MOLECULAR TEMPLATES

Corporate Presentation I July 2021

(NASDAQ: MTEM)

Forward-Looking Statements

Except for statements of historical fact, the statements in this presentation are forward-looking statements, including, but not limited to, statements regarding the future development of our proprietary Engineered Toxin Body (ETB) technology; statements relating to the development of MT-5111, TAK-169, and MT-6402, and our preclinical pipeline; our utilization of a next-generation ETB scaffold that has been designed to reduce or eliminate the propensity for innate immunity, including CLS, and to reduce the propensity for aggregation; our plans to enter the clinic with multiple candidates; our expected receipt of clinical data; our future cash needs; and statements relating to the outcome of our collaborations as they relate to our ETB platform; whether our collaborators will exercise their options and our receipt of future development, regulatory and sales milestones and royalty payments. These statements constitute "forward-looking statements" within the meaning of Section 27A of the Securities Act and Section 21E of the Securities Exchange Act and are usually identified by the use of words such as "anticipates," "believes," "estimates," "expects," "intends," "may," "plans," "projects," "seeks," "should," "will," and variations of such words or similar expressions. These forward-looking statements reflect our current views about our plans, intentions, expectations, strategies and prospects, which are based on the information currently available to us and on assumptions we have made. Although we believe that our plans, intentions, expectations, strategies and prospects as reflected in or suggested by those forward-looking statements are reasonable, we can give no assurance that the plans, intentions, expectations or strategies will be attained or achieved. Furthermore, actual results may differ materially from those described in the forward-looking statements and will be affected by a variety of risks and factors that are beyond our control. These statements involve risks and uncertainties that can cause actual results to differ materially from those in such forward-looking statements. Important factors that may cause actual results to differ materially from the results discussed in the forward-looking statements include risks and uncertainties, including (1) our failure to secure and maintain relationships with collaborators; (2) risks relating to clinical trials and other uncertainties of product candidate development; (3) risks relating to the commercialization, if any, of our proposed product candidates (such as marketing, regulatory, product liability, supply, competition, and other risks); (4) dependence on the efforts of third parties including our strategic partners; (5) dependence on intellectual property; and (6) risks from global pandemics including COVID-19. Further information regarding these and other risks is included under the heading "Risk Factors" in our filings with the Securities and Exchange Commission available from the SEC's website (www.sec.gov). Existing and prospective investors are cautioned not to place undue reliance on these forward-looking statements, which speak only as of the date hereof. These forward looking statements reflect management’s current views and we do not undertake to update any of these forward-looking statements to reflect a change in events or circumstances that occur after the date of this presentation except as required by law.

MTEM: Developing Novel Therapeutics With a Unique Platform

Unique MOA

Engineered Toxin Bodies (ETBs) have the specificity of an antibody, can induce their own internalization, and are designed to act through a potent and unique mechanism of action(s): ribosomal destruction, antigen seeding

Global Partners

BMS: Multi-target collaboration (oncology)

Takeda: Multi-target collaboration (oncology)

Vertex: Multi-target collaboration (myeloablation)

Advancing Pipeline

POC with 1st-Gen ETB (CD20) demonstrated forced internalization, clinical activity. Two 2nd-Gen ETBs (HER2, CD38) and one 3rd-Gen ETB (PD-L1) in Phase 1 with improved activity, tolerability, and manufacturability over 1st-Gen.

Future Opportunities

ETB platform provides continued pipeline opportunities via partnerships and internal development. Next-Gen ETBs in preclinical development against targets including CTLA-4, TROP-2, SLAMF-7, CD45, CD20

Known Targets for Early Signs of Tolerability and Response

ETBs against validated targets can provide evidence of tolerability and response as early as Phase 1

