

- 80 -

CLAIMS

What is claimed is:

1. A system for rapid analysis of biological samples, comprising:
 - a mobile device that receives at least one integrated chip;
 - the mobile device processing the integrated chip to analyze a biological sample loaded thereon;
 - the mobile device and the integrated chip together being configured to perform at least one of manipulation and control of a molecule or a fluidic system on the integrated chip;
 - and wherein the mobile device and integrated chip together are configured to precision control at least one parameter that governs at least one of a plurality of steps of the analysis of the biological sample to within plus or minus 10%, plus or minus 1%, plus or minus 0.1%, plus or minus 0.01%, plus or minus 0.001% or plus or minus 0.0001%.
2. The system of Claim 1,
 - wherein the mobile device comprises a portable control assembly that receives the at least one compact integrated chip, the integrated chip comprising:
 - an extraction module;
 - optionally a nucleic acid amplification module, in fluid communication with the extraction module; and
 - a biological sample detection module, in fluid communication with the nucleic acid amplification module or extraction module,
 - said portable control assembly processing the integrated chip to analyze a biological sample loaded thereon by employing:
 - an extraction control module;
 - a nucleic acid amplification control module operably connected to the extraction control module; and
 - a biological sample detection control module operably connected with the nucleic acid amplification module and the extraction module.
3. The system of Claim 1 or 2, wherein the portable control assembly further comprises a means for loading a biological sample and, optionally, one or more reagents, onto the integrated chip.

- 81 -

4. The system of any one of Claims 1-3, wherein the nucleic acid extraction control module further comprises a chemical lysis means for effecting lysis of cells in the biological sample loaded onto the integrated chip.
5. The system of any one of Claims 1-4, wherein the extraction control module further comprises a sonication means for generating ultrasound within the biological sample loaded onto the integrated chip, said ultrasound being sufficient to disrupt cell membranes of cells in the biological sample.
6. The system of any one of Claims 1-5, wherein the extraction control module further comprises fluid pressure generating means for generating sufficient fluid pressure to mechanically shear cells in the biological sample loaded onto the integrated chip on microfabricated protrusions disposed on the integrated chip.
7. The system of any one of Claims 1-6, wherein the extraction control module further comprises a electroporation means for applying variable voltage to biological sample loaded onto the integrated chip, said voltage sufficient to disrupt cells in the biological sample.
8. The system of any one of Claims 1-7, wherein the extraction control module further comprises a silica particles capturing means for capturing silica particles introduced into the biological sample loaded onto the integrated chip.
9. The system of any one of Claims 1-8, wherein the nucleic acid extraction control module further comprises a magnetic particles capturing means for capturing magnetic particles introduced into the biological sample loaded onto the integrated chip.
10. The system of any one of Claims 1-9, wherein the magnetic particles capturing means include a magnet.
11. The system of any one of Claims 1-10, wherein the nucleic acid amplification module further comprises a means for well-based nucleic acid amplification.
12. The system of any one of Claims 1-11, wherein the means for well-based nucleic acid amplification includes a thermoelectric heating means for heating/cooling the nucleic acid amplification module of the integrated chip.
13. The system of any one of Claims 1-12, wherein the thermoelectric heating means for heating/cooling the nucleic acid amplification module of the integrated chip includes a temperature sensor, a power control means for controlling the thermoelectric heating means, and a processing unit for storing and executing instructions for nucleic acid amplification.

14. The system of any one of Claims 1-13, wherein the means for well-based nucleic acid amplification includes a means for infrared heating of the nucleic acid amplification module of the integrated chip.
15. The system of any one of Claims 1-14, wherein the means for well-based nucleic acid amplification includes a means for microwave heating of the nucleic acid amplification module of the integrated chip.
16. The system of any one of Claims 1-15, wherein the means for well-based nucleic acid amplification includes a means for applying controlled tension to nucleic acid strands within the nucleic acid amplification module of the integrated chip.
17. The system of any one of Claims 1-16, wherein the controlled tension is mechanical tension, hydrodynamic tension or electromagnetic tension.
18. The system of any one of Claims 1-17, wherein the means for applying controlled tension to the nucleic acid strands are configured to operate isothermally.
19. The system of any one of Claims 1-18, wherein the nucleic acid amplification module further comprises fluid-based nucleic acid amplification means comprising a fluid flow generating means for generating a flow of buffers through the nucleic acid amplification module of the integrated chip, said fluid flow generating means operably connected to a temperature controlling means for controlling the temperature of the nucleic acid amplification module of the integrated chip.
20. The system of any one of Claims 1-19, wherein the nucleic acid amplification module comprises a real-time polymerize chain reaction (PCR) control means for effecting nucleic acid amplification.
21. The system of any one of Claims 1-20, wherein the biological sample detection control module comprises a fluorescence detection means for detecting nucleic acids.
22. The system of any one of Claims 1-21, wherein the fluorescence detection means include a light-emitting diode and/or a laser diode, a data acquisition device, and a processing units for storing and processing the acquired data.
23. The system of any one of Claims 22, wherein the nucleic acid detection control module further comprises a capillary electrophoresis (CE) control means for effecting separation of nucleic acids, said CE control means operably connected to the fluorescence detection means.
24. The system of any one of Claims 1-23, wherein the CE control means further include a high voltage control unit for applying voltage across the nucleic acid detection module

of the integrated chip, said voltage being sufficient for effecting separation of nucleic acids.

25. The system of any one of Claims 1-24, wherein the nucleic acid detection control module further comprises a hybridization microarray.
26. The system of any one of Claims 1-25, wherein the nucleic acid detection control module comprises an electrochemical means for detecting nucleic acids.
27. The system of any one of Claims 1-26, wherein the nucleic acid detection control module comprises an impedance-measuring means for detecting nucleic acids.
28. The system of any one of Claims 1-27, further comprising a fluid pressure generating means for moving a biological sample and/or nucleic acids through the integrated chip.
29. The system of any one of Claims 1-28, further comprising a data processing means for storing, classifying, quantifying and transferring data acquired by analyzing the biological sample.
30. The system of any one of Claims 1-29, wherein the data processing means include a means for wireless data transfer.
31. The system of any one of Claims 1-30, wherein the data processing means further include a viral load computing means for computing viral loads.
32. The system of any one of Claims 1-31, further comprising a data displaying means for outputting data.
33. The system of any one of Claims 1-32, wherein the system is a mobile device.
34. The system of any one of Claims 1-33, wherein the integrated chip is disposable.
35. A system for rapid analysis of biological samples, comprising:
 - a portable control assembly that receives at least one compact integrated chip, said integrated chip comprising:
 - an injection port for loading a biological sample and, optionally, one or more reagents, onto the integrated chip;
 - an extraction module;
 - a nucleic acid amplification module, in fluid communication with the extraction module; and
 - a detection module, in fluid communication with the nucleic acid amplification module,
 - said portable assembly comprising:

