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**USING COLD CHAIN ANALYTICS  
TO TURN DATA INTO ACTIONABLE DECISIONS**  
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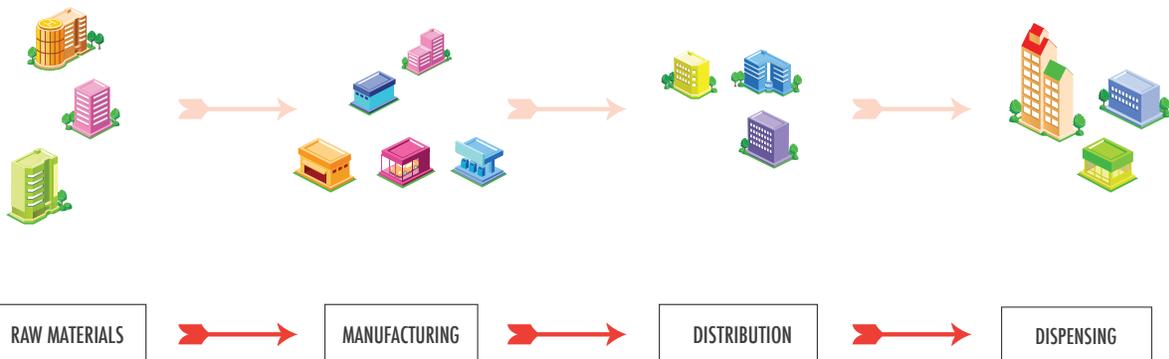
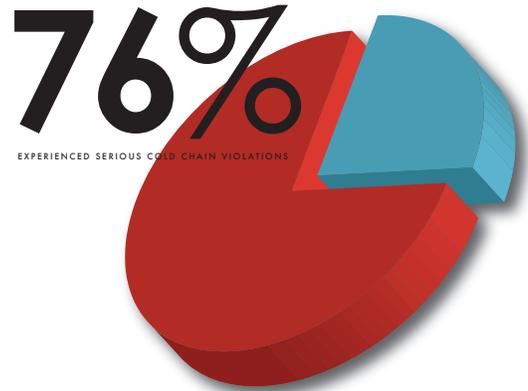
MAGPIE SENSING  
COLD CHAIN MONITORING AND ANALYTICS

**BUSINESS TO BUSINESS TECHNOLOGY AND SERVICE**

Maintaining cold chain integrity is increasingly vital for researchers, clinicians, and healthcare product manufacturers. A 2012 study by the Centers for Disease Control and Prevention looked at handling of cold chain vaccines by forty five healthcare providers around the United States. **Three quarters of the providers experienced serious cold chain violations.**

Gathering information about cold storage units in real time allows researchers, doctors, and product manufacturers to ensure that these kinds of violations do not damage their products or reduce product efficacy.

For products in transit, gathering location-tagged environmental data can also assist with audits when a biological product or vaccine has spoiled, and a chain of custody needs to be identified to assign liability. **Healthcare supply chains can involve up to 14 parties, making chain-of-custody monitoring all the more essential.** Location monitoring can be used to combat drug counterfeiting and shipment theft as well.



**HEALTHCARE SUPPLY CHAINS CAN HAVE UP TO 14 PARTIES**

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Often, however, simple data gathering is not enough. Ensuring cold chain integrity requires using rich analytics algorithms to turn raw data into actionable recommendations and warnings which can *improve cold storage processes, guide business decisions, and prevent cold chain failures before they occur.*

**A B O U T M A G P I E S E N S I N G**

Magpie Sensing provides a suite of cold chain monitoring and analysis technologies for the healthcare industry. Magpie's shippable, wireless temperature and humidity monitor provides real-time, location-aware tracking of cold chain products during shipment. Our real-time, fixed-location monitoring device then safeguards products from their arrival at a lab or clinic until the moment of use.

At the core of Magpie Sensing's solutions are rich analytics algorithms which leverage data from our monitoring devices to improve cold chain processes and **predict cold storage problems before they occur.**

**THE MAGPIE SENSING ANALYTICS SYSTEM**

Magpie Sensing applies a range of analytical techniques to derive useful information from data captured by our monitoring devices. This includes *descriptive, predictive, and prescriptive* analytic tiers that each help solve business problems.

