The default display on the reader will be to show the assay METHOD (in this case Cortisol) and the Lot ID, it also gives you the opportunity to enter a Sample ID.

*It is important that the Lot ID displayed is the same as the Lot Number displayed on the Label of the LFD foil pouch*; the specific calibration characteristics are programmed to the reader for each batch of strips manufactured.

When ready to scan the Cortisol LFD (10 minutes after the reddish colour has appeared in the LFD test window), scroll down to MEASURE on the reader display using the DOWN (6) button (press 3 times with short presses). Finally, press the ENTER button for half a second to commence the Scan.

The Scan takes about 20 seconds and you will then see the Cortisol result displayed.
In the top left hand corner of the display NT (Next Test) is highlighted, press the ENTER button to bring back the default menu, enabling the immediate performance of another scan.

5.52 CHANGING THE LOT ID

This is done by connecting the IPRO LFD READER to a PC via the serial USB link cable supplied. The process requires the supplied IPRO software and installation of drivers supplied on the memory stick that comes with the LFD Reader. The appropriate calibration method is usually emailed by IPRO to the client when a new Lot ID is dispatched.

5.53 OTHER READER BASICS

To turn the Reader off, press and hold the ON / OFF button for three seconds. You will hear three beeps and the reader will shut down.

The reader will shut down after a period of inactivity, in order to preserve battery power. The length of time for this shut down can be adjusted within the SETUP menu.

**Charging the rechargeable batteries:**
To do this, the reader must be switched ON. The reader will not charge the batteries when it is turned OFF, *even if it is plugged into mains power.*

The Reader will record and store up to 100 readings in its internal memory. When it has 100 readings, it will start to overwrite previous readings, starting with the oldest.

Do not move the reader when it is scanning. Movement whilst scanning can increase the risk of damage to the reader!!
Only valid results are shown on the IPRO LFD Reader. If the test result states INVALID, then it is advised that the test be repeated. A likely cause of this is that the sample has not been mixed sufficiently in the buffer before adding to the LFD. It is also possible that insufficient sample has been added to the sample window; this can be the case if large air bubbles are present in the drops. Try to hold the bottle perpendicular to the surface on which the Reader is placed to obtain consistent drop size; holding the bottle at an angle can whilst dispensing the sample / buffer mix can add to variability in your readings. Another possible cause of INVALID readings is that the test result is outside of the effective measurement range. If it is suspected that the value is very high, it is possible to titrate the sample and test again. Alternatively the sample can be sent to the IPRO Laboratory for confirmation.

Unlike other assays on the IPRO LFD, in some samples the behavior of the cortisol LFD can see a change of signal over the first four hours from collection time. This can give what appear to be spuriously high readings if measured straightaway, but these drop after four hours. After this point the readings are stable and similar to those read on on 24 hours or at a later point. Figure Six shows that the correlation between readings analysed immediately and 4 hours later is high but absolute values can drop.

**Figure Six: cortisol values on the LFD run immediately and post 4 hours**

This change in signal stabilises after four hours. It is possible to run the test in real-time straight after mixing, as long as this is consistently done. *Where time of data is not of a premium we recommend running cortisol LFDs 4 hours post collection to reduce variability in your readings.* In the sporting environment, this is typically a case of collecting samples when athletes / players arrive at a training venue and analysing those samples after training. All data will be ready to influence training decisions the next day.
The Cortisol LFD shows good agreement with the IPRO cortisol laboratory ELISA assay. Given that this latter process takes a number of hours to complete, the data in Figure Seven shows a comparison of the cortisol LFD results, run 4 hours after collection, with the laboratory ELISA assay. Although the agreement is good, it should be remembered that the ELISA itself is a laboratory test, it is no gold standard in its own right.

**Figure Seven:** cortisol values run on the LFD and ELISA

![Graph showing cortisol values run on the LFD and ELISA](image)

\[ R^2 = 0.69524 \]

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**7.0 Interpretation of Test Result**

The measurement of the Cortisol LFD test result can only be done in combination with the IPRO LFD Reader. This is a fully quantitative result. Monitoring of cortisol via the blood or saliva is a useful way of measuring the stress response of an individual. About 15% of cortisol is found in its unbound or biologically active form whilst the rest is bound to serum proteins. Unbound serum cortisol will enter the saliva via passive diffusion within 5 minutes. The close agreement (r>0.9) between unbound blood and saliva cortisol levels has been well established for some time (Vining et al., 1987, Aardal and Holm 1995).
Figure Eight: Typical diurnal pattern of salivary cortisol

It has also long been established that there is a clear circadian pattern to cortisol production in humans, which means care is needed with interpretation of single values. Values in the healthy individual are high upon awakening and then rise, peaking approximately 30 minutes later (often referred to as CAR – cortisol awakening response) Schmidt-Reinwald et al. 1999), from where the value declines throughout the rest of the day to minimal values at night-time as seen in figure one. It is normally expected for cortisol to be 50% higher 30 minutes after awakening (Wust et al. 2000).