- 84 -

an extraction control module, comprising a magnetic particles capturing means for capturing magnetic particles introduced into the biological sample loaded onto the integrated chip;

a nucleic acid amplification control module operably connected to the extraction control module, said nucleic acid amplification means comprising a thermoelectric heating means for heating/cooling the nucleic acid amplification module of the integrated chip; and

a detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module, said detection control module comprising:

a fluorescence detection means for detecting nucleic acids or proteins; and

a capillary electrophoresis (CE) control means operably connected to the fluorescence detection means, said CE control means further including a high voltage control unit for applying voltage across the nucleic acid detection module of the integrated chip, said voltage being sufficient for effecting separation of nucleic acids or proteins; and

a fluid pressure generating means for moving the biological sample and/or nucleic acids through the integrated chip.

36. The system of Claim 35, the magnetic particles capturing means include a permanent and/or electromagnet for capturing magnetic beads.
37. The system of Claim 35 or 36, wherein the fluorescence detection means include a light-emitting diode and/or a laser diode, a data acquisition device, and a processing units for storing and processing the acquired data.
38. The system of any one of Claims 35-37, further comprising a data processing means for storing, classifying, quantifying and transferring data.
39. The system of any one of Claims 35-38, wherein the data processing means include a means for wireless data transfer.
40. The system of any one of Claims 35-39, further comprising a data displaying means for outputting data.
41. The system of any one of Claims 35-40, wherein the system is hand-held.
42. The system of any one of Claims 35-41, wherein the integrated chip is disposable.
43. A method for rapid analysis of biological samples, comprising:
 - (1) providing at least one integrated chip, said integrated chip comprising:

- 85 -

a nucleic acid extraction module;
a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,

(2) loading the at least one biological sample onto the at least one integrated chip;
(3) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:

a nucleic acid extraction control module;
a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and
a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

and

(4) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip.

44. The method of Claim 43, further including computing a viral load.
45. The method of Claim 43 or 44, wherein the biological sample is any one or more of blood, saliva, semen, urine, amniotic fluid, cerebrospinal fluid, synovial fluid, vitreous fluid, gastric fluid, nasopharyngeal aspirate or lymph.
46. The method of any one of Claims 43-45, wherein the sample is a tissue sample, a water sample, an air sample, a food sample or a crop sample.
47. The method of any one of Claims 43-46, wherein the biological sample analysis detects any one or more of water-born pathogen, air-born pathogen, food-born pathogen or crop-born pathogen.
48. An integrated chip for rapid sequential extraction, amplification and separation of nucleic acid in a biological sample, said integrated chip comprising:
a housing having integrated therein microfluidic channels in sequential fluid communication with a nucleic acid extraction module, a nucleic acid amplification module and a nucleic acid separation module
at least one sample inlet port for injecting biological samples and reagents in fluid communication with the nucleic acid extraction module;

- 86 -

wherein the nucleic acid extraction module comprises at least one extraction chamber for extracting nucleic acids from the biological samples, said extraction chamber connected to the sample inlet port by at least one sample transport channel;

wherein the nucleic acid amplification module comprises at least one amplification chamber for amplifying nucleic acids, said nucleic acid amplification chamber connected to the extraction chamber by at least one nucleic acid transport channel; and

wherein the nucleic acid separation module comprises at least one detection channel for separating and detecting the nucleic acids, said detection channel connected to nucleic acid amplification chamber by at least one amplification product transport channel.

49. The integrated chip of Claim 48, wherein the at least one extraction chamber includes magnetic beads.
50. The integrated chip of Claim 48 or 49, wherein the at least one extraction chamber includes reagents for cell lysis and nucleic acid extraction.
51. The integrated chip of any one of Claims 48-50, wherein the nucleic acid amplification module further includes at least one reagent addition port in fluid communication with at least one nucleic acid transport channel.
52. The integrated chip of any one of Claims 48-51, wherein the nucleic acid separation module further comprises at least one sample well in fluid communication with at least one amplification product transport channel.
53. The integrated chip of any one of Claims 48-52, wherein the nucleic acid separation module further comprises:
 - at least one sample waste well in fluid communication with at least one detection channel;
 - a buffer waste well in fluid communication with at least one detection channel;
 - and
 - a buffer well in fluid communication with at least one detection channel.
54. The integrated chip of any one of Claims 48-53, comprising:
 - at least two sample inlet ports;
 - at least two nucleic acid extraction chambers, each said nucleic acid extraction chamber connected to one of the at least two sample inlet ports by a respective sample transport channel;

- 87 -

at least two nucleic acid amplification chambers, each said nucleic acid amplification chamber connected to one of the at least two extraction chambers by a respective nucleic acid transport channel; and

at least two detection channels, each said detection channel connected to a respective nucleic acid amplification chamber by a respective amplification product transport channel.

55. The integrated chip of any one of Claims 48-54, wherein the at least two detection channels intersect.
56. The integrated chip of any one of Claims 48-55, further comprising at least two reagent addition ports, each said reagent addition port in fluid communication with a respective nucleic acid transport channel.
57. The integrated chip of any one of Claims 48-56, further comprising at least two sample wells, each said sample well in fluid communication with a respective amplification product transport channel.
58. The integrated chip of any one of Claims 48-57, wherein the at least two sample wells are configured for use for addition and/or disposal of additional reagents.
59. The integrated chip of any one of Claims 48-58, further comprising at least one sample waste well, each said at least one sample waste well connected with at least two detection channels by at least two sample waste channels.
60. The integrated chip of any one of Claims 48-59, wherein said at least one sample waste well is configured for use for addition and/or disposal of additional reagents.
61. The integrated chip of any one of Claims 48-60, further comprising:
 - at least one buffer waste well, each said buffer waste well in fluid communication with at least two detection channels; and
 - a buffer well in fluid communication with at least two detection channel.
62. The integrated chip of any one of Claims 48-61, wherein said at least one buffer waste well and said buffer well are configured for use for addition and/or disposal of additional reagents.
63. The integrated chip of any one of Claims 48-62, wherein the buffer well is disposed at the point of intersection of at least two detection channels, and wherein said buffer well is in fluid communication with said intersecting detection channels.
64. The integrated chip of any one of Claims 48-63, comprising:
 - at least eight sample inlet ports;
 - at least eight nucleic acid extraction chambers;

