Using Wireless Technology to Automate Specimen Monitoring and Logistics

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Importance of Diagnostic Testing

7B Tests Annually

70% Of Diagnosis
Importance of Quality

Error Rates & Daily False Results For 10,000 samples/day Laboratory

![Graph showing error rates and daily false results. The graph indicates that for 10,000 samples per day, the error rates are significantly low, with a focus on achieving a 6σ level of performance.](image-url)

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Where do mistakes happen in lab testing?

- Preanalytical: 62%
  - Transportation: 29%
  - Temperature: 26%
  - QNS: 21%
  - Wrong Specimen: 8%
  - Test Request: 7%
  - Patient ID: 6%
  - Other: 3%

- Analytical: 15%

- Postanalytical: 23%

Why is Analytical Such a Small % of the Total Error

labs spend billions on automation to process samples...
...And Pre-Analytical Such a High %

Not so much spent on monitoring samples during transport to prevent sample spoilage.

“What is measured Improves.”

Peter Drucker—Management Guru
# Methods of Pickup & Delivery Confirmation

<table>
<thead>
<tr>
<th>Written log</th>
<th>Bar code scanning</th>
<th>GPS + Wireless Beacons</th>
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</thead>
<tbody>
<tr>
<td>• Manual</td>
<td>• Manual</td>
<td>• Not accurate indoors</td>
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<tr>
<td></td>
<td></td>
<td>• Fully automated and room level accuracy</td>
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</tbody>
</table>

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# Methods of Temperature Verification

<table>
<thead>
<tr>
<th>Volume of refrigerant</th>
<th>Temperature logger</th>
<th>Written log</th>
<th>Wireless Sensors</th>
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</thead>
<tbody>
<tr>
<td>• Manual &amp; Inaccurate</td>
<td>• Manual</td>
<td>• Too late to correct</td>
<td>• Fully automated, accurate &amp; real time</td>
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</table>
Solution

Monitor Location & Temperature In Transit
The Sensors

- Totes / Coolers
  - Temperature
  - 3 days of data

- Vehicles
  - Temperature
  - Location Beacon
  - Room Level Location
  - Beacon
  - Battery Life: 1 Year
  - NIST-traceable Calibration
The Cell Phone

Temperature Status

Out of Range Warning
The Cloud

Status
Monitor Points: 4  Violations: 0  Users: 1

Sensor  | Temp.  | Reading  
--- | --- | ---
Refrig L220  | 7.1 C  | Oct 28, 16:39  
Room Grey and Black  | 19.2 C  | Oct 28, 16:39  
Room Red and Black  | 15.6 C  | Oct 28, 16:39  
Refrig M220  | 3.1 C  | Oct 28, 16:39  

Active Monitor Points
Click Segment For Details
User 1—Corrected After Training
Ivan’s Results—Baseline Day One
Ivan’s Results—Test Day One

Custom temperature Readings for ivanrodriguez

Click and drag in the plot area to zoom in

Temperature (°C)

Time/Date

- Ivan Vehicle–Room
- Refriger L220–Refrigerated
- Room Green and Grey–Room
- Room Grey and Black–Room
- Room Red and Black–Room
- Refriger M220–Refrigerated
Ivan’s Results—Test Day Two

Custom temperature Readings for ivanrodriguez

Click and drag in the plot area to zoom in

- Ivan Vehicle–Room
- Refrig L220–Refrigerated
- Room Green and Grey–Room
- Room Red and Black–Room
- Refrig M220–Refrigerated

[Graph showing temperature readings over time]
Scenario 2—Lost Tote
Discovering Tote Not Delivered

- Courier Picked up tote with 191 samples
  - Route had 5 pickups each with a different tote
  - Route also had 5 return totes to drop off
- Arrived at Core Lab and Dropped off 4 totes
- Courier left for next route
- 1 hour later tech realized 1 tote was missing
  - Not sure which courier responsible another couple of hours
  - Research started
Finding the Lost Tote (Manual Method)

- **Lab Services Contacts the Courier**
  - Finally contacted courier after shift was over
  - Courier Confirmed pick up
  - Not sure what happened to it after
  - Lab services spent 2 days calling pickup locations and finally found the tote.

- **Remediation is Required**
  - Contacting 63 patients to get redraws
No Lost Coolers with Automatic Tracking

Inventory by Item Anna Room 1

**Last Reporter:** anna  
**Last Location:** 1993 Palomar Airport Road, Carlsbad, California, 92011  
**Last Seen:** Oct. 28, 2015, 1:08 p.m.

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Scenario 3—Self Correcting
Anna’s Results—First Day
Anna’s Results—Second Day
Anna’s Results—Third Day
Live Demo

- Dashboard Summary
- Dashboard Details
- Courier Details
- Last location
Lessons Learned

- Automation reduces error
- Billions spent on automating analytical phase
  - This reduced errors dramatically
- Now must automate pre-analytical phase
- Largest remaining error—Temperature & Transportation
- Automated wireless tracking is the only way to do this effectively
Contact Information

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