Rapid diagnosis of *A. baumannii* is critical for identifying appropriate antibiotic therapy and controlling the spread of infection in a clinical setting. Current commercially available methods for detecting *A. baumannii* infections include phenotypic methods (e.g., VITEK 2, Biomerieux) and DNA-based methods (e.g., PCR amplification of 16s rRNA) (Li P, et al., 2015). However, a need exists for assays that can rapidly detect the presence of *A. baumannii* in biological samples without requiring the use of native phages, which must infect the host bacteria to complete the lytic life cycle and also encounter bacterial host defense mechanisms.

SUMMARY

The present disclosure describes compositions comprising novel bacteriophages specific to *A. baumannii* that have broad host range within this species. In one example, the novel bacteriophage is Abi 33, which belongs in the Myoviridae family. In another example, the novel bacteriophage is Abi 49 or Abi 147, which belong in the Siphoviridae family. The present disclosure also describes the production of non-replicative transduction particles (NRTPs) that exhibit specificity for *A. baumannii* that are derived from the genomes of these novel bacteriophages. Thus, in one aspect, the present disclosure refers to a composition comprising a bacteriophage genome, wherein the bacteriophage genome is derived from a bacteriophage selected from the group consisting of Abi 33, Abi 49 and Abi 147 and wherein the bacteriophage genome contains a disruption of one or more genes that encode packaging-related enzymatic activity. In one example, the one or more genes that encode packaging-related enzymatic activity comprises a terS gene, a terL gene or both terS and terL genes. In one example, the disruption of the one or more genes that encode packaging-related enzymatic activity comprises a deletion of a nucleotide sequence selected from SEQ ID NO: 1, SEQ ID NO: 2 or SEQ ID NO: 3.

The present disclosure also describes a bacterial cell packaging system for packaging a reporter plasmid comprising a reporter gene into a Smarticles non-replicative transduction particle (NRTP) for introduction into an *A. baumannii* cell. In one example, the packaging system comprises a host *A. baumanni* cell, a first nucleic acid construct inside the host *A. baumannii* cell comprising or consisting of a bacteriophage genome having a disruption of one or more genes that encode packaging-related enzymatic activity, wherein the disruption prevents packaging of the bacteriophage genome into the NRTP, and wherein the bacteriophage genome is selected from the group consisting of the genome of bacteriophage Abi 33, the genome of bacteriophage Abi 49, and the genome of bacteriophage 147, and a second nucleic acid construct inside the host *A. baumannii* cell, which is separate from the first nucleic acid

construct, said second nucleic acid construct comprising a reporter nucleic acid molecule having a reporter gene and one or more genes that encode packaging-related enzymatic activity that complements the disruption on the bacteriophage genome and facilitates packaging of a replicon of the reporter nucleic acid molecule into the NRTP. Thus, in one aspect, the present disclosure refers to a bacterial cell packaging system for packaging a reporter plasmid comprising a reporter gene into a non-replicative transduction particle (NRTP) for introduction into an *A. baumannii* cell, the packaging system comprising: a host *A. baumannii* cell; a first nucleic acid construct inside the host *A. baumannii* cell comprising a bacteriophage genome having a disruption of one or more genes that encode packaging-related enzymatic activity, wherein the disruption prevents packaging of the bacteriophage genome into the NRTP, and wherein the bacteriophage genome is selected from the group consisting of the genome of bacteriophage Abi 33, the genome of bacteriophage Abi 49, and the genome of bacteriophage 147; and a second nucleic acid construct inside the host *A. baumannii* cell and separate from the first nucleic acid construct, said second nucleic acid construct comprising a reporter nucleic acid molecule comprising a reporter gene and one or more genes that encode packaging-related enzymatic activity that complements the disruption on the bacteriophage genome and facilitates packaging of a replicon of the reporter nucleic acid molecule into the NRTP. In one example, the one or more genes that encode packaging-related enzymatic activity comprises a terS gene, a terL gene or both terS and terL genes. In one example, the disruption of the one or more genes that encode packaging-related enzymatic activity comprises a deletion of a nucleotide sequence selected from SEQ ID NO: 1, SEQ ID NO: 2 or SEQ ID NO: 3. In some examples, the disruption is via deletion, insertion, mutation, or replacement. In another example, the reporter nucleic acid molecule comprises a nucleotide sequence selected from SEQ ID NO: 4, SEQ ID NO: 5 or SEQ ID NO: 6.

In another aspect, the present disclosure refers to a method of producing non-replicative transduction particles (NRTPs) using the bacteria cell packaging system as disclosed herein, comprising the steps of a) inducing a lytic phase of the bacterial cell packaging system as disclosed herein, and b) allowing the replicon of the reporter molecule to be packaged to produce the NRTPs. The present disclosure also describes a method of producing NRTPs from the aforementioned bacterial cell packaging system comprising inducing a lytic phase of the bacterial cell packaging system and allowing the replicon of the reporter molecule to be packaged to produce the NRTPs. In one example, the one

or more genes that encode packaging-related enzymatic activity comprises a terS gene, a terL gene or both terS and terL genes. In one example, the disruption of the one or more genes that encode packaging-related enzymatic activity comprises a deletion of a nucleotide sequence selected from SEQ ID NO: 1, SEQ ID NO: 2 or SEQ ID NO: 3. In another example, the reporter nucleic acid molecule comprises a nucleotide sequence selected from SEQ ID NO: 4, SEQ ID NO: 5 or SEQ ID NO: 6.

In one aspect, the present disclosure also refers to a method of detecting *A. baumannii* in a sample comprising the steps of providing NRTPs derived from bacteriophage Abi 33, NRTPs derived from bacteriophage Abi 49, NRTPs derived from bacteriophage Abi 147, or any combination of the above that are produced by the aforementioned NRTP production method to the sample, providing conditions for the reporter gene to produce a detectable signal, and detecting the presence or absence of the detectable signal to indicate the presence or absence of *A. baumannii*. In one example, the method comprises a step before or after providing NRTPs to the sample of providing an antimicrobial agent to the sample and detecting for the presence or absence of the detectable signal to indicate whether the sample contains *A. baumannii* that is resistant or susceptible to the antimicrobial agent. In one example, the NRTPs comprise a reporter nucleic acid molecule that comprises a nucleotide sequence selected from SEQ ID NO: 4, SEQ ID NO: 5 or SEQ ID NO: 6.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1a shows TEM images of Abi 33 lysate containing 2 populations of Myoviridae phages.