- 88 -

- at least eight nucleic acid amplification chambers;
 - at least eight detection channels;
 - at least eight reagent addition ports;
 - at least eight sample wells;
 - at least four sample waste wells;
 - at least four buffer waste wells; and
 - at least one buffer well.
65. The integrated chip of any one of Claims 48-64, further including microfabricated protrusions disposed in the at least one nucleic acid extraction chamber and /or in the at least one sample transport channel.
66. The integrated chip of any one of Claims 48-65, further including at least two electrodes for applying voltage across the at least one detection channel.
67. The integrated chip of any one of Claims 48-66, further comprising at least one nucleic acid flow control valve for controlling fluid flow through the at least one nucleic acid transport channel.
68. The integrated chip of any one of Claims 48-67, further comprising at least one amplification product control valve for controlling fluid flow through the at least one amplification product transport channel.
69. The integrated chip of any one of Claims 48-68, further comprising:
- at least two nucleic acid flow control valves for controlling fluid flow through a respective nucleic acid transport channel; and
 - at least two amplification product control valves for controlling fluid flow through a respective amplification product transport channel.
70. The integrated chip of any one of Claims 48-69, wherein the at least two nucleic acid flow control valves and the at least two amplification product control valves are passive plugs configured for insertion into respective reagent addition ports and/or respective sample wells.
71. The integrated chip of any one of Claims 48-70, wherein the at least two nucleic acid flow control valves and the at least two amplification product control valves are electromagnetically controllable valves.
72. The integrated chip of any one of Claims 48-71, wherein the electromagnetically controllable valves are ferrofluidic valves.
73. The integrated chip of any one of Claims 48-72, wherein the at least two sample inlet ports, the at least two reagent addition ports, the at least two sample wells, the at least

- 89 -

four sample waste wells, the at least four buffer waste wells, and the at least one buffer well are configured to receive a passive plug.

74. The integrated chip of any one of Claims 48-73, wherein the at least one extraction chamber has the volume of at least 5 μ L.

75. A system for rapid analysis of biological samples, comprising:

a hardware system that receives at least one integrated chip,
said integrated chip comprising:

an injection port for loading a biological sample and, optionally, one or more reagents, onto the integrated chip;

a nucleic acid extraction module;

a nucleic acid amplification module, in fluid communication with the nucleic extraction module; and

a nucleic acid separation module, in fluid communication with the nucleic acid amplification module,

said hardware system comprising:

a nucleic acid extraction control module, comprising a magnetic particles capturing means for capturing magnetic particles introduced into the biological sample loaded onto the integrated chip;

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module, said nucleic acid amplification means comprising a thermoelectric heating means for heating/cooling the nucleic acid amplification module of the integrated chip; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module, said nucleic acid detection control module comprising:

a fluorescence detection means for detecting nucleic acids; and

a capillary electrophoresis (CE) control means operably connected to the fluorescence detection means, said CE control means further including a high voltage control unit for applying voltage across the nucleic acid separation module of the integrated chip, said voltage being sufficient for effecting separation of nucleic acids; and

a fluid pressure generating means for moving the biological sample and/or nucleic acids through the integrated chip.

- 90 -

76. The system of Claim 75, the magnetic particles capturing means include a permanent and/or electromagnet for capturing magnetic beads.
77. The system of Claim 75 or 76, wherein the fluorescence detection means include a light-emitting diode and/or a laser diode, a data acquisition device, and a processing units for storing and processing the acquired data.
78. The system of any one of Claims 75-77, further comprising a data processing means for storing, classifying, quantifying and transferring data.
79. The system of any one of Claims 75-78, further comprising a data displaying means for outputting data.
80. The system of any one of Claims 75-79, wherein the thermoelectric heating means for heating/cooling the nucleic acid amplification module of the integrated chip includes a temperature sensor, a power control means for controlling the thermoelectric heating means, and a processing unit for storing and executing instructions for nucleic acid amplification.
81. The system of any one of Claims 75-80, wherein the nucleic acid amplification module comprises a real-time polymerize chain reaction (PCR) control means for effecting nucleic acid amplification.
82. The system of any one of Claims 75-81, wherein the fluorescence detection means include a light-emitting diode and/or a laser diode, a data acquisition device, and a processing units for storing and processing the acquired data.
83. The system of any one of Claims 75-82, wherein the nucleic acid detection control module further comprises a capillary electrophoresis (CE) control means for effecting separation of nucleic acids, said CE control means operably connected to the fluorescence detection means.
84. The system of any one of Claims 75-83, wherein the CE control means further include a high voltage control unit for applying voltage across the nucleic acid separation module of the integrated chip, said voltage being sufficient for effecting separation of nucleic acids.
85. The system of any one of Claims 75-84, wherein the high voltage control unit applies from 10 V to 10 kV across the nucleic acid separation module of the integrated chip.
86. The system of any one of Claims 75-85, wherein the nucleic acid detection control module further comprises a hybridization microarray.
87. The system of any one of Claims 75-86, wherein the fluid pressure generating means comprises a pump module that supplies either positive or negative pressure.

- 91 -

88. A method for rapid analysis of a biological sample, comprising the steps of:
providing an integrated chip, said integrated chip comprising:
at least one sample inlet port for injecting biological samples and reagents;
a nucleic acid extraction module, comprising at least one extraction chamber for extracting nucleic acids from the biological samples, said extraction chamber connected to the sample inlet port by at least one sample transport channel;
a nucleic acid amplification module, comprising at least one amplification chamber for amplifying nucleic acids, said nucleic acid amplification chamber connected to the extraction chamber by at least one nucleic acid transport channel; and
a nucleic acid separation module, comprising at least one detection channel for separating and detecting the nucleic acids, said detection channel connected to nucleic acid amplification chamber by at least one amplification product transport channel;
injecting at least one biological sample and, optionally, reagents, through the at least one sample injection port into at least one extraction chamber;
extracting nucleic acids from the at least one biological sample in the at least one extraction chamber by adding said at least one biological sample to magnetic beads having molecular probes attached thereto;
transporting the nucleic acids from the at least one extraction chamber to the at least one nucleic acid amplification chamber;
amplifying the nucleic acids in the at least one nucleic acid amplification chamber by a thermal polymerase chain reaction (PCR);
transporting the nucleic acids from the nucleic acid amplification chamber into the at least one detection channel; and
separating the nucleic acids by size and detecting the nucleic acids in the at least one detection channel.
89. The method of Claim 88, wherein the step of extracting nucleic acids from the at least one biological sample in the at least one extraction chamber includes extracting nucleic acid from a few cells to a few thousand cells.
90. The method of Claim 88 or 89, wherein the step of extracting nucleic acids from the at least one biological sample includes lysing the cells, retaining the extracted nucleic

