

THE INVISIBLE WELFARE CHECK: Why You Should Be Concerned About Your Rodents' Temperature.

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Unified Information Devices

Sunday, October 25, 2026

THE CENTRAL QUESTION

When a child feels unwell, what is one of the first things we do?

We check temperature.



Temperature is a fast, reliable indicator of physiological stress, infection, inflammation, recovery, and disease progression.

So why not continuously check temperature in study animals — quietly, objectively, and without disrupting the cage?



TODAY'S AGENDA

Four main questions:

- Why body temperature is a valuable biomarker of animal health and welfare?
- What are the limitations of traditional welfare monitoring approaches?
- What does published research tell us about temperature changes in disease, treatment, recovery, and humane endpoint determination?
- How can continuous home-cage monitoring be implemented in practical research and vivarium settings?

Why temperature matters?

Temperature is a dynamic vital sign that reflects physiology before many visible welfare indicators change.

TEMPERATURE IS A VITAL SIGN

- Reflects infection, inflammation, stress, anesthesia, metabolism, and disease progression.
- Small animals may show fever or hypothermia depending on model and severity.
- Temperature changes can precede visible clinical signs.

↑/↓

Stress /
inflammation

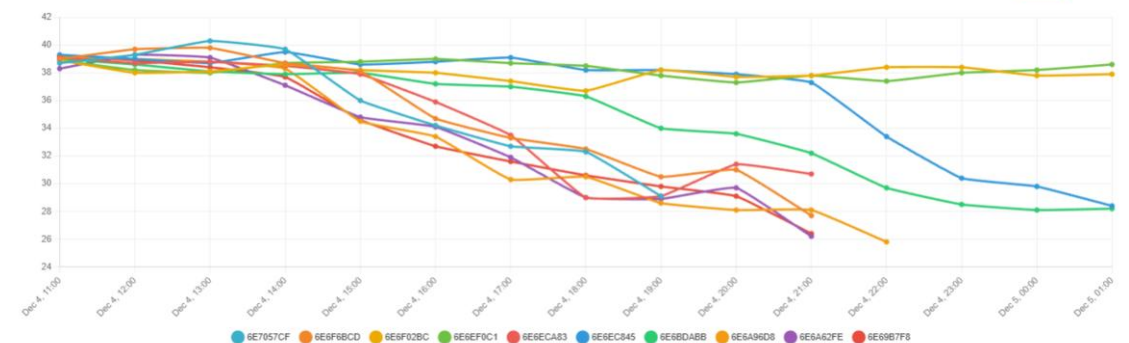
Trend

Disease
progression

Time

Recovery status

Temperature Over Time



BOTULISM STUDY:

Hypothermia as a Non-invasive Biomarker for Neurotoxicity and Treatment Efficacy

SOURCE

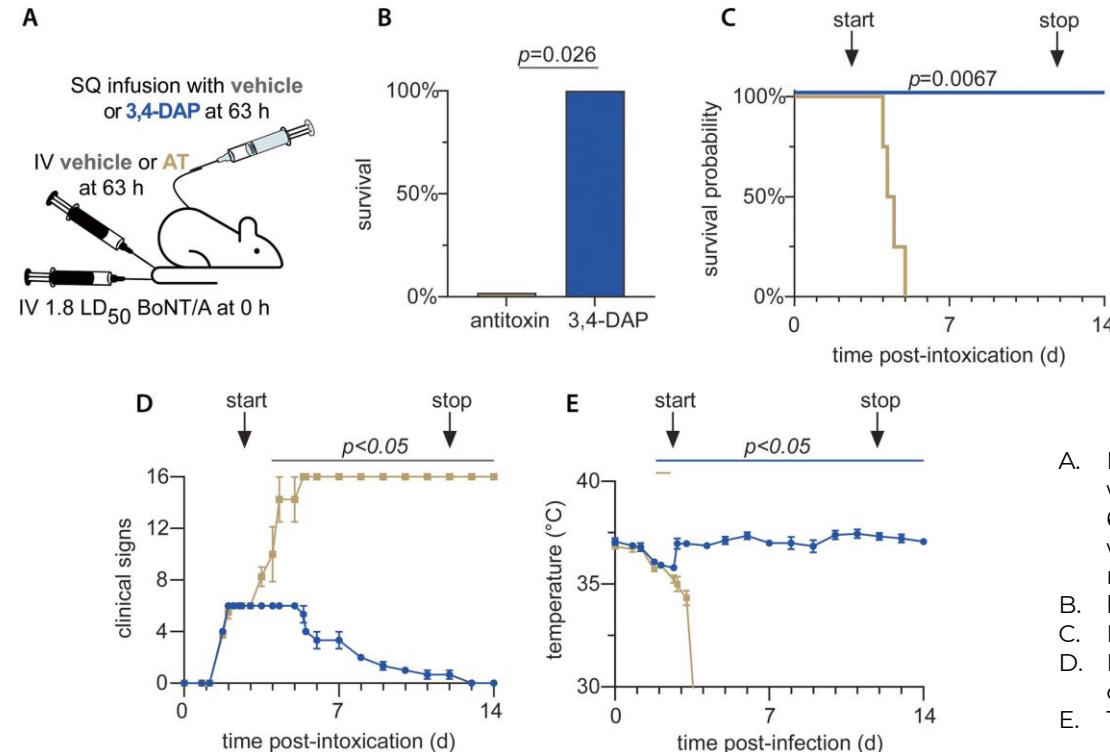
O'Brien, Sean W., et al. "Combined treatment with antitoxin and 3, 4-diaminopyridine improves survival outcomes after lethal botulinum neurotoxin challenge." *Molecular Medicine* 31.1 (2025): 270.

OBJECTIVE

- Investigate the therapeutic potential of 3,4-Diaminopyridine (3,4-DAP), a potassium channel blocker, in reversing botulinum neurotoxin (BoNT/A)-induced paralysis and improving survival in a rat model of botulism.
- Explore body temperature (hypothermia) as a potential early biomarker of intoxication and recovery.

KEY FINDINGS

- 3,4 DAP reversed paralysis and restored survival even when given at late stages of BoNT intoxication.
- Combination therapy with 3,4 DAP and antitoxin dramatically extended the therapeutic window and improved clinical outcomes.
- BoNT-induced hypothermia resolved quickly following 3,4-DAP treatment, suggesting it may be a useful clinical biomarker.



- A. Percent survival. Rats challenged (IV) with botulinum neurotoxin A (BoNT/A). 63 h post-challenge, rats were treated with 3,4-DAP (1.0 mg/kg/h; SQ) or neutralizing antitoxin (20,000 units; IV).
- B. I for each treatment.
- C. Kaplan-Meier survival curves.
- D. Progression of clinical signs of botulism over time.
- E. Temperature over time.

"This study provides novel evidence that core body temperature is a reliable biomarker of intoxication progression and therapeutic efficacy. Implanted temperature-monitoring biochips revealed significant hypothermia preceding overt clinical symptoms..."

TEMPERATURE SUPPORTS ANIMAL WELFARE DECISIONS

1

**Early detection of
health changes**

2

**Objective welfare
assessment**

3

**Humane endpoint
support**

4

**Reduced handling
stress**

Before

Early warning

Objective

Quantitative measure

Endpoint

Ethical intervention

Refine

Less disruption

SEPSIS STUDY:

Temperature as Quantitative Biomarker for Humane Endpoints

CLP-induced polymicrobial sepsis model monitored with body temperature and clinical signs.

BRIEF METHODS

- Visual parameters (respiratory status, activity and response to stimulus (ASR) and eye appearance), body temperature (via subcutaneous transponders), nesting behavior, body weight, and clinical signs.
- The scoring system and temperatures were used to monitor C57BL/6J mice (n = 80, male and female) until death or for 7 days after cecal ligation and puncture (CLP).

CONCLUSIONS

- Subcutaneous temperature below 32°C identified as a reliable, non-invasive biomarker for predicting mortality in the study.
- Temperature was quantitative and predictive of mortality risk.
- The novel scoring system and a subcutaneous temperature threshold <32 °C offers a robust, reproducible, and humane method to predict and act on mortality risk in septic mice. It balances ethical imperatives with scientific rigor and supports international standardization of humane endpoints in murine sepsis research.