However, it should be remembered that many factors influence cortisol values, alongside the time of day and these should be controlled or at least acknowledged in your interpretation of data. Some obvious factors to consider are eating (especially caffeine), exercise and acute exercise, as well as chronic stress events. This means that the smooth, more theoretical curve in Figure Eight may look more like the pattern in Figure Nine, if many samples were taken through a typical day, involving meals, exercise and acute stress events.

Figure Nine: A realistic unsmoothed salivary cortisol profile in a day
Because saliva hormones correlate well with the amount of hormones inside cells, it can be argued that saliva measurements are more insightful than blood or urine samples.

More detailed information on the measuring of cortisol and other biomarkers for the monitoring of stress can be found in the IPRO document “Using Salivary Biomarkers to measure and monitor stress.” For advice on sporting applications and protocols please contact IPRO directly.

### 8.0 ASSAY CHARACTERISTICS

#### 8.1 CORTISOL LFD CHARACTERISTICS

**Sample Material:** 0.5 mL of oral fluid, collected with IPRO OFC

**Incubation Time:** 10 minutes from first appearance in test window

**Sensitivity:** 0.75 ng/mL (2nM)

**Dynamic Range:** 0.75 ng/mL to 15 ng/mL (2 to 40 nM)

**Specificity:** Specific to human cortisol

Cross-Reactivity (50% inhibition) of the anti-cortisol antibody used in the test:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Cross Reactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol</td>
<td>100%</td>
</tr>
<tr>
<td>11-Deoxycortisol</td>
<td>0.9%</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5.6%</td>
</tr>
<tr>
<td>Corticosterone</td>
<td>0.6%</td>
</tr>
<tr>
<td>Danazol</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>11-Deoxycorticosterone</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>Progesterone</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>17-Hydroxyprogesterone</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Testosterone, Estradiol, Estriol</td>
<td>&lt;0.1%</td>
</tr>
</tbody>
</table>

**Method Comparison:** Highly correlated with IPRO Cortisol ELISA (r=0.83)

**Precision:** Intra-assay CVs are shown in Table Two
## Table Two: Intra-assay CVs for the IPRO Cortisol LFD

<table>
<thead>
<tr>
<th>Standard number</th>
<th>Conc nM</th>
<th>Conc ng/ml</th>
<th>Concentration ng/ml</th>
<th>Mean</th>
<th>SD</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2.43</td>
<td>0.88</td>
<td>0.53</td>
<td>0.62</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>4</td>
<td>4.83</td>
<td>1.75</td>
<td>1.87</td>
<td>1.43</td>
<td>1.50</td>
<td>0.34</td>
</tr>
<tr>
<td>5</td>
<td>9.67</td>
<td>3.5</td>
<td>3.55</td>
<td>3.33</td>
<td>3.34</td>
<td>0.20</td>
</tr>
<tr>
<td>6</td>
<td>19.34</td>
<td>7.0</td>
<td>9.20</td>
<td>9.50</td>
<td>9.27</td>
<td>0.20</td>
</tr>
<tr>
<td>7</td>
<td>38.67</td>
<td>14</td>
<td>12.52</td>
<td>12.36</td>
<td>12.47</td>
<td>0.10</td>
</tr>
<tr>
<td>8</td>
<td>77.35</td>
<td>28</td>
<td>14.88</td>
<td>14.79</td>
<td>14.79</td>
<td>0.09</td>
</tr>
</tbody>
</table>
8.2 RELIABILITY

The data in Table Three and the scatterplot in Figure Ten show repeated measures of 17 samples assessed in real-time at a Premier League football club training ground. All samples were collected within 15 minutes of one another and then analysed in duplicate on the same reader sequentially. It can be seen the Typical Error is 0.47 ng/ml and the mean cv is 9.6%.

Table Three: Repeated measurement using cortisol LFD (ng/ml)

