Nontraditional Products for Bacterial Infections in Clinical Development

As of June 2019, an estimated 29 new nontraditional products[1] with the potential to treat or prevent serious bacterial infections were in clinical development. Below is a snapshot of the current nontraditional products pipeline, based on publicly available information and informed by external experts. It is updated periodically, as products advance or are known to drop out of development. Because of the periodic updates, endnote numbers may not be sequential. Please contact **abxpipeline@pewtrusts.org** with additions or updates.

Drug name	Development phase[2]	Company	Type of product	Potential indication(s)[3]
DSTA4637S/ RG7861	Phase 1	Genentech Inc. (member of the Roche Group)/Seattle Genetics Inc./ Symphogen A/S	Antibody-antibiotic conjugate	Bacteremia (*S. aureus*)
MET-2	Phase 1	NuBiyota LLC/Takeda Pharmaceutical Company Ltd.	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections
PolyCAb	Phase 1[8]	MicroPharm Ltd.	Antibody	Treatment of *C. difficile* infections
SER-262	Phase 1	Seres Therapeutics Inc.	Live biotherapeutic product	Prevention of *C. difficile* infections
STEBVax	Phase 1	Integrated BioTherapeutics Inc.	Vaccine	Prevention of toxic shock syndrome from staphylococcal enterotoxin B
514G3	Phase 2	XBiotech Inc.	Antibody	Bacteremia (*S. aureus*)
Aerucin (AR-105)	Phase 2	Aridis Pharmaceuticals Inc.	Antibody	Ventilator-associated pneumonia (*P. aeruginosa*)
Aerumab (AR-101)	Phase 2[4]	Aridis Pharmaceuticals Inc./ Shenzhen Arimab Biopharmaceuticals Co. Ltd.	Antibody	Hospital-acquired pneumonia (*P. aeruginosa* serotype 011)
CAL02	Phase 2[6]	Combioxin SA	Virulence inhibitor (liposome)	Community-acquired bacterial pneumonia (*S. pneumoniae*)
CP101	Phase 2	Finch Therapeutics Group Inc.	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections

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DAV132	Phase 2[6]	Da Volterra	Antibiotic inactivator[5]	Prevention of *C. difficile* infections
Exebacase (CF-301)	Phase 2	ContraFect Corp.	Lysin	Bacteremia including endocarditis (*S. aureus*)
ExPEC4V (JNJ-6387 1860)	Phase 2	Janssen Research & Development LLC/GlycoVaxyn AG (wholly owned subsidiary of GlaxoSmithKline PLC)	Vaccine	Prevention of extra-intestinal pathogenic *E. coli* serotypes O1A, O2, O6A, and O25B infections
GVGH Shigella Sonnei Vaccine (1790GAHB) (GSK3536852A)	Phase 2[6]	GlaxoSmithKline PLC	Vaccine	Prevention of *shigellosis (S. sonnei)*
IMM-529	Phase 2[4]	Immuron Ltd.	Antibody	Prevention and treatment of *C. difficile* infections
MEDI3902	Phase 2	AstraZeneca PLC	Antibody	Prevention of ventilator-associated pneumonia (*P. aeruginosa*)
NDV-3A	Phase 2	NovaDigm Therapeutics Inc.	Vaccine	Prevention of nasal colonization (*S. aureus*), bacteremia,[6] and skin and soft tissue infections[6]
N-Rephasin SAL200 (Tonabacase)	Phase 2[4]	Roivant Sciences Inc./iNtRON Biotechnology Inc.	Lysin	Persistent bacteremia (*S. aureus*)
RBX7455	Phase 2[6]	Rebiotix Inc. (wholly owned subsidiary of Ferring Pharmaceuticals Inc.)	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections
Ribaxamase (SYN-004)	Phase 2	Synthetic Biologics Inc.	Antibiotic inactivator[5]	Prevention of *C. difficile* infections
Suvratoxumab (MEDI4893)	Phase 2	AstraZeneca PLC	Antibody	Prevention of ventilator-associated pneumonia (*S. aureus*)
VE303	Phase 2	Vedanta Biosciences Inc.	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections
PF-06425090	Phase 3	Pfizer Inc.	Vaccine	Prevention of *C. difficile* infections
PF-06482077[7]	Phase 3	Pfizer Inc.	Vaccine	Prevention of pneumococcal disease (*S. pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 8, 9V, 10A, 11A, 12F, 14, 15BC, 18C, 19A, 19F, 22F, 23F, and 33F)