**DESCRIPTIVE**

Our descriptive analytics derive properties of the cold storage system being monitored. These include the set point of the system's thermostat, the typical range of temperature values in the system, the duty cycle of the system's compressor, etc. This information informs the user as to whether their storage unit is properly configured to store a particular product.

Laboratories and clinics often use simple consumer refrigerators, even to store sensitive cold chain products. Many consumer refrigerators have thermostats with only basic High and Low settings, or numerical settings which don't correspond directly to a particular temperature. This makes it challenging to determine what temperature a simple refrigerator's thermostat is set to. Using only incoming data from a Magpie monitoring device, Magpie's algorithms can determine the set point of a refrigerator's thermostat. This allows users to set thermostats precisely, even on simple consumer refrigerators.

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**PREDICTIVE**

Magpie Sensing's *predictive analytics* detect cold chain problems before temperature bounds are violated. These problems fall into three general categories.

**POOR EQUIPMENT CONFIGURATION**

Using its Descriptive analytics systems, Magpie can determine the basic properties of a cold storage system. If the system is configured incorrectly for the products stored, Magpie's predictive analytics algorithms spot these configuration problems and alert the system's users.

If a clinic must store a vaccine above freezing, for example, and their cold storage unit's average temperature is 2 degrees with a range of 4 degrees, the Magpie system alerts the clinic that their system will drop below freezing each time the compressor cycles on.



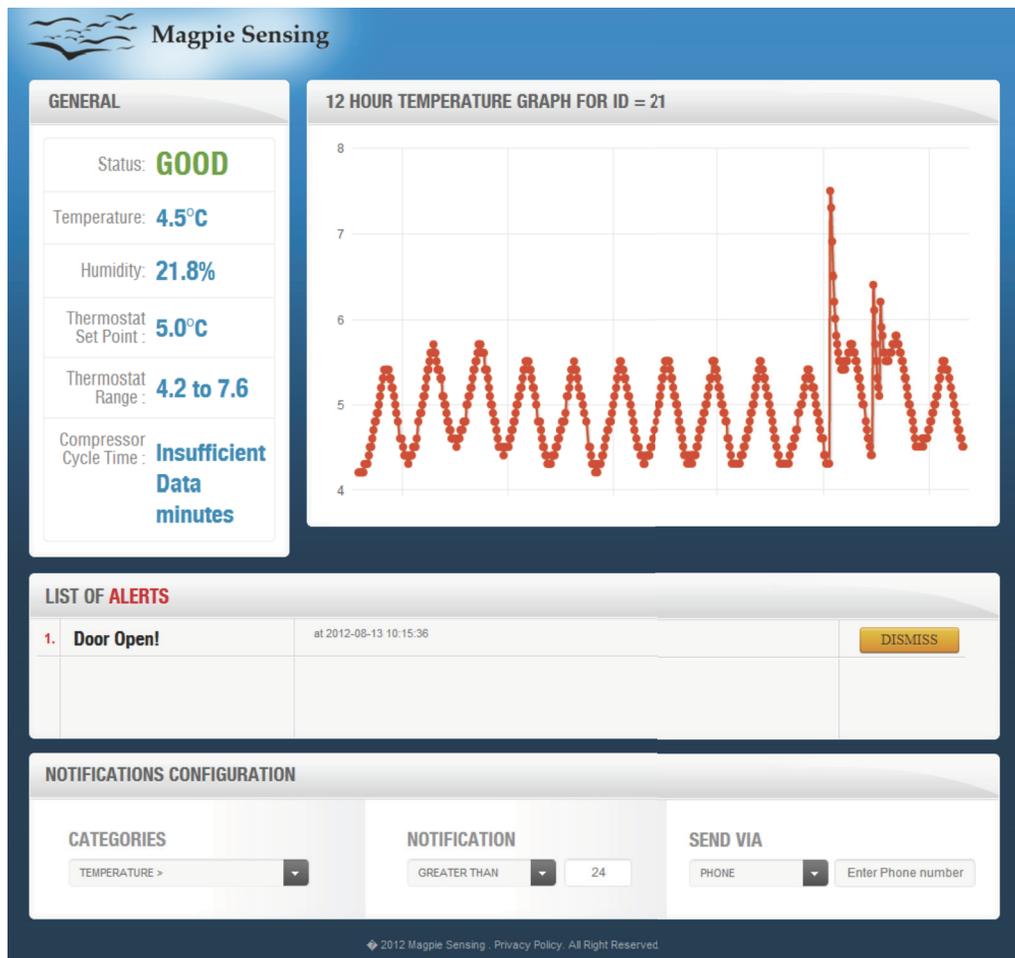
Consumer refrigerators don't provide specific temperature data.