Key message: validated temperature thresholds can support earlier, more objective intervention.

SOURCE

Ferguson, Lindsey T., et al. "A Novel Scoring System for Humane Endpoints in Mice with Cecal Ligation and Puncture-Induced Sepsis." *Comparative Medicine* 73.6 (2023): 446-460.

Average total scores for surviving and non-surviving mice

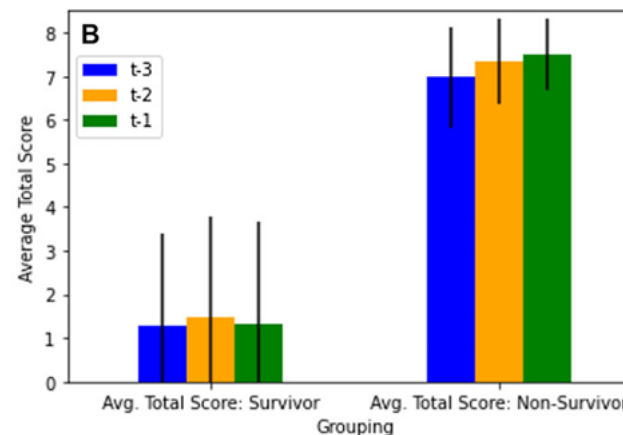


Fig 3b. Ferguson et al (2023)

Average temperatures for surviving (n = 26) and non-surviving (n = 54) mice after CLP.

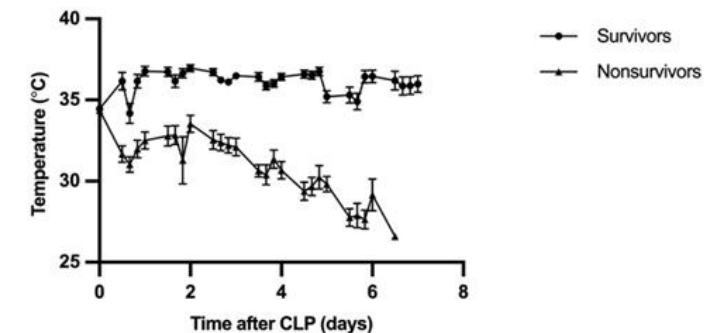


Fig 6. Ferguson et al (2023)

"While overall our ASR-eye scores had substantial ability to predict death, **temperature provides a quick, quantitative evaluation** of a mouse disease state and subcutaneous **temperatures below 32 °C could be a distinct humane endpoint** for CLP-induced sepsis in mice."

The welfare monitoring gap

Traditional checks are essential — but they are intermittent, subjective, and often affected by handling.

THE SNAPSHOT PROBLEM

**Most welfare observations are scheduled.
Physiology is continuous.**

- Events can occur overnight, on weekends, or between daily checks.
- By the time visible signs appear, physiology may already be advanced.
- Intermittent data can miss onset, severity, and recovery profile.

1

AM
Check

2

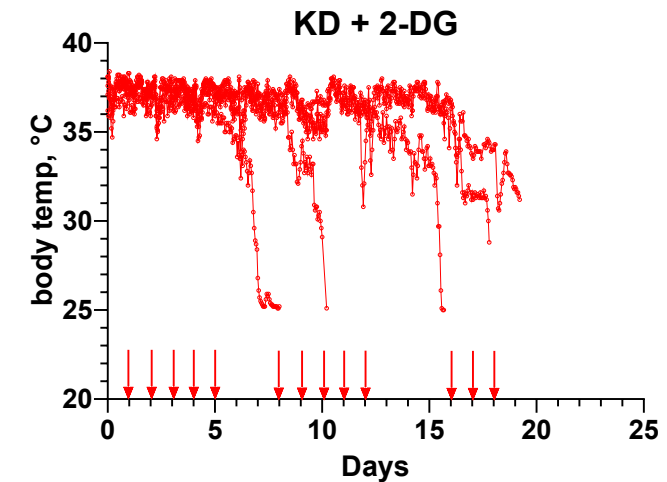
Missed
Change

3

PM
Check

4

Escalation



Zielinski et al. (2023)