- 92 -

- acids, and purifying the extracted nucleic acid within the at least one extraction chamber.
91. The method of any one of Claims 88-90, further including removal of cell debris from the at least one extraction chamber.
92. The method of any one of Claims 88-91, wherein the PCR is a real-time quantitative PCR.
93. The method of any one of Claims 88-92, wherein the step of detecting the nucleic acids in the at least one detection channel includes:
- applying voltage across the at least one detection channel; and
 - illuminating the at least one detection channel by a light source; and
 - detecting fluorescence signal from the at least one detection channel.
94. The method of any one of Claims 88-93, wherein the integrated chip includes:
- at least two sample inlet ports;
 - at least two nucleic acid extraction chambers, each said nucleic acid extraction chamber connected to one of the at least two sample inlet ports by the sample transport channel;
 - at least two nucleic acid amplification chambers, each said nucleic acid amplification chamber connected to one of the at least two extraction chambers by one nucleic acid transport channel; and
 - at least two detection channels, each said detection channel connected to one of the at least two nucleic acid amplification chambers by one amplification product transport channel,
- wherein the at least two detection channels intersect.
95. The method of any one of Claims 88-94, further including injecting at least two biological sample and, optionally, reagents, through the at least two sample injection ports into at least two extraction chamber, wherein the step of detecting is performed simultaneously or sequentially to analyze each of the at least two biological samples.
96. The method of any one of Claims 88-95, wherein the integrated chip further comprises:
- at least one nucleic acid flow control valve for controlling fluid flow through the at least one nucleic acid transport channel; and
 - at least one amplification product control valve for controlling fluid flow through the at least one amplification product transport channel.
97. The method of any one of Claims 88-96, wherein the integrated chip further comprises:

at least one buffer waste well, each said buffer waste well in fluid communication with at least two detection channels; and
a buffer well in fluid communication with at least two detection channel,
wherein said at least one buffer waste well and said buffer well are configured for use for addition and/or disposal of additional reagents.

98. The method of any one of Claims 88-97, wherein the buffer well is disposed at the point of intersection of at least two detection channels, and wherein said buffer well is in fluid communication with said intersecting detection channels.
99. The method of any one of Claims 88-98, further including the step of loading said at least two detection channels with a sieving matrix for separating the nucleic acids.
100. The method of any one of Claims 88-99, wherein detecting the nucleic acids in the at least one detection channel includes detecting of not greater than 0.5 μL of the PCR-amplified nucleic acids.
101. The method of any one of Claims 88-100, wherein the step of separating the nucleic acids by size and detecting the nucleic acids is performed within less than 2 hours, less than 1 hour, less than 30 minutes, less than 1 minute or less than 1 second.
102. The method of any one of Claims 88-101, wherein the step of extracting nucleic acids from the at least one biological sample is performed within at least one of: 3 to 4 minutes; and 5 to 30 minutes.
103. In a microfluidic device, a valve assembly, comprising:
a microfluidic channel for transporting fluid, said microfluidic channel formed between a top surface and a bottom surface and having a longitudinal axis;
a valving port in the top surface for receiving a passive plug; and
a passive plug configured for insertion into the valving port,
wherein the portion of the bottom surface opposite the valving port has uniform depth along longitudinal axis.
104. In a microfluidic device, a valve assembly, comprising:
a transport channel for transporting fluid;
a ferrofluidic channel intersecting said transport channel;
a first ferrofluidic reservoir and a second ferrofluidic reservoir, said first and second ferrofluidic reservoirs connected by the ferrofluidic channel;
ferrofluid in either one or both ferrofluidic reservoirs; and
a permanent magnet or an electromagnet for filling the ferrofluidic channel with the ferrofluid.

- 94 -

105. In a microfluidic device, a valve assembly, comprising:
- a reservoir;
 - an inflow transport channels for transporting fluid having an output end connected to the reservoir;
 - a first and a second outflow channels for transporting fluid, each having an input end connected to the reservoir;
 - ferrofluid disposed in the reservoir; and
 - a magnet for controlling the position of the ferrofluid in the reservoir,
- wherein the ferrofluid within the reservoir is positioned to close:
- either the output end of the inflow channel;
 - or the input end of the first outflow channel, but not the input end of the second outflow channel;
 - or the input end of the second channel, but not the input end of the first outflow channel;
 - or neither the output end of the inflow channel, nor the input ends of the first and the second outflow channels.
106. In a microfluidic device, a valve assembly, comprising:
- a microfluidic channel for transporting fluid, said microfluidic channel formed between a top surface and a bottom surface;
 - a valving port in the top surface for receiving an inflatable elastic membrane;
 - an inflatable elastic membrane configured for insertion into the valving port;
 - and
 - an inlet air tube coupled to the inflatable elastic membrane for inflating the inflatable elastic membrane, the inflatable elastic membrane allowing fluid transport through the microfluidic channel when uninflated, and preventing fluid transport through the microfluidic channel when inflated.
107. The valve assembly as claimed in claim 106 wherein the inflatable elastic membrane and inlet air tube are embedded in the chip.
108. The valve assembly as claimed in claim 106 or 107 wherein the inflatable elastic membrane is disposed between the top and bottom surfaces.
109. In a microfluidic device, a valve assembly, comprising:
- a loading well for receiving fluid;
 - a first transport channel connected to the loading well;

- 95 -

an enclosed chamber in fluid communication with the loading well via the first transport channel;

a second transport channel connected to the enclosed chamber;

an open well in fluid communication with the enclosed chamber via the second transport channel;

a first inflatable elastic membrane in the first transport channel allowing fluid communication between the loading well and the enclosed chamber when uninflated, and preventing fluid communication between the loading well and the enclosed chamber when inflated;

a second inflatable elastic membrane in the enclosed chamber to expel fluid when in inflated; and

a third inflatable elastic membrane in the second transport channel allowing fluid communication between the enclosed chamber and the open well when uninflated, and preventing fluid communication between the loading well and the enclosed chamber when inflated.

110. The valve assembly as claimed in claim 109 further including first, second, and third pneumatic input tubes connected to the first, second, and third inflatable elastic membranes, respectively.

