PRINT® NANOPARTICLE VACCINE CARRYING BACTERIAL POLYSACCHARIDE AND PROTEIN ANTIGENS INDUCES ENHANCED B- AND T-CELL (IL-17) IMMUNITY

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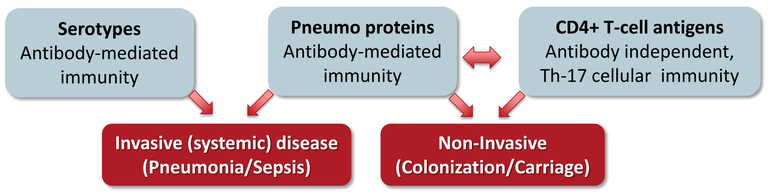
Liquidia's Pneumo Program with PATH (PVS) offers a capitally efficient path to address a significant global health

Goal: Advance a vaccine with better protection against infection and colonization/carriage



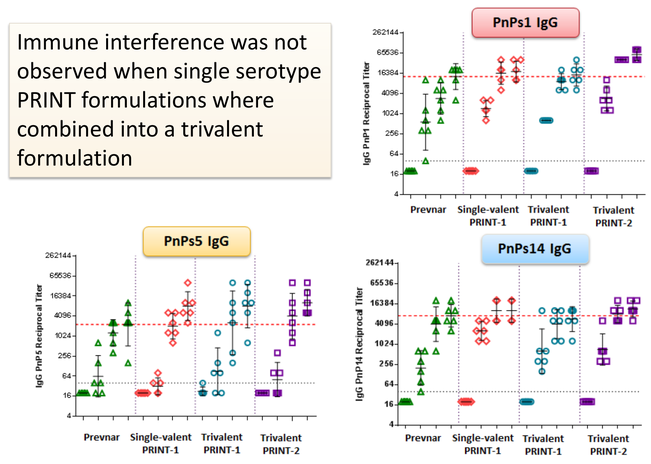
- The PRINT nanoparticle platform offers enhanced vaccine performance through the incorporation of novel proteins
- In addition to improved performance, the PRINT approach offers development, manufacturing and cost advantages over traditional conjugates

PRINT Technology offers a new paradigm for broadened efficacy, more affordable and simplified manufacturing for multivalent Pneumococcal Vaccines

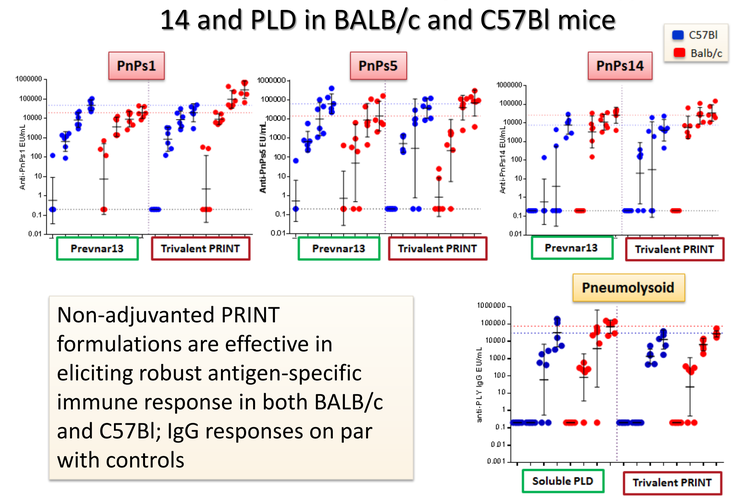
- PRINT platform provides broad multi-antigen formulation flexibility; potential for broadened efficacy
  - Liquidia has demonstrated POC on at least 7 strains vs. Prevnar13; potential for high probability of success with remaining Prevnar13 serotypes
  - PRINT trivalent formulations consistently generate significantly strong antibody responses to Prevnar-13 for the 3 serotypes of focus (1, 5, 14)
  - Initial efforts with new strains provide further PoC for multi-strain flexibility
- Multiple PRINT formulations generate anti-protein IgG and neutralizing antibodies
  - Demonstrated with a second pneumococcal protein; immune response are chemistry independent
  - Immune response can be optimized through chemistry and addition of alum
- PRINT offers additional benefit by inducing protein-specific IL-17 cytokine response, a key marker in reduction of carriage

Trivalent PRINT formulations maintain elevated IgG levels when compared to single valent formulation

Immune interference was not observed when single serotype PRINT formulations where combined into a trivalent formulation

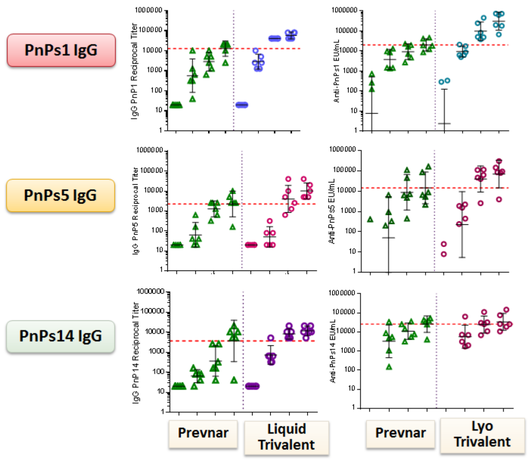


PRINT formulations are immunogenic for serotypes 1, 5, 14 and PLD in BALB/c and C57Bl mice



Non-adjuvanted PRINT formulations are effective in eliciting robust antigen-specific immune response in both BALB/c and C57Bl; IgG responses on par with controls

