

CLAIMS:

1. An environmental control and monitoring system for transportation and analysis of a semen sample, the system comprising:
 - a sample container, configured to contain a semen sample;
 - 5 an environmental control element configured to operate within an optimal range for semen viability; and
 - a sensor system for monitoring an environmental condition of the sample container, wherein the sensor system is in thermal contact with at least one of the sample container or the environmental control element.
- 10 2. The environmental control and monitoring system of claim 1, wherein the system further comprises:
 - a positioning retainer for restraining movement of the sample container, the environmental control element, and the sensor relative to one another.
- 15 3. The environmental control and monitoring system of claim 2, wherein the positioning retainer comprises a packing material.
- 20 4. The environmental control and monitoring system of claim 1, wherein the sensor system further comprises:
 - a sensor for measuring the environmental condition;
 - a data store in electronic communication with the sensor, wherein the data store is configured to store measurements from the sensor; and
 - a data port in electronic communication with the data store.
- 25 5. The environmental control and monitoring system of claim 4, wherein the sensor comprises a temperature sensor and the environmental condition comprises temperature.
- 30 6. The environmental control and monitoring system according to any one of claims 4-5, wherein the sensor comprises a humidity sensor and the environmental condition comprises humidity.
7. The environmental control and monitoring system according to any one of claims 4-6, wherein the sensor measures the environmental condition at least one time every minute.

8. The environmental control and monitoring system according to any one of the preceding claims, wherein measurements from the sensor system are stored on the data store.

9. The environmental control and monitoring system according to any one of the preceding claims, wherein the data port electronically communicates measurements from the sensor system to a remote server.

10. The environmental control and monitoring system of claim 9, wherein the measurements are stored on the data store prior to being transmitted to the remote server.

11. The environmental control and monitoring system of claim 10, wherein the remote server comprises:

a server data port for sending and receiving data, wherein the data comprises the measurements;

a server data store in electronic communication with the server data port for storing the data; and

a sever processor for analyzing the data.

12. The environmental control and monitoring system according to any one of the preceding claims, wherein the environmental control element comprises a phase transition material.

13. The environmental control and monitoring system of claim 12, wherein the phase transition material is configured to go through a phase change within the optimal temperature range.

14. The environmental control and monitoring system according to any one of the preceding claims, wherein the optimal range comprises temperatures ranging from 4°C to 37°C.

15. The environmental control and monitoring system according to any one of the preceding claims, further comprising a container wall surrounding an internal cavity, wherein the positioning retainer fits within the internal cavity, wherein the cavity is surrounded by the container wall.

16. The environmental control and monitoring system according to any one of the preceding claims, wherein the sample container holds a semen preservation solution.

17. The environmental control and monitoring system according to any one of claims 4-16 the preceding claims, wherein the data port and the server data port each comprise a wireless adaptor.

5 18. The environmental control and monitoring system of claim 1, wherein the sensor system comprises a temperature indicator.

19. The environmental control and monitoring system of claim 18, wherein the indicator displays a level of exposure.

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20. The environmental control and monitoring system according to any one of claims 18-19, wherein the temperature indicator is in physical and thermal contact with an exterior surface.

15 21. The environmental control and monitoring system according to any one of claims 18-19, wherein the temperature indicator is in physical and thermal contact with an interior surface.

22. The environmental control and monitoring system according to any one of claims 18-19, wherein the temperature indicator is in physical and thermal contact with a retainer surface.

20 23. An environmental control and monitoring method for transportation and analysis of a semen sample, the method comprising:

transporting a sensor system, an environmental control element, and a sample container, wherein the sensor system is in thermal contact with at least one of the sample container or the environmental control element;

25 controlling one or more environmental conditions of the sample container during transport using the environmental control element;

recording a plurality of measurements of the one or more environmental conditions during transport of the sample container to a log; and

comparing the log to a reference to determine a condition of the sample container.

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24. The environmental control and monitoring method of claim 23, further comprising the step of introducing a semen sample into the sample container prior to the transporting step.

25. The environmental control and monitoring method of claim 24, further comprising the step of registering the semen sample with a laboratory to associate a subject with the semen sample.

5 26. The environmental control and monitoring method according to any one of claims 23-25, wherein the one or more environmental conditions comprises temperature.

27. The environmental control and monitoring method according to any one of claims 23-26, wherein the one or more environmental conditions comprises humidity.

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28. The environmental control and monitoring method according to any one of claims 23-27, wherein the plurality of measurements are recorded every 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 minutes.