THE SNAPSHOT PROBLEM

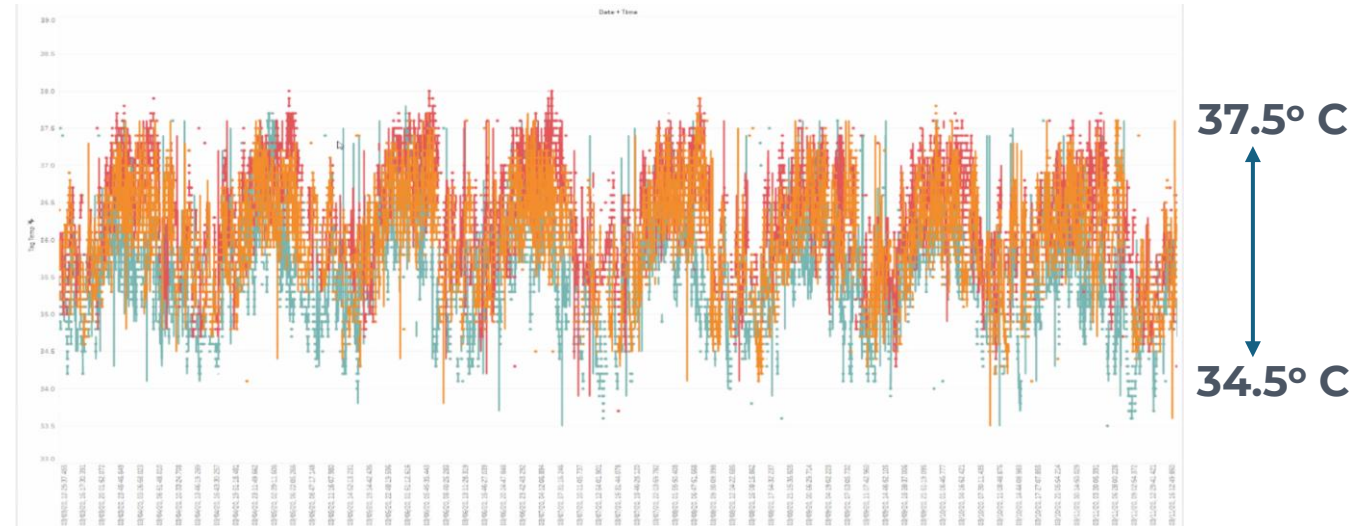
AM Body
Temperature

35.5° C

PM Body
Temperature

36.5° C

- Individual baselines account for normal biological variation.
- Circadian rhythm provides context for day/night temperature changes.
- Meaningful signals include slope, duration, amplitude, and failure to recover.



CLINICAL SCORING AND BODY WEIGHT NEED PHYSIOLOGICAL CONTEXT

- Clinical signs can be interpreted differently across observers.
- Body weight may change late or be confounded by tumor mass, hydration, or food intake.
- Temperature adds a quantitative signal that can strengthen welfare scoring.

1

**Body
weight**

2

**Clinical
score**

3

Activity

4

**Temperature
trend**

Best practice: interpret temperature alongside weight, behavior, nesting, clinical signs, and veterinary judgment.