Strong Cash Position

Current cash funds operations into 2H23

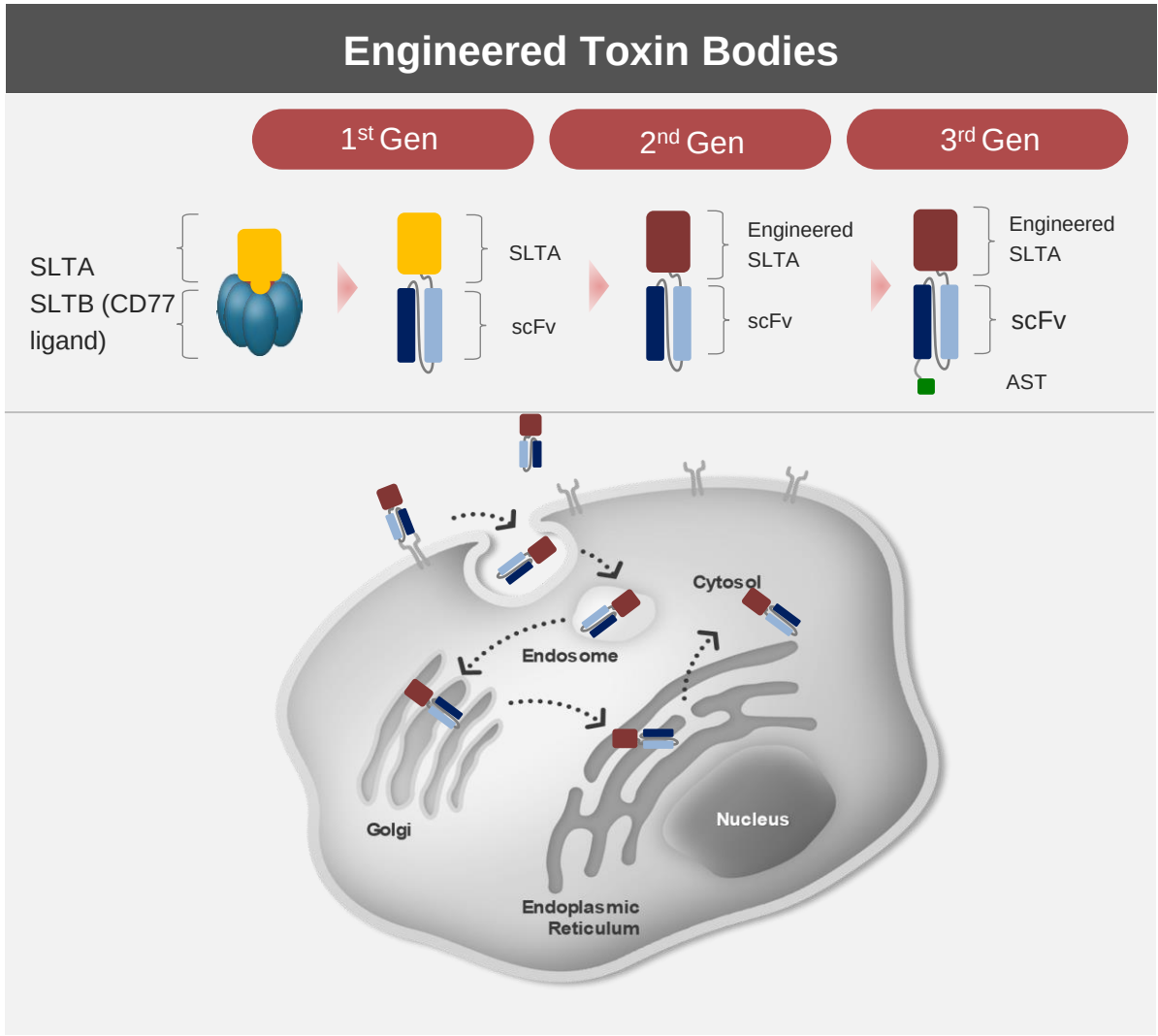
ETBs: Novel Mechanisms of Action in Oncology

ETBs use an antibody domain for targeting genetically fused to a de-immunized SLTA

- ETBs can be made to bind any extracellular target
- ETBs retain the SLTA-mediated:
  - Internalization (even against non-internalizing targets)
  - Routing to the cytosol
  - Enzymatic and irreversible destruction of ribosome

Iterative improvements made to ETB scaffold

- Clinical validation of forced internalization and activity with 1st-Gen ETB (MT-3724)
  - MT-3724's increased propensity for aggregation led to decision to discontinue
- 2nd-ETBs have been engineered to have:
  - Increased potency
  - Decreased adaptive immunity
  - Decreased innate immunity via reduced TLR4 affinity
  - Reduced propensity for aggregation
- 3rd-Gen ETBs have all the properties of the 2nd-Gen and can specifically alter the immunophenotype of tumor cells via antigen seeding technology (AST)



Oncology Pipeline With Novel MOAs Driven by ETB Platform

Program	Ownership	Indication (Target)	Preclinical	Phase 1	Phase 2	Phase 3
MT-5111	MOLECULAR TEMPLATES	Multiple – solid tumors (HER2)				
TAK-169	MOLECULAR TEMPLATES	Multiple Myeloma (CD38)				
MT-6402	MOLECULAR TEMPLATES	Multiple – solid tumors (PD-L1)				
CTLA-4	MOLECULAR TEMPLATES	Multiple – solid tumors (CTLA-4)				
TROP-2	MOLECULAR TEMPLATES	Triple-negative MBC (TROP-2)				
SLAMF-7	MOLECULAR TEMPLATES	Multiple myeloma (SLAMF-7)				