111. A method for rapid analysis of biological samples, comprising:

(a) providing at least one integrated chip, said integrated chip comprising:

a nucleic acid extraction module;

a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and

a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,

(b) loading the at least one biological sample onto the at least one integrated chip;

(c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:

a nucleic acid extraction control module;

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

- (d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;
 - (e) based on the detection of the nucleic acid from the biological sample, determining at least one biomarker associated with a person who is the source of the at least one biological sample; and
 - (f) based on the at least one biomarker, determining at least one of:
 - (i) a dosage of at least one drug to effect therapeutic treatment of a disease condition associated with the at least one biomarker;
 - (ii) a combination of a plurality of drugs to effect therapeutic treatment of the disease condition associated with the at least one biomarker; and
 - (iii) a determination of whether the person who is the source of the at least one biological sample is a responder to a drug therapy for the disease condition associated with the at least one biomarker.
112. The method according to Claim 111, wherein the at least one biomarker is specific to a specific strain of a pathogen or disease.
113. The method according to Claim 111 or 112, comprising determining at least one of:
 - (i) a dosage of at least one drug to effect therapeutic treatment of a disease condition associated with the at least one biomarker; and
 - (ii) a combination of a plurality of drugs to effect therapeutic treatment of the disease condition associated with the at least one biomarker;the method comprising uniquely determining at least one of the dosage of the at least one drug and the combination of the plurality of drugs based on the specific strain.
114. The method according to any one of Claims 111 to 113, further comprising delivering the uniquely determined dosage or combination based on the specific strain.
115. The method according to any one of Claims 111 to 114, wherein the specific strain comprises a strain of human immunodeficiency virus (HIV).
116. A method for rapid analysis of biological samples, comprising:
 - (a) providing at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,
 - (b) loading the at least one biological sample onto the at least one integrated chip;

- 97 -

(c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:

a nucleic acid extraction control module;

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

(d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;

(e) based on the detection of the nucleic acid from the biological sample, determining an amount, in the at least one biological sample, of at least one biomarker associated with a person who is the source of the at least one biological sample; and

(f) based on the amount of the at least one biomarker in the at least one biological sample, determining a degree of progress of treatment of a disease condition associated with the at least one biomarker, in the person who is the source of the at least one biological sample.

117. A method for rapid analysis of biological samples, comprising:

(a) providing at least one integrated chip, said integrated chip comprising:

a nucleic acid extraction module;

a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and

a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,

(b) loading the at least one biological sample onto the at least one integrated chip;

(c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:

a nucleic acid extraction control module;

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

(d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;

- 98 -

- (e) based on the detection of the nucleic acid from the biological sample, determining at least one biomarker associated with a person who is the source of the at least one biological sample; and
 - (f) based on the at least one biomarker, determining at least one of (i) a selection of a personal care product for the person who is the source of the at least one biological sample, (ii) a delivery amount of the personal care product for the person, (iii) a cosmetic skin type of the person, and (iv) an amount of at least one cosmetic biomarker of the person in the at least one biological sample.
118. A method for rapid analysis of biological samples, comprising:
- (a) providing at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module;
 - (b) loading the at least one biological sample onto the at least one integrated chip;
 - (c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:
 - a nucleic acid extraction control module;
 - a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and
 - a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;
 - (d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;
 - (e) based on the detection of the nucleic acid from the biological sample, determining an amount, in the at least one biological sample, of at least one cosmetic biomarker associated with a person who is the source of the at least one biological sample; and
 - (f) based on the amount of the at least one biomarker in the at least one biological sample, determining a degree of progress of a cosmetic treatment in the person who is the source of the at least one biological sample.
119. A method for rapid analysis of biological samples, comprising:
- (a) providing at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;

- 99 -

- a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,
- (b) loading the at least one biological sample onto the at least one integrated chip;
 - (c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:
 - a nucleic acid extraction control module;
 - a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and
 - a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;
 - (d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;
 - (e) based on the detection of the nucleic acid from the biological sample, determining at least one biomarker associated with a person who is the source of the at least one biological sample; and
 - (f) based on the at least one biomarker, determining a degree or type of health of the person who is the source of the at least one biological sample.
120. The method according to Claim 119, wherein determining the degree or type of health of the person comprises determining at least one of (i) a degree of nutritional health of the person or (ii) a nutritional need of the person, and (iii) an ayurvedic body type of the person.
121. The method according to Claim 119 or 120, wherein determining the degree or type of health of the person comprises quantifying at least one biomarker associated with diabetes in the person.
122. A method for rapid analysis of biological samples, comprising:
- (a) providing at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,
 - (b) loading the at least one biological sample onto the at least one integrated chip;

- 100 -

- (c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:
- a nucleic acid extraction control module;
 - a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and
 - a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;
- (d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;
- (e) based on the detection of the nucleic acid from the biological sample, determining at least one biomarker associated with a person who is the source of the at least one biological sample; and
- (f) based on the at least one biomarker, determining whether the person who is the source of the at least one biological sample is a member of a subset genetic population relative to the at least one biomarker.
123. The method according to any preceding method claim, further comprising, based on the detection of the nucleic acid from the biological sample, delivering at least one of (i) a dosage of at least one drug to effect therapeutic treatment of a disease condition; and (ii) a combination of a plurality of drugs to effect therapeutic treatment of the disease condition.
124. The method according to any preceding method claim, wherein the detected nucleic acid from the biological sample comprises at least one of the following: a nucleic acid indicative of a food safety pathogen; a nucleic acid indicative of an agricultural disease; a nucleic acid indicative of a veterinary disease; a nucleic acid from an archaeological sample; a nucleic acid from a forensic sample; a nucleic acid from a water sample; a nucleic acid indicative of an environmental condition; a nucleic acid from a customs sample; a nucleic acid related to security; a nucleic acid related to biological defense; a nucleic acid related to a biofuel; a nucleic acid related to a sport participant; and a nucleic acid related to wellness of a person.
125. The method according to any preceding method claim, further comprising, using a communications module coupled to the portable control assembly, performing at least one of transmitting and receiving modulated data signals pertaining to the biological sample.