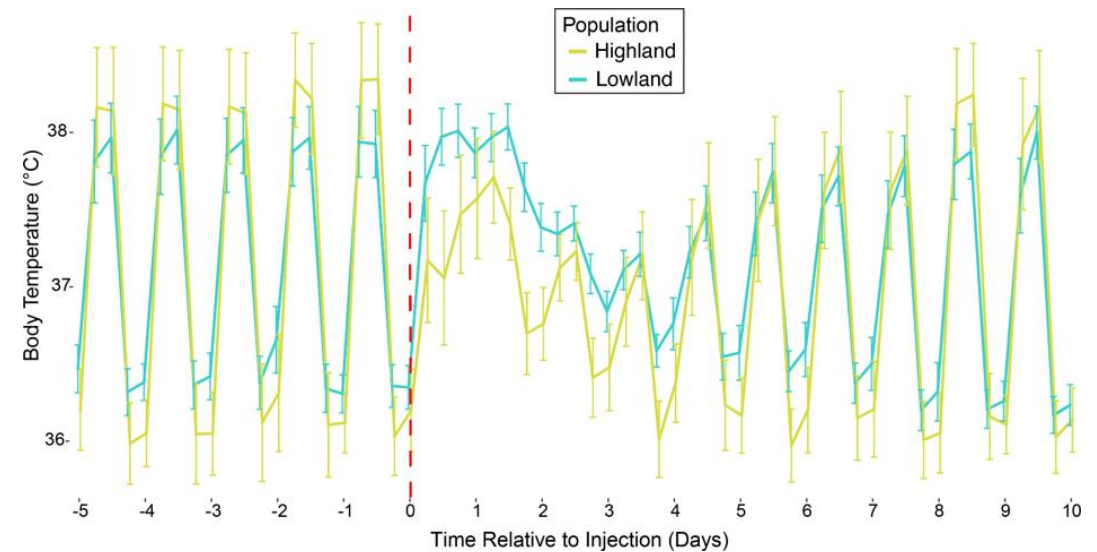
CONTINUOUS MONITORING CHANGES THE QUESTION

Instead of asking:

“What was temperature when we checked?”

We can ask:

“How did temperature change across the entire day, night, treatment, or disease course?”



Butler et al. (2026).

CONTINUOUS TEMPERATURE MONITORING SUPPORTS THE 3RS

Less handling

Refinement

More data per animal

Reduction

Better endpoints

Refinement



- Reduces repeated restraint and manual measurements.
- Improves sensitivity by capturing longitudinal within-animal trends.
- Supports earlier, validated humane intervention

Bringing the experiment to the cage

Home-cage monitoring captures data where animals spend nearly all of their time.

WHY THE HOME CAGE MATTERS

- Animals spend most of their time in the home cage.
- Home-cage data reduces novelty, restraint, and handling effects.
- Group housing and light/dark cycles can be preserved.
- Measurements can continue nights, weekends, and between routine checks.

1

**Home
environment**

2

**Undisturbed
behavior**

3

**Circadian
context**

4

**More
representative
data**



UID TEMPERATURE TRANSPONDER

Minimally Invasive

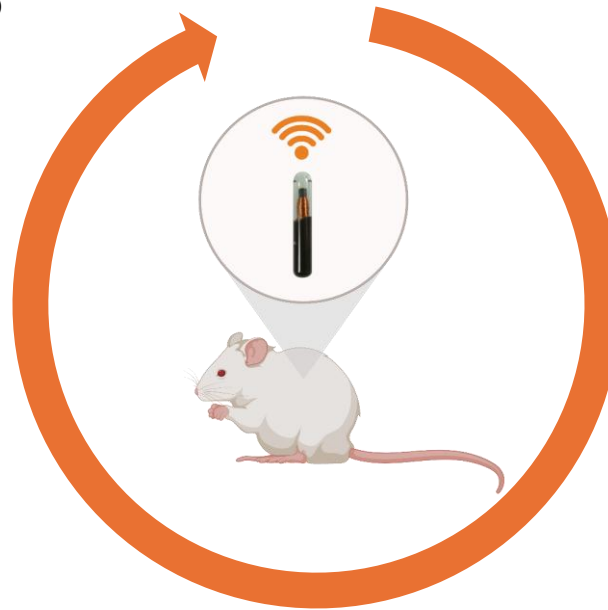
Simple injection – no surgery required

Improved Welfare

Reduces stress by eliminating invasive procedures and handling

Long-Term Monitoring

insertion supports full-lifespan studies



High Accuracy

$\pm 0.1^{\circ}\text{C}$ precision for reliable data

Cost Effective

A fraction of the cost of telemetry implants (~\$12 per transponder)