Completed In-Progress

2nd-Generation ETBs

Increased Potency; Better Tolerability; Reduced Aggregation

Next-Gen ETBs Designed to Have Significantly Improved Potency, Safety, Developability

	1st-Gen ETB (MT-3724)	Next-Gen ETBs
Potency	Nanomolar	Pico to sub-picomolar • Improvements via ETB structure engineering
Toxin Scaffold	Wild-type SLTA	SLTA Engineered for reduced innate and adaptive immunogenicity
Therapeutic Index	NHP Tox: HNSTD < 150 ug/kg[a] **Therapeutic Index** Nanomolar IC_{50}	NHP Tox: HNSTD > 500 ug/kg[b] **Therapeutic Index** Pico to sub-picomolar IC_{50}
Payload delivery	None	Delivery of viral antigens (Antigen Seeding)
Manufacturing	Complex Propensity for aggregation due to unpaired cysteine and intermediate (mixed diabody and monobody) scFv linker length	Streamlined No unpaired cysteine; short (diabody) or long (monobody) linker length

a) HNSTD due to innate immunity
b) For next-gen ETBs, HNSTD has been due to highest does tested, not toxicity

2nd-Generation ETBs

MT-5111 / HER2

MT-5111: A 2nd-Generation HER-Targeted ETB

HER2 TARGETED

Single-chain variable fragment (scFv) with specificity to HER2. Binds a distinct epitope from trastuzumab/pertuzumab

SMALL SIZE FOR BETTER PENETRATION

55 kDa versus ~145 kDa for Mabs/ADCs

DEIMMUNIZED PAYLOAD

De-immunized SLTA payload for reduced innate and adaptive response. Reduced TLR4 interaction to minimize innate triggering (CLS)

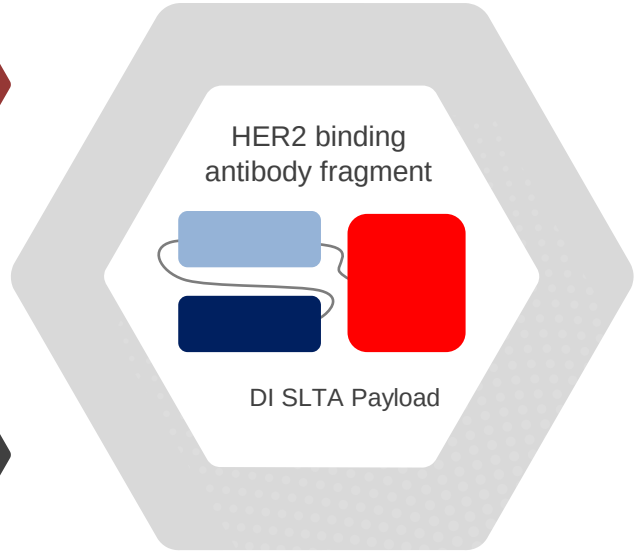
NOVEL ENZYMATIC PAYLOAD

Primary mechanism of cell-kill - enzymatic ribosome destruction. pM potency against HER2+ cells