- 101 -

126. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over a network comprising a wired network.
127. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over a network comprising a wireless network.
128. The method according to any preceding method claim, wherein the network is configured to operate according to a Bluetooth standard.
129. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over a modem.
130. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over a cloud network.
131. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving to provide clinical health care at a distance from the portable control assembly.
132. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving to provide at least one of medical care and public health service using the portable control assembly.
133. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over a network comprising a mobile device network.
134. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving via a text message system.
135. The method according to any preceding method claim, comprising performing the at least one of transmitting and receiving over at least one of a Local Area Network, a Wide Area Network, and the Internet.
136. The method according to any preceding method claim, wherein the at least one of transmitting and receiving comprises connecting to a remote genomic database that stores at least one genomic profile.
137. The method according to any preceding method claim, wherein the at least one of transmitting and receiving comprises engaging in a two-way exchange of modulated data signals between a central data center and the communications module.
138. The method according to any preceding method claim, comprising, using the communications module, (i) receiving pathogen or disease mapping information from the central data center, and (ii) transmitting at least one assay result to the central data center.

- 102 -

139. The method according to any preceding method claim, wherein the at least one of transmitting and receiving comprises transmitting geographic location information to a central data center.
140. The method according to any preceding method claim, wherein the at least one of transmitting and receiving comprises receiving a notification from a central data center of detection of a detected pattern of disease outbreak from a plurality of communications modules.
141. The method according to any preceding method claim, further comprising, using a communications module coupled to the portable control assembly, performing at least one of storing, transmitting and receiving a signal profile of a single reference sample.
142. The method according to any preceding method claim, comprising, based on the detected nucleic acid from the biological sample, determining at least one of a viral load, a predicted cell count per volume, and a titration of drug dosing.
143. The system of any preceding system claim, wherein the system is configured to permit control of the position or orientation of a molecule to within a dimension of less than 100 nm, less than 10 nm, or less than 1 nm.
144. The system of any preceding system claim, wherein the system comprises at least one reaction chamber comprising a largest dimension of less than 10 mm, less than 1 mm, less than 100 microns, less than 10 microns, less than 1 micron, less than 100 nm, less than 10 nm or less than 1 nm.
145. The system of any preceding system claim, wherein the system is configured to control a parameter that governs a reaction used to analyze the biological sample to within plus or minus 10%, plus or minus 1%, plus or minus 0.1%, plus or minus 0.01%, plus or minus 0.001% or plus or minus 0.0001%.
146. The system of any preceding system claim, wherein the extraction module is a nucleic acid extraction module.
147. The system of any preceding system claim, wherein the extraction module is a protein extraction module.
148. The system of any preceding system claim, wherein the nucleic acid amplification module comprises an isothermal nucleic acid amplification module.
149. The system of any preceding system claim, wherein the isothermal nucleic acid amplification module comprises at least one of: a Loop Mediated Isothermal Amplification module, a Helicase-Dependent Amplification module, a Strand

- 103 -

Displacement Amplification module, a bridge amplification module, or a rolling circle amplification module.

150. The system of any preceding system claim, wherein the isothermal nucleic acid amplification module comprises a module to amplify a nucleic acid by a method comprising:
- (a) contacting one or more template strands of single-stranded nucleic acid with one or more oligonucleotide primers complementary to a portion of the one or more template strands;
 - (b) annealing at least one primer of the one or more primers to the portion of the one or more template strands to which the primer is complementary;
 - (c) contacting the one or more template strands with a nucleic acid polymerase and at least four different nucleoside triphosphates;
 - (d) extending the at least one annealed primer by the nucleic acid polymerase thereby forming one or more extension products bound to the one or more template strands;
 - (e) separating the one or more extension products from the one or more template strands; and
 - (f) repeating steps (a), (b), (c), (d) and (e) to amplify the nucleic acid, wherein at least one of the one or more extension products in step (e) is used as template strands in a subsequent cycle of steps (a)-(e), wherein, for the last cycle, step (e) is optional, and wherein at least one of steps (b) or (d) comprises applying tension that tends to stretch the nucleic acid to the one or more template strands.
151. The system of any preceding system claim, wherein the system is a hand held.
152. A method for rapid analysis of biological samples, comprising:
- (1) providing at least one integrated chip, said integrated chip comprising:
 - a protein extraction module; and
 - a protein detection module, in fluid communication with the protein extraction module,
 - (2) loading the at least one biological sample onto the at least one integrated chip;
 - (3) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:
 - a protein extraction control module; and

- 104 -

a protein detection control module operably connected with the protein extraction module;

and

(4) activating the portable control assembly to effect extraction and detection of protein from the biological sample loaded onto said integrated chip.

153. A method for rapid analysis of biological samples, comprising:

(a) providing at least one integrated chip, said integrated chip comprising:

a nucleic acid extraction module;

a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and

a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,

(b) loading the at least one biological sample onto the at least one integrated chip;

(c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:

a nucleic acid extraction control module;

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

(d) activating the portable control assembly to effect extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;

(e) based on the detection of the nucleic acid from the biological sample, determining at least one biomarker associated with a person who is the source of the at least one biological sample; and

(f) based on the at least one biomarker, determining at least a portion of a personalized genomic profile of a person who is the source of the at least one biological sample.

154. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to wellness of the person.

155. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to sports nutrition of the person.

- 105 -

156. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to diet of the person.
157. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to nutrition of the person.
158. The method according to Claim 157, wherein the nucleic acid related to nutrition of the person comprises a nucleic acid related to a nutritional predisposition of the person.
159. The method according to Claim 158, wherein the predisposition comprises at least one of: a nutritional allergy, a nutritional sensitivity and a nutritional intolerance of the person.
160. The method according to Claim 159, wherein the nucleic acid related to nutrition of the person comprises a nucleic acid related to at least one of: gluten sensitivity, gluten intolerance and lactose intolerance.
161. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to at least one of: effect of a nutraceutical on the person; a nutritional profile of the person; effect of a cosmeceutical on the person; effect of a pharmaceutical on the person; and effect of a food or beverage on the person.
162. The method according to any one of Claims 153 to 161, wherein determining the at least a portion of the personalized genomic profile comprises detecting at least one inflammatory marker.
163. The method according to Claim 162, wherein the at least one inflammatory marker comprises at least one inflammatory marker for a traumatic injury.
164. The method according to Claim 162, wherein the at least one inflammatory marker comprises at least one inflammatory marker related to toleration of a diet.
165. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting at least one RNA marker for at least one type of phenotypic expression.
166. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid related to a nutritional deficiency.
167. The method according to Claim 166, wherein the nutritional deficiency comprises a micronutrient deficiency.

