

## CLAIMS

1. A portable on-site detection system for detecting pathogens in a small volume of a liquid sample of no more than 100 ml on-site, the system  
5 comprising:

a filtration module comprising a mixture of dead-end filtration elements and cross-flow filtration elements configured to obtain a sample population of pathogens from the liquid sample,

an amplification module configured to amplify one or more target  
10 biological elements present in one or more target species of pathogens in the sample population of pathogens; and

a detection module configured to detect presence of amplified products of the one or more target biological elements present in the one or more target species of pathogens,

15 wherein a positive reading on the detection module indicates the presence of the one or more target species of pathogens, and

wherein the system is configured to perform detection of pathogens on-site in less than 90 minutes.

20 2. The system of claim 1, further comprising,

a treatment module comprising a composition for preferentially interacting with one or more biological elements present in non-viable pathogens in the sample population of pathogens to render said one or more biological elements incapable of amplification.

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3. The system of claim 1 or 2, wherein the pathogens are selected from the group consisting of bacteria, viruses, parasites and fungi.

4. The system of any one of claims 1 to 2, wherein the one or more biological elements comprise DNA.

5 5. The system of any one of claims 2 to 4, wherein the composition for preferentially interacting with one or more biological elements comprises propidium monoazide.

10 6. The system of any one of claims 1 to 5, wherein the amplification module comprises recombinase polymerase amplification of the one or more target DNAs from the one or more target species of pathogens in the sample population of pathogens.

15 7. The system of any one of claims 1 to 6, wherein the amplification module comprises a probe and at least one primer, wherein the probe and the at least one primer comprise a nucleotide sequence having at least 80% sequence identity to a sequence selected from the group consisting of SEQ ID NO. 1 to SEQ ID NO. 5 for detecting *Pseudomonas aeruginosa*.

20 8. The system of any one of claims 1 to 7, wherein the amplification module comprises a probe and at least one primer, wherein the probe and the at least one primer comprise a nucleotide sequence having at least 80% sequence identity to a sequence selected from the group consisting of SEQ ID NO. 6 to SEQ ID NO. 10 for detecting *Legionella pneumophila*.

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9. The system of any one of claims 1 to 8, wherein the amplification module comprises a probe and at least one primer, wherein the probe and

the at least one primer comprise a nucleotide sequence having at least 80% sequence identity to a sequence selected from the group consisting of SEQ ID NO. 11 to SEQ ID NO. 15 for detecting Enterococcus species.

5           10.    The system of any one of claims 1 to 9, wherein the amplification module further comprises reagents comprising a freeze-dried enzyme mixture, a rehydration buffer, a solution of magnesium acetate, a labelled probe, a positive control template DNA and water, wherein the reagents are formulated for storage at ambient temperature and ready to use upon a single  
10   mixing step.

          11.    The system of any one of claims 1 to 10, wherein the amplification module further comprises one or more portable, battery-operated heating devices for providing one or more operating temperatures  
15   to perform amplification.

          12.    The system of any one of claims 1 to 11, wherein the detection module comprises a lateral flow strip configured to detect labelled amplified products.

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          13.    The system of any one of claims 1 to 11, wherein the detection module comprises a fluorescence detector configured to detect fluorescence-labelled amplified products.

25           14.    The system of any one of claims 1 to 13, wherein the system has a sensitivity of at least 80%.

15. The system of any one of claims 1 to 14, wherein the system has a specificity of at least 75%.

16. The system of any one of claims 1 to 15, wherein said system is  
5 capable of detecting pathogens in the liquid sample at a concentration range from 0.8 to 1.5 CFU per 100 ml.

17. A method for detecting pathogens in a small volume of a liquid sample of no more than 100 ml on-site in less than 90 minutes, the method  
10 comprising,

filtering the liquid sample with the filtration module of the detection system of any one of claims 1 to 16;

amplifying one or more target biological elements present in one or more target species of pathogens in the sample population of pathogens with  
15 the amplification module of the detection system of any one of claims 1 to 16;  
and

detecting the presence of amplified products of the one or more target biological elements present in the one or more target species of pathogens with the detection module of the detection system of any one of claims 1 to  
20 16.

18. The method of claim 17, further comprising treating the sample population of pathogens with a composition for preferentially interacting with one or more biological elements present in non-viable pathogens in the  
25 sample population of pathogens to render said one or more biological elements incapable of amplification.

19. The method of claim 17 or 18, wherein the pathogens are selected from the group consisting of bacteria, virus, parasites and fungi.

20. The method of any one of claims 17 to 19, wherein the one or  
5 more biological elements comprise DNA.

21. The method of any one of claims 18 to 20, wherein the step of treating the sample population of pathogens with a composition comprises exposing the sample population of pathogens to propidium monoazide.

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22. The method of any one of claims 17 to 21, wherein the step of amplifying comprises performing recombinase polymerase amplification of the one or more target biological elements from the one or more target species of pathogens in the sample population of pathogens.

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23. The method of any one of claims 17 to 22, wherein the step of amplifying comprises using a probe and at least one primer, wherein the probe and the at least one primer comprise a nucleotide sequence having at least 80% sequence identity to a sequence selected from the group  
20 consisting of SEQ ID NO. 1 to SEQ ID NO. 5 for detecting *Pseudomonas aeruginosa*.

24. The method of any one of claims 17 to 23, wherein the step of amplifying comprises using a probe and at least one primer, wherein the  
25 probe and the at least one primer comprise a nucleotide sequence having at least 80% sequence identity to a sequence selected from the group

consisting of SEQ ID NO. 6 to SEQ ID NO. 10 for detecting *Legionella pneumophila*.

25. The method of any one of claims 17 to 24, wherein the step of  
5 amplifying comprises using a probe and at least one primer, wherein the  
probe and the at least one primer comprise a nucleotide sequence having at  
least 80% sequence identity to a sequence selected from the group  
consisting of SEQ ID NO. 11 to SEQ ID NO. 15 for detecting *Enterococcus*  
species.

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26. The method of any one of claims 17 to 25, wherein the step of  
amplifying comprises using reagents comprising a freeze-dried enzyme  
mixture, a rehydration buffer, a solution of magnesium acetate, a labelled  
probe, a positive control template DNA and water, wherein the reagents are  
15 formulated for storage at ambient temperature and ready to use upon a single  
mixing step.

27. The method of any one of claims 17 to 26, wherein the step of  
amplifying comprises providing one or more operating temperatures with one  
20 or more portable, battery-operated heating devices.

28. The method of any one of claims 17 to 27, wherein the step of  
detecting comprises using a lateral flow strip configured to detect labelled  
amplified products.

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29. The method of any one of claims 17 to 27, wherein the step of detecting comprises using a fluorescence detector configured to detect fluorescence-labelled amplified products.

5           30. The method of any one of claims 17 to 29, wherein the method has a sensitivity of at least 80%.

31. The method of any one of claims 17 to 30, wherein the method has a specificity of at least 75%.

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32. The method of any one of claims 17 to 31, wherein said method is capable of detecting pathogens in the liquid sample at a concentration range from 0.8 to 1.5 CFU per 100 ml.

15           33. The system of any one of claims 7 to 9 or a method of any one of claims 23 to 25, wherein said at least one pair of primers comprises a pair of primers.