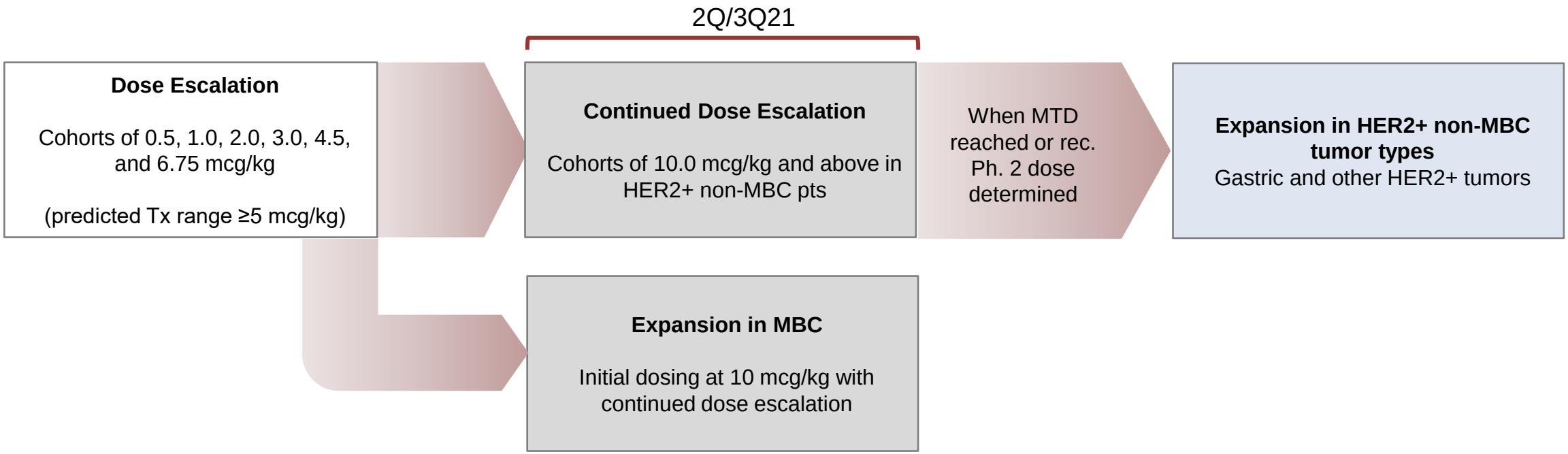
OTHER PROPERTIES

Fusion protein; no linker chemistry. Short serum half-life; irreversible intra-cellular effects

MT-5111:
2nd-Generation ETB



MT-5111 Phase 1 dose Escalation Ongoing



- Tumor types enrolled include MBC (n=6; all ≤3 µg/kg); biliary (n=6); pancreatic (n=2); one colon and one GE junction
  - 1 pt w/ MBC (1 µg/kg) w/ unmeasurable disease by RECIST remained on tx for 10 cycles w/ SD, had 3 sub-cm lesions that disappeared at cycle 8
- No DLTs or cardiotoxicity have been observed to date
- 10 mcg/kg cohort is on-going; expansion cohort for breast cancer expected to initiate shortly
  - HER2 ADCs required dose escalation of ~10-fold above starting dose in 3+ HER2 MBC/gastric patients before observing activity

2nd-Generation ETBs

TAK-169 / CD38

TAK-169: A 2nd-Generation CD38-Targeted ETB

CD38 TARGETED

Single-chain variable fragment (scFv) with specificity to CD38. Binds in the presence of daratumumab

FORCED RECEPTOR INTERNALIZATION

Efficient internalization against CD38, a poorly-internalizing receptor

DEIMMUNIZED PAYLOAD

De-immunized SLTA payload for reduced innate and adaptive response. Reduced TLR4 interaction to minimize innate triggering (CLS)

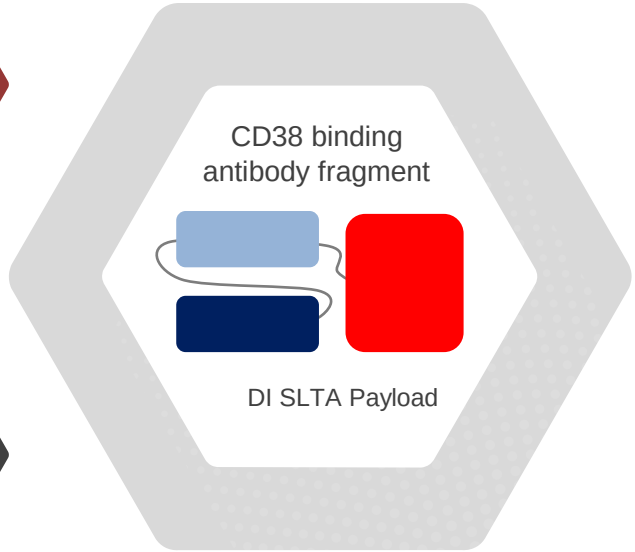
NOVEL ENZYMATIC PAYLOAD

Primary mechanism of cell-kill - enzymatic ribosome destruction. pM potency against CD38+ cells, including Dara-refractory cells

OTHER PROPERTIES

Fusion protein; no linker chemistry. Short serum half-life; irreversible intra-cellular effects