<table>
<thead>
<tr>
<th>Sample</th>
<th>RT 1</th>
<th>RT2</th>
<th>mean</th>
<th>diff</th>
<th>SD</th>
<th>cv</th>
</tr>
</thead>
<tbody>
<tr>
<td>JB</td>
<td>8.20</td>
<td>7.65</td>
<td>7.93</td>
<td>-0.55</td>
<td>0.39</td>
<td>4.91</td>
</tr>
<tr>
<td>FC</td>
<td>2.84</td>
<td>3.67</td>
<td>3.26</td>
<td>0.83</td>
<td>0.59</td>
<td>18.03</td>
</tr>
<tr>
<td>JF</td>
<td>4.92</td>
<td>6.41</td>
<td>5.67</td>
<td>1.49</td>
<td>1.05</td>
<td>18.60</td>
</tr>
<tr>
<td>SG</td>
<td>5.77</td>
<td>5.29</td>
<td>5.53</td>
<td>-0.48</td>
<td>0.34</td>
<td>6.14</td>
</tr>
<tr>
<td>DG</td>
<td>7.72</td>
<td>7.26</td>
<td>7.49</td>
<td>-0.46</td>
<td>0.33</td>
<td>4.34</td>
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<tr>
<td>JH</td>
<td>1.21</td>
<td>2.67</td>
<td>1.94</td>
<td>1.46</td>
<td>1.03</td>
<td>53.22</td>
</tr>
<tr>
<td>CH</td>
<td>6.36</td>
<td>6.09</td>
<td>6.23</td>
<td>-0.27</td>
<td>0.19</td>
<td>3.07</td>
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<tr>
<td>CJ</td>
<td>3.80</td>
<td>4.30</td>
<td>4.05</td>
<td>0.50</td>
<td>0.35</td>
<td>8.73</td>
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<tr>
<td>TL</td>
<td>6.21</td>
<td>5.91</td>
<td>6.06</td>
<td>-0.30</td>
<td>0.21</td>
<td>3.50</td>
</tr>
<tr>
<td>JMc</td>
<td>2.68</td>
<td>2.58</td>
<td>2.63</td>
<td>-0.10</td>
<td>0.07</td>
<td>2.69</td>
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<tr>
<td>SMc</td>
<td>5.02</td>
<td>4.93</td>
<td>4.98</td>
<td>-0.09</td>
<td>0.06</td>
<td>1.28</td>
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<tr>
<td>BM</td>
<td>9.00</td>
<td>9.50</td>
<td>9.25</td>
<td>0.50</td>
<td>0.35</td>
<td>3.82</td>
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<td>HR</td>
<td>4.40</td>
<td>5.67</td>
<td>5.04</td>
<td>1.27</td>
<td>0.90</td>
<td>17.84</td>
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<tr>
<td>IN</td>
<td>9.76</td>
<td>9.83</td>
<td>9.80</td>
<td>0.07</td>
<td>0.05</td>
<td>0.51</td>
</tr>
<tr>
<td>OR</td>
<td>7.20</td>
<td>7.27</td>
<td>7.24</td>
<td>0.07</td>
<td>0.05</td>
<td>0.68</td>
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<td>RS</td>
<td>2.46</td>
<td>2.94</td>
<td>2.70</td>
<td>0.48</td>
<td>0.34</td>
<td>12.57</td>
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<tr>
<td>MT</td>
<td>3.25</td>
<td>3.41</td>
<td>3.33</td>
<td>0.16</td>
<td>0.11</td>
<td>3.40</td>
</tr>
</tbody>
</table>

SD 0.67
Mean 5.34 5.61
TE 0.47
Mean cv 9.61

Figure Ten: Repeated measurement on cortisol LFD (ng/ml)
8.3 The Effect of Scan Timings on results:

It is important to keep to all aspects of the protocol stated in sections 5 and 6 above. The timing of the scan after addition to the sample window is important. Depending on the viscosity and other characteristics of oral fluid, it can be seen that after the initial flow in one direction, the saliva buffer mix can sometimes start to run backwards. The chemistry on the LFD is still changing for about 20 minutes, so care is needed to scan on exactly 10 minutes, as demonstrated in Table Four and Figure Eleven.

### Table Four: Effect of scan timing on cortisol LFD result (ng/ml)

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
<th>Sample 4</th>
<th>Sample 5</th>
<th>Sample 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>5.92</td>
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<td>1.96</td>
<td>2.23</td>
<td>3.75</td>
<td>8.49</td>
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</table>

### Figure Eleven: Effect of scan timing on cortisol LFD result (mg/mL)
## 9.0 Technical Specifications of IPRO LFD Reader

<table>
<thead>
<tr>
<th>Batteries</th>
<th>3 x 1.2V_{DC} AA Ni-MH rechargeable batteries 2700mAh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Adapter</td>
<td>AC 100-240V, 0.5 A, 50-60Hz</td>
</tr>
<tr>
<td>Power Port</td>
<td>DC 12 V, 1.25 A</td>
</tr>
</tbody>
</table>

### Storage Conditions

- **Temperature**: -20 °C to +70 °C
- **Relative humidity (non condensing)**: ≤ 70%
- **Air Pressure**: 300-1060 hPa

### Operating Conditions

- **Temperature**: +15 °C to +40 °C
- **Relative humidity (non condensing)**: ≤ 70%
- **Air Pressure**: 300-1060 hPa
- **Maximum altitude**: 2000m
- **Protection category**: IP21

### Physical Data

- **Housing material**: ABS
- **Dimensions HxWxD**: 46mm x 178 mm x 165 mm
- **Weight**: 620g

### Interface

- **PC interface**: USB
- **I/O Input**: 5 V logic
- **I/O Output**: 5 V logic

---

**Storage of IPRO LFD:**

Temperature: +5°C to +30°C

**Operation of IPRO LFD:**

Temperature: +15°C to +30°C
10 References