Battery Free

Passive design enables maintenance-free, lifelong monitoring

UID LAB ANIMAL TEMPERATURE MONITORING OPTIONS

Spot checks

Handheld readers



~\$425/reader

Flexible cage monitoring

AnyCage⁺



~\$300/cage

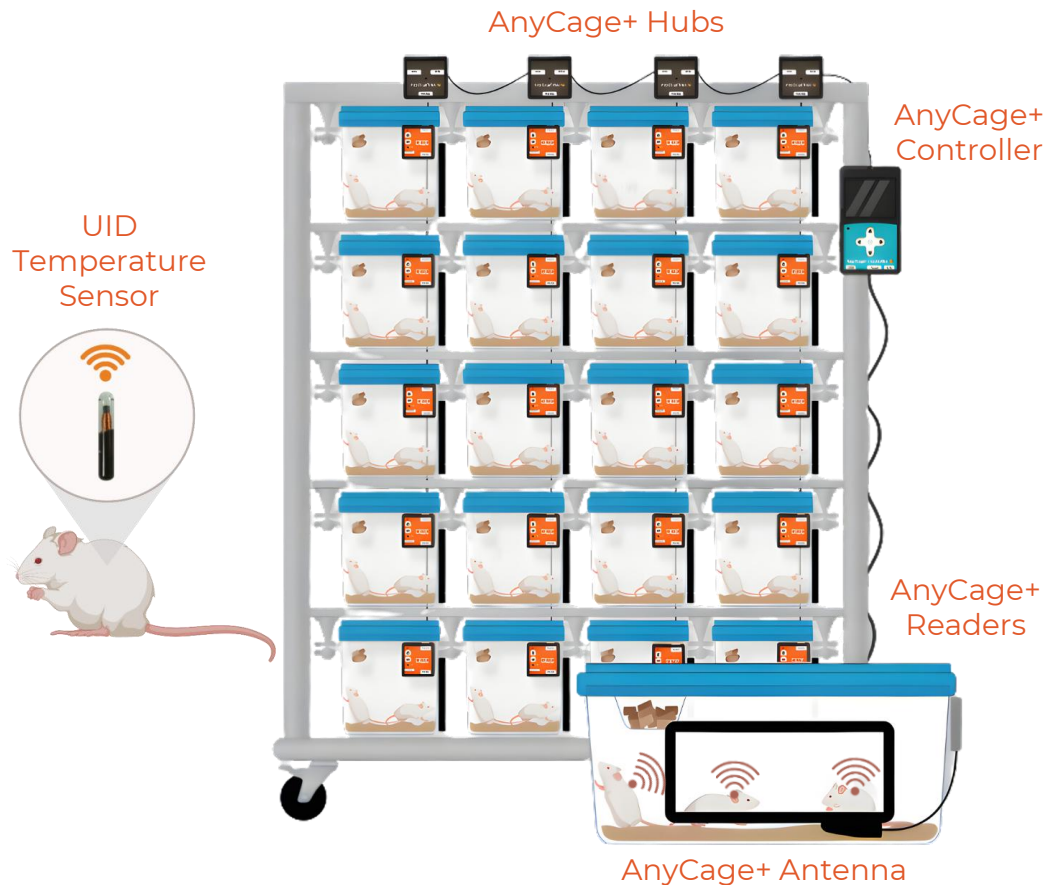
High-resolution continuous monitoring

Mouse Matrix



~\$3-3.5K/cage

ANYCAGE+: SCALABLE RACK-LEVEL WELFARE VISIBILITY



- Continuous home-cage temperature monitoring across multiple cages.
- Tracks individual animal ID and body temperature in group housing.
- Scalable to full rack configurations and compatible with all cage & rack types
- VivoTraq software supports graphing, alerts, and local/cloud data workflows.

Ideal for animal health monitoring.

Designed for vivarium staff and research teams that need routine, scalable, minimally disruptive monitoring.



VivoTraq

BENEFITS FOR VIVARIUM AND WELFARE TEAMS

- Earlier visibility into animals that may need attention.
- Objective documentation for welfare decisions.
- Reduced reliance on manual checks and subjective cage-side assessments.
- Potential reduction in unexpected morbidity and found-dead events.

1

Observe

2

Flag

3

Prioritize

4

Intervene

5

Document

Continuous monitoring enables a shift from reactive checks to proactive welfare management.

KEY TAKEAWAYS

- Body temperature is a sensitive, objective physiological biomarker.
- Continuous monitoring captures events missed by intermittent checks.
- Temperature is strongest when combined with clinical scoring, weight, behavior, and veterinary judgement.
- Home-cage monitoring supports welfare, refinement, reproducibility, and translational research.

77TH AALAS NATIONAL MEETING

OCTOBER 25-29 | HOUSTON, TX

Any Questions?

UID Booth

#1436

Thank You!



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