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Drug name	Development phase[2]	Company	Type of product	Potential indication(s)[3]
RBX2660	Phase 3	Rebiotix Inc. (wholly owned subsidiary of Ferring Pharmaceuticals Inc.)	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections, vancomycin-resistant enterococci elimination,[6] and recurrent urinary tract infections, including those caused by multidrug-resistant pathogens[6]
Reltecimod (AB103)	Phase 3	Atox Bio Ltd.	Peptide immunomodulator	Necrotizing soft tissue infections and sepsis-associated acute kidney injury
Salvecin (AR-301)	Phase 3[6]	Aridis Pharmaceuticals Inc./Shenzhen Arimab Biopharmaceuticals Co. Ltd.	Antibody	Ventilator-associated pneumonia (*S. aureus*)
SER-109	Phase 3	Seres Therapeutics Inc.	Live biotherapeutic product	Treatment of recurrent *C. difficile* infections
V114[7]	Phase 3	Merck & Co. Inc.	Vaccine	Prevention of pneumococcal disease (*S. pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, 22F, 23F, and 33F)

For definitions of drug development terms and nontraditional product types, visit:

https://www.pewtrusts.org/en/research-and-analysis/articles/2014/03/12/glossary-for-the-antibiotic-pipeline

Note: The following drugs have been removed from the pipeline. Removed candidates will be included in future updates if development resumes:

June 2019: *S. pneumoniae* next generation vaccine (GSK-2189241A) was discontinued, according to a press release from the company.

December 2018: SA4Ag was removed because development was discontinued, according to a press release from the company.

June 2018: ASN100, GEN 004, Group B *Streptococcus* vaccine, and VLA84 (IC84) were removed because they were no longer included in the research and development pipeline on the company's website.

September 2017: Shigamab and Cdiffense were removed because they were no longer included in the research and development pipeline on the company's website.

Endnotes

1 Products listed here contain at least one component not previously approved in the United States. This pipeline is limited to products with the potential to treat or prevent infections caused by bacterial pathogens considered by the Centers for Disease Control and Prevention to be urgent, serious, or concerning threats (CDC, "Antibiotic Resistance Threats in the United States, 2013," https://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf). All analyses were limited to systemic products (drugs that work throughout the body) and therapies to treat *Clostridioides difficile*-associated disease. Additionally, we excluded drugs to treat mycobacterial infections, such as tuberculosis and *Mycobacterium avium complex*, *Helicobacter pylori*, and biothreat pathogens. Lastly, locally acting therapies such as topical, ophthalmic, and inhaled products were also excluded. Many of the listed products are not likely to be used as a standalone treatment, but as an adjunct to standard-of-care antibiotics.

2 Based on the most advanced development phase for any indication according to trials registered at clinicaltrials.gov, unless direct communication from the company indicated differently. If no trials were included at clinicaltrials.gov, the phase listed on the company website or provided directly by the company is noted.

3 Based on clinical trials currently registered at clinicaltrials.gov, unless otherwise noted.

4 Registered at clinicaltrials.gov, but with no current study sites within the U.S.

5 Ribaxamase is a β-lactamase, which is given orally and prophylactically with an IV antibiotic. Ribaxamase degrades penicillins and cephalosporins (without ß-lactamase inhibitor) in the gastrointestinal tract to minimize collateral damage to the gut microbiome and prevent occurrence of *C. difficile*. DAV132 is an activated charcoal approach, which is given prophylactically and acts to absorb antibiotic residues in the GI tract to minimize damage to the gut microbiome and prevent the occurrence of *C. difficile*. DAV132 is being regulated as a drug by the U.S. Food and Drug Administration, but as a medical device in Europe.

6 Information obtained from the company via a corporate website, news release, and/or direct company communication.

7 Vaccines for *S. pneumoniae* have been approved and widely used. The products in development listed in this table have the potential for expanded serotype coverage.

8 Clinical trial information for PolyCAb is currently registered in the WHO International Clinical Trials Registry Platform (http://apps.who.int/trialsearch/).

For further information, please visit:

pewtrusts.org/antibiotic-pipeline

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