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**HUMAN ERROR**

Simple *human error* leads to many cold chain violations. In a hectic lab or clinic, doctors and researchers often fail to consistently shut refrigerator or freezer doors, or to ensure that a good seal is established when a door is shut. Overfull or aging storage systems compound this problem.

From temperature trend data alone, the Magpie system determines when a cold storage system door has been left open, alerting the system's users via a web interface, text message or audible alert before temperature bounds are violated.



The Magpie system detects problems and alerts the user.  
Here, the system has detected a door left open (shown by spike in graph).

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**EQUIPMENT FAILURE**

Compressor breakdown and power failure are all-too-common causes of cold chain violations. Even small clinics may hold \$50,000 to \$70,000 worth of product in their cold storage systems, and many biological samples used in research are irreplaceable. If a cold storage system fails, these sensitive materials can be destroyed. A compressor failure can be particularly devastating if it occurs at night or on a holiday.

Magpie's predictive analytics systems detect compressor or power failure, alerting users via text message or an automated phone call before bounds are violated. The system can even calculate the estimated time before the cold storage system reaches an unsafe temperature. This gives the user time to pack the failed cold storage system with dry ice, restore power, or take another action to *prevent product spoilage*.



Magpie's prescriptive analytics *improve* cold storage processes.

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PRESCRIPTIVE

In addition to predicting cold chain violations before they occur, Magpie Sensing's analytics systems provide prescriptive recommendations to improve cold storage processes and business decisions during normal operation.

When configuring refrigeration equipment, for example, users often struggle with determining the correct thermostat setting. A higher setting reduces the risk of products freezing, but a lower setting provides a larger "margin of error" should a failure occur, since products stored at a lower temperature will take longer to spoil if cooling is lost. Magpie's prescriptive analytics help users "dial in" the optimal thermostat setting for a particular product, helping to achieve the right balance between freezing risk and spoilage risk.

Magpie's prescriptive analytics systems also derive useful meta-information about a cold storage system, including the times of day that are busiest and the periods where the system's door is opened the most. This can guide staff training and institutional policies, ensuring that particular systems are not overused, or that system use is more evenly distributed over a working day.

Using prescriptive analytics, Magpie's systems can further be used to guide equipment purchase decisions, or to optimally distribute products between a variety of existing cold storage systems. Which refrigerator takes the longest time to cool down? Which is the most stable and should be used to store the most sensitive items? Which brand of cold storage system has the most desirable properties for a particular application? Magpie's prescriptive systems assist in answering these questions.

THE ADVANTAGES OF MAGPIE COLD CHAIN ANALYTICS

- **Save time and money** by avoiding product spoilage
- **Save lives** by preventing healthcare workers from administering damaged products to patients
- **Ensure compliance** with state and federal safety regulations, and save time **through automatic data gathering and reporting**
- **Make better equipment purchasing decisions** and **develop better cold storage processes**

FOR MORE INFORMATION

Magpie Sensing is currently beta testing its devices and systems with several prominent partners, including the Johns Hopkins Medical Institutions, rated best in the world for medical care from 1991-2011 by U.S. News & World Report.

For more information about *Magpie Sensing*, or for information about *Beta trials*, please email [contact@magpiesensing.com](mailto:contact@magpiesensing.com) or call 443-451-7341.