- 106 -

168. The method according to Claim 167, wherein the micronutrient comprises a vitamin.
169. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises determining at least one probiotic or prebiotic that is deficient or altered in a microbiome of the person.
170. The method according to Claim 153, wherein determining the at least a portion of the personalized genomic profile comprises detecting a nucleic acid indicative of a type or subtype of diabetes.
171. A system for rapid analysis of biological samples, the system comprising:
- (i) at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,at least one biological sample being loaded onto the at least one integrated chip;
 - (ii) a portable control assembly comprising:
 - a nucleic acid extraction control module;
 - a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and
 - a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;the portable control assembly effecting extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;
 - (iii) a genetic analysis unit configured to determine, based on the detection of the nucleic acid from the biological sample, at least one biomarker associated with a person who is the source of the at least one biological sample;
 - (iv) the genetic analysis unit being further configured to determine, based on the at least one biomarker, at least a portion of a personalized genomic profile of a person who is the source of the at least one biological sample.

172. The system of Claim 171, further comprising a dispensing control unit configured to determine at least a portion of a product to dispense based at least in part on the at least a portion of the personalized genomic profile.
173. The system of Claim 172, further comprising a dispensing activator coupled to the dispensing control unit, and configured to dispense at least a portion of the product under control of the dispensing control unit.
174. The system of Claim 173, wherein the dispensing activator comprises at least a portion of one of: a vending machine; an automated teller machine; and a kiosk.
175. The system of Claim 173 or 174, wherein the dispensing activator comprises a three dimensional printer configured to print at least a portion of the product.
176. The system of Claim 173 or 174, wherein the dispensing activator is configured to dispense a prepackaged product.
177. The system of any one of Claims 172 to 176, wherein the product comprises at least one of: a food, a beverage, a cosmeceutical, a nutraceutical, a pharmaceutical, a herbal medicine, an alternative medicine and a cosmetic.
178. The system of any one of Claims 172 to 177, wherein the dispensing control unit is configured to determine the at least a portion of the product to dispense based at least in part on at least one of: a nutritional predisposition, a nutritional deficiency, and at least one probiotic or prebiotic that is deficient or altered in a microbiome.
179. The system of any one of Claims 172 to 178, wherein the system for rapid analysis of biological samples is configured to augment the experience of a consumer obtaining the product from the dispensing activator.
180. A system for rapid analysis of biological samples, the system comprising:
- (i) at least one integrated chip, said integrated chip comprising:
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic extraction module; and
 - a nucleic acid detection module, in fluid communication with the nucleic acid amplification module,at least one biological sample being loaded onto the at least one integrated chip;
 - (ii) a portable control assembly comprising:
 - a nucleic acid extraction control module;

- 108 -

a nucleic acid amplification control module operably connected to the nucleic acid extraction control module; and

a nucleic acid detection control module operably connected with the nucleic acid amplification module and the nucleic acid extraction module;

the portable control assembly effecting extraction, amplification and detection of nucleic acid from the biological sample loaded onto said integrated chip;

(iii) a genetic analysis unit configured to determine, based on the detection of the nucleic acid from the biological sample, at least one biomarker associated with a person who is the source of the at least one biological sample;

a cardiac pulsation control unit coupled to the genetic analysis unit and configured to control a cardiac pulsation unit based on the at least one biomarker.

181. The system of Claim 180, wherein the at least one biomarker comprises a biomarker implicated in an atherosclerotic process, and wherein the cardiac pulsation control unit is configured to reverse a cardiac atherosclerotic condition.
182. The system of Claim 180 or 181, wherein the cardiac pulsation unit comprises an Enhanced External Counter Pulsation (EECP) therapy machine.
183. The method according to any preceding method claim, comprising at least one of diagnosing, classifying or monitoring a chronic disease via a nucleic acid marker.
184. The method according to any preceding method claim, wherein the chronic disease comprises diabetes.
185. The method according to any preceding method claim, wherein the nucleic acid marker comprises an inflammation marker.
186. The method according to any preceding method claim, comprising genotyping an organism, thereby determining at least one of: predisposition to a genetic disease, a strain of a disease, and antibiotic resistance of a disease condition.
187. The method according to any preceding method claim, comprising performing at least one of: point-of-care detection of an HIV strain, HIV viral load determination and HIV genotyping.
188. The method according to any preceding method claim, comprising determining a type of viral hepatitis.
189. The method according to any preceding method claim, comprising identifying a cancer gene.

- 109 -

190. The method according to any preceding method claim, comprising performing drug monitoring.
191. The method according to any preceding method claim, comprising using a mobile device to perform at least one of monitoring and preventing mother to child transmission of HIV.
192. The method according to any preceding method claim, comprising determining a pathogen present in a patient and at least one of the sensitivity and resistance profile of the pathogen to at least one antibiotic or other treatment.
193. The method according to any preceding method claim, comprising at least one of performing drug monitoring, using a device as a prognostic indicator of disease, and using a device as a theragnostic device.
194. The system of any preceding system claim, wherein the system is configured to permit control of the position or orientation of the molecule to within a dimension of less than 100 nm, less than 10 nm, or less than 1 nm.
195. The system of any preceding system claim, the fluidic system comprising at least one reaction chamber comprising a largest dimension of less than 10 mm, less than 1 mm, less than 100 microns, less than 10 microns, less than 1 micron, less than 100 nm, less than 10 nm or less than 1 nm.
196. The system of any preceding system claim, wherein one or more module shares a common reaction chamber.
197. A system according to any preceding system claim configured for delivery to the patient as an injectable device, an implantable device, a wearable device or an ingestible device.
198. A system of any preceding system claim, wherein the nucleic acid amplification module is configured to perform only one cycle of amplification, replication or sequencing.
199. A system according to Claim 198, wherein the only one cycle is isothermal.
200. A system according to Claim 198, wherein the only one cycle is thermal.

CLAIMS

1. A system for analysis of a biological sample, comprising:
 - a mobile device configured to receive at least one integrated chip, said integrated chip being configured to analyze a biological sample loaded thereon, and said mobile device and said integrated chip together being configured such that at least one of:
 - i) a portable control assembly of the mobile device,
 - ii) said integrated chip, and
 - iii) a processor,are effective to precision control at least one of: a) at least one parameter that governs at least one of a plurality of steps of the analysis of the biological sample; b) at least one action of extraction, amplification or detection, or c) at least one environmental or operational parameter of said integrated chip.
2. The system of Claim 1, wherein said mobile device and said integrated chip are together configured such that at least one of: (i) said portable control assembly of the mobile device, (ii) said integrated chip, and (iii) said processor, are effective to precision control at least one of: fluid flow, fluid pressure, temperature, tension on a nucleic acid, and concentration of at least one reagent, on said integrated chip.
3. The system of Claim 1, wherein said integrated chip comprises:
 - an extraction module;
 - a nucleic acid amplification module, in fluid communication with an extraction module;
 - a biological sample detection module in fluid communication with said nucleic acid amplification module or said extraction module; and
 - said portable control assembly is configured to process said integrated chip to analyze a biological sample loaded thereon by employing:
 - an extraction control module;
 - a nucleic acid amplification control module operably connected to the extraction control module; and
 - a biological sample detection control module.