TAK-169:
2nd-Generation ETB



TAK-169 Update: MTEM to Assume Full Rights to Program

- **On April 5th, 2021, MTEM announced that it would be assuming full rights to the TAK-169 program**
  - Takeda communicated that its decision to turn over full rights of TAK-169, was the result of ongoing portfolio prioritization
- **Study update**
  - Takeda has enrolled and treated four subjects in the Phase 1 study since the first patient was dosed in Feb 2020
  - No CLS or life-threatening toxicities; MTD has not been reached, patient screening continues, and dose escalation is ongoing
  - One DLT (grade 2 myocarditis) seen in one pt. A mild elevation in Troponin I observed in pt after the third dose of TAK-169
    - No EKG or echocardiographic abnormalities and no clinical symptoms were noted
    - A stable elevation in high-sensitivity troponin was seen although no comparison to baseline was available
    - An independent radiologist and cardiologist reviewed the imaging in the case and concluded that there was weak to intermediate evidence of myocarditis. The subject had multiple pre-existing cardiac risk factors
    - No other cardiac adverse events were observed in any other subject
  - Pharmacokinetic and pharmacodynamic data of this first cohort have been in-line with predicted outcomes
- **Budget impact and economics**
  - MTEM's assumption of the full rights to TAK-169 is expected to result in cost savings in 2021
  - Upon transfer of the full TAK-169 rights to MTEM, per the terms of the collaboration agreement, MTEM will owe Takeda low-single digit royalties on future net sales of TAK-169
  - Full transfer of program in progress
    - Anticipation of additional sites being opened with interim data read by year's end

3rd-Gen ETBs / Novel Approach to IO

MT-6402: PD-L1 targeting ETB with antigen seeding

MT-6402: A 3rd-Generation ETB Targeting PD-L1+ Tumor and TME Immune Cells

PD-L1 TARGETED

Single-chain variable fragment (scFv) with specificity to PD-L1. Binds PD-L1 on tumor and immune cells.

FORCED RECEPTOR INTERNALIZATION

Efficient internalization against PD-L1, a poorly-internalizing receptor.

DEIMMUNIZED PAYLOAD

De-immunized SLTA payload for reduced innate and adaptive response. Reduced TLR4 interaction to minimize innate triggering (CLS)

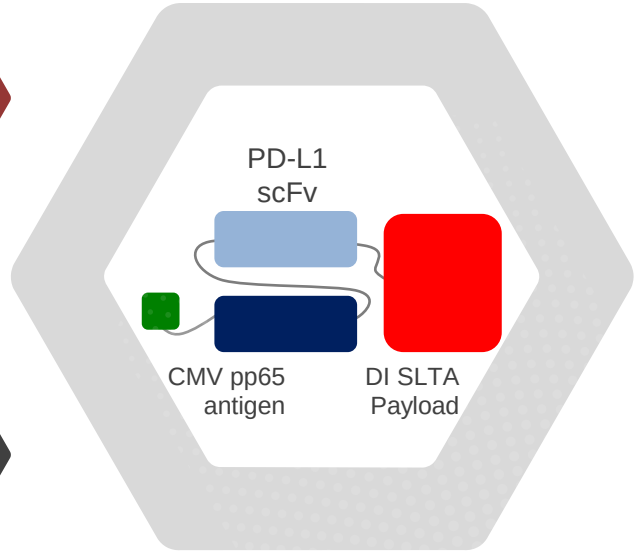
NOVEL ENZYMATIC PAYLOAD

pM direct cell-kill potency against PD-L1+ tumor and immune cells. All other checkpoint agents rely on indirect cell kill of tumor cells and have no activity against PD-L1 immune cells.

ANTIGEN SEEDING

MT-6402 induces expression of foreign class I pp65 antigen on surface of HLA-A2 tumor cells.

MT-6402:
3rd-Generation ETB



MT-6402: Phase I Study Initiated

- **First patient dosed 7/8/21**
  - Eligibility based on presence of PD-L1+ tumor and/or immune cells in TME
  - No restrictions on tumor type
  - Patients must have progressed on approved therapies including any indicated checkpoint inhibitors before MT-6402 therapy

- **Starting dose of 16 mcg/kg**
  - No class toxicity concerns with PD-1 or PD-L1 targeted-therapy (unlike HER2)
  - Starting dose is predicted to have pharmacodynamic effects in patients
  - Multiple sites open with good enrollment projected

- **Interim data expected by year's end**

ETBs and IO: PD-L1 ETB in the Clinic; Potential New IO Targets in the Works

Potent effect on PD-L1+ tumor cells and immune cells

- Direct cell-kill on tumor cells through ribosomal destruction (MOA1) independent of tumor microenvironment
- Novel alteration of cancer cell immunophenotype for pre-existing, synaptic T-cell recognition of tumor (MOA2)
- Early in vivo and in vitro data suggest potent activity on PD-L1 immune cells and activation of immune system

Exploration of additional IO targets where ETB approach may provide substantial differentiation

- CTLA4 lead development work underway; Phase 1 start expected in 2022
- Potential safety and efficacy benefits around direct cell-kill of CTLA4+ T cells vs blocking

Engineered Toxin Bodies

A Robust Pipeline with Clinical Data in 2021

Robust Clinical Pipeline Supporting Value of Drug Candidates and Platform