

SYSTEM AND METHOD FOR DIAGNOSIS OF INFECTIOUS DISEASES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of International PCT Patent Application No. PCT/US2007/006521, filed Mar. 14, 2007 (now pending); which claims the benefit of Australia Provisional Patent Application No. 2006901314, filed Mar. 14, 2006. These applications are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to the general fields of molecular biology and medical science, and more particularly to a system for point-of-care detection of a target nucleic acid.

[0004] 2. Description of the Related Art

[0005] A range of tests exist for the detection of nucleic acid sequences, for example tests for diagnosis of infectious diseases, tests for detection of genes and genetic markers implicated in hereditary diseases, and hereditary testing, among others. Depending on the particular test or method which is applied, there can be wide variation in terms of the cost per test, the accuracy of the test, and the speed at which the test results may be obtained. Present commonly applied tests generally fall in one of two different classes.

[0006] In a first class of tests, for many infectious diseases there are rapid tests available which may be procured at low cost. These tests are typically of the type described as lateral flow immunoassays in a dip-stick format. Similar such tests are also widely marketed for home pregnancy testing. Lateral flow immunoassays typically use an antibody immobilized onto a membrane to capture an antigen in the analyte. As part of the immunoassay protocol, a subsequent step then binds an antibody and reporter to the captured antigen in a 'sandwich'. The presence of the captured antigen in the analyte can then be visually observed, usually as a visible stripe in the test window if the test result is positive. Thus the test result is qualitative in that the presence of a particular infectious disease is provided on either a "Test Positive" or "Test Negative" basis as indicated by the presence or absence of the visible stripe.

[0007] A problem with rapid lateral flow immunoassays is that a significant amount of the target antigen must be present in the analyte in order for the antibody-antigen-antibody-label 'sandwich' to develop into a visible line. Thus, these types of tests suffer from a lack of sensitivity, and are known to deliver a substantial number of false negative results, particularly when a patient is in the early stages of an infection, and when the amount of a particular antigen or virus in the patient may be low. Moreover, it is in these early stages of detection that it is most important that diagnosis is correctly performed in order to administer an appropriate therapeutic to the patient, or to quarantine the patient to prevent the further spread of the infectious disease to the remainder of the community.

[0008] In the second class of tests are the many tests which are now available for clinical laboratories which are based on the detection of nucleic acid molecules. These tests commonly use, for example, nucleic acid based probes and nucleic acid amplification techniques such as the Polymerase

Chain Reaction (PCR). For many infectious disease tests, PCR, RT-PCR (Reverse Transcriptase Polymerase Chain Reaction) and rtPCR (real time Polymerase Chain Reaction) based methods have become the "gold standard", displacing more traditional test formats such as cell culturing. The reason why these tests have become the "gold standard" in many cases is that they allow very low copies of the target nucleic acid sequence of, for example, an infectious agent such as a virus present in a patient sample, to be amplified to a level at which the amplicons may be detected. Thus a patient is able to be correctly diagnosed as positive, even when the level of infectious agent in the patient is low and the patient is in the early stages of infection. Furthermore, PCR, RT-PCR and rtPCR tests are able to deliver accurate qualitative test data indicating the actual amounts of a particular infectious agent which may be present. Such information may be useful to the clinician in terms of deciding on the therapeutic course to be administered, and analyzing the subsequent efficacy of the course of treatment.

[0009] A problem with PCR-based clinical laboratory testing in general is the high cost of such tests. These tests typically require expensive reagent kits, highly expensive equipment, and specially trained personnel with expertise in molecular biology in order to be able to be performed correctly. Adequate controls and safeguards must be put in place to prevent false positive results which can arise in the event of sample cross-contamination. Furthermore, for many infectious diseases extensive laboratory safety, containment, and waste handling measures must be put in place to safeguard personnel from the possibility of infection.

[0010] Furthermore, there have been recent concerns about the possibility of a pandemic, for example an influenza pandemic related to the H5N1 avian influenza virus. If such a pandemic were to occur, the existing clinical laboratory infrastructure for performing PCR-based tests would likely be overwhelmed, and there would not be sufficient equipment or skilled personnel available to deal with the required test throughput. Further, with the need for clinical laboratory infrastructure and skilled personnel, such laboratory-based test methods do not easily provide for mobile field testing.

[0011] Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

[0012] Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

BRIEF SUMMARY OF THE INVENTION

[0013] According to a first aspect, the present invention provides a system for testing for presence of a target nucleic acid, the system comprising:

[0014] a sample carrier for carrying a sample to be tested;

[0015] a microfluidic cartridge comprising a dock for accepting the sample carrier in a sealed fluidic connection, the cartridge comprising inner works in fluidic