4. The system of Claim 3, wherein said extraction control module further comprises fluid pressure generating means for generating sufficient fluid pressure to shear cells in the biological sample loaded onto the integrated chip.
5. The system of Claim 3, wherein said extraction control module further comprises a means for retaining or capturing magnetic particles on said integrated chip.
6. The system of Claim 3, wherein the nucleic acid amplification control module is configured to effect precision control of the nucleic acid amplification module of the integrated chip.
7. The system of Claim 6, wherein the nucleic acid amplification control module is configured to apply tension to nucleic acid strands within said integrated chip.
8. The system of Claim 7, wherein said tension is applied using one or more of applying mechanical tension, hydrodynamic tension or electromagnetic tension.
9. The system of Claim 1, wherein at least one of said mobile device and said integrated chip are configured, individually or in combination, to quantify at least one of a viral load and a bacterial load in the biological sample.
10. A system for analysis of biological samples, comprising:
 - a hardware system that receives at least one integrated chip,
 - said integrated chip comprising:
 - a port for loading a biological sample and, optionally, one or more reagents, onto the integrated chip;
 - a nucleic acid extraction module;
 - a nucleic acid amplification module, in fluid communication with the nucleic acid extraction module; and
 - a nucleic acid separation module, in fluid communication with the nucleic acid amplification module,
 - wherein one or more of said hardware system and said integrated chip are configured to provide individually or in combination, at least one of:
 - a nucleic acid extraction control module;
 - a nucleic acid amplification control module; and

a nucleic acid detection control module;

at least one of the nucleic acid extraction module, nucleic acid amplification module, nucleic acid separation module, nucleic acid extraction control module, nucleic acid amplification control module, and nucleic acid detection control module, being configured to provide precision control;

a means for generating fluid pressure for moving at least one of the biological sample and a nucleic acid through the integrated chip.

11. The system of Claim 10, wherein one or more of said hardware system and said integrated chip are configured to provide, individually or in combination, at least one of: a means for retaining or capturing magnetic beads; a means for fluorescence detection; a data storage or processing device; a device configured to transfer data wirelessly; a means for displaying data; a processing unit for storing and executing instructions.
12. The system of Claim 10, wherein said system is configured to control a parameter that governs a reaction used to analyze the biological sample to within plus or minus 10%, plus or minus 1%, plus or minus 0.1%, plus or minus 0.01%, plus or minus 0.001% or plus or minus 0.0001%.
13. A method for analysis of biological samples, comprising:
 - subjecting a biological sample to at least one of:
 - i) precision control of at least one parameter that governs at least one of a plurality of steps of the analysis of the biological sample
 - ii) precision control of at least one environmental or operational parameter of the analysis of biological sample
 - iii) precision control of extraction to provide an extracted nucleic acid component of the biological sample;
 - iv) precision control of amplification to provide an amplicon from the extracted nucleic acid component; and
 - v) precision control of detection of the extracted nucleic acid component.

14. The method of Claim 13 comprising performing precision control of at least one of: fluid flow, fluid pressure, temperature, tension on a nucleic acid, and concentration of at least one reagent, on said integrated chip.
15. The method of claim 14, further comprising:
 - a) detecting a nucleic acid from the biological sample;
 - b) determining at least one biomarker associated with a person who is the source of the at least one biological sample; and
 - c) based on the at least one biomarker, determining at least one of:
 - i) a dosage of at least one drug to effect therapeutic treatment of a disease condition associated with the at least one biomarker;
 - ii) a combination of a plurality of drugs to effect therapeutic treatment of the disease condition associated with the at least one biomarker; and
 - iii) a determination of whether the person who is the source of the at least one biological sample is a responder to a drug therapy for the disease condition associated with the at least one biomarker.
16. The method of Claim 15 comprising determining at least one of:
 - i) a dosage of at least one drug to effect therapeutic treatment of a disease condition associated with the at least one biomarker; and
 - ii) a combination of a plurality of drugs to effect therapeutic treatment of the disease condition associated with the at least one biomarker;wherein the at least one biomarker is specific to a specific strain of a pathogen or disease, or to a specific health or wellness condition.
17. The method of Claim 16, further comprising determining uniquely at least one of the dosage of the at least one drug and the combination of the plurality of drugs based on the specific strain.
18. The method of Claim 13, further comprising providing information relevant to the condition of a subject, the condition being selected from the group consisting of: sports nutrition of the subject; diet of the subject; a nutritional allergy, deficiency, sensitivity or intolerance of the subject; an inflammatory marker, at least one RNA marker for at least one type of phenotypic expression in the subject; determining at

least one probiotic or prebiotic that is deficient or altered in a microbiome of the subject; a nucleic acid indicative of a type or subtype of diabetes in the subject; a biomarker implicated in an atherosclerotic process in the subject.

19. The method of Claim 13, further comprising diagnosing, classifying, or monitoring a chronic disease via a nucleic acid marker.
20. The method of Claim 13, comprising performing at least one of:
 - point-of-care detection of an infectious disease or a cancer;
 - drug monitoring;
 - precision or personalized medicine;
 - prevention of mother to child transmission;
 - using a device as a prognostic indicator of disease; and
 - using a device as a theragnostic device.
21. The method of Claim 20, comprising performing at least one of: point-of-care detection of an HIV strain, point-of-care HIV viral load determination and point-of-care HIV genotyping.
22. The method of Claim 20, wherein the infectious disease comprises a hemorrhagic fever or hepatitis.
23. A method for analysis of biological samples, comprising:
 - a) providing at least one integrated chip, said integrated chip comprising:
 - a protein extraction module; and
 - a protein detection module, in fluid communication with the protein extraction module,
 - b) loading the at least one biological sample onto the at least one integrated chip;
 - c) operably connecting a portable control assembly with at least one integrated chip, said portable control assembly comprising:
 - a protein extraction control module; and
 - a protein detection control module operably connected with the protein extraction module; and

activating the portable control assembly to effect extraction and detection of protein from the biological sample loaded onto said integrated chip.