29. The environmental control and monitoring method according to any one of claims 15 23-28, wherein the log comprises a plurality of temperature and timestamp pairs.

30. The environmental control and monitoring method according to any one of claims 23-29, wherein the reference comprises off-target temperature values.

20 31. The environmental control and monitoring method of claim 30, wherein the reference comprises exposure durations for the off-target temperature values.

32. The environmental control and monitoring method according to any one of claims 30-31, wherein the reference is based on published research data.

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33. The environmental control and monitoring method according to any one of claims 30-31, wherein the reference is based on data acquired using the environmental control and monitoring method.

30 34. The environmental control and monitoring method according to any one of claims 23-33, wherein the condition determines whether the sample undergoes fertility testing and is based on sperm count, motility count, semen volume, or morphology.

35. The environmental control and monitoring method according to any one of claims 23-35, wherein the step of controlling comprises causing a phase transition material of the environmental control element to undergo a phase transition.

5 36. The environmental control and monitoring method of claim 35, wherein the phase transition occurs between 18-24°C

37. The environmental control and monitoring method according to any one of claims 35-37, wherein the environmental control element comprises a flexible material containing the phase
10 transition material.

38. The environmental control and monitoring method of claim 37, wherein the flexible material comprises a 0.5mm plastic film.

15 39. The environmental control and monitoring method according to any one of claims 35-38, wherein the phase transition material comprises a salt solution.

40. The environmental control and monitoring method according to any one of claims 35-39, wherein the phase transition material comprises a solution comprising sugar, NaCl, oil,
20 glucose, water, mineral spirits, or a surfactant.

41. The environmental control and monitoring method according to any one of claims 23-40 wherein the environmental control element comprises a mass between 90-110 grams.

25 42. The environmental control and monitoring method according to any one of claims 23-41, wherein the log comprises a temperature indicator.

43. The environmental control and monitoring method of claim 42, wherein the temperature indicator comprises an adhesive strip including a temperature sensitive region, wherein
30 the temperature sensitive region gradually changes appearance based on duration of exposure to off-target temperature values.

44. The environmental control and monitoring method according to any one of claims 23-43, further comprising the steps of:

storing the log on a data store in digital format;
transmitting the log from the data store to a remote server; and
5 completing the comparing step on the remote server.

45. The environmental control and monitoring method according to any one of claims 23-44, wherein the step of transporting comprises traveling more than 10 miles.

10 46. The environmental control and monitoring method according to any one of claims 23-45, wherein the step of transporting comprises traveling more than 10 minutes.

47. A kit for transporting a semen sample, comprising:
a sample container for storing a semen sample;
15 an environmental control element for controlling a temperature of the sample container; and
a sensor system for monitoring the temperature of the sample container.

48. The kit of claim 47, wherein the sensor system comprises:
a temperature sensor;
20 a data store for recording measurements produced by the temperature sensor; and
a data port for transmitting the measurements.

49. The kit according to any one of claims 47-48, wherein the kit further comprises a positioning retainer for restraining movement of the sample container, the environmental control
25 element, and the sensor system relative to one another.

50. The kit according to any one of claims 47-49, wherein the kit further comprises a preservation container comprising a preservation fluid.

30 51. The kit according to any one of claims 47-50, wherein the sensor system comprises an appearance changing temperature indicator.

52. The kit of claim 51, wherein the appearance change involves a material going through a chemical transition after exposure to an off-target temperature or pH.

53. The kit according to any one of claims 47-52, wherein the temperature control element comprises a phase transition material.

54. The kit of claim 53, wherein the phase transition material has been optimized to
5 operate within a validated range for semen sample viability.

55. The kit according to any one of claims 47-54, wherein the environmental control element is a gel pack.

10 56. The environmental control and monitoring system of claim 13, wherein the phase change occurs between 18-24°C.

57. The environmental control and monitoring system of claim 56, wherein the environmental control element comprises a flexible material containing the phase transition material.
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58. The environmental control and monitoring system of claim 57, wherein the flexible material comprises a 0.5mm plastic film.

59. The environmental control and monitoring system according to any one of claims 57-
20 58, wherein the phase transition material comprises a salt solution.

60. The environmental control and monitoring system according to any one of claims 57-
58, wherein the phase transition material comprises a solution comprising sugar, NaCl, oil, glucose,
water, mineral spirits, or a surfactant.
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61. The environmental control and monitoring system according to any one of claims 1-
22 and 56-60, wherein the environmental control element comprises a mass between 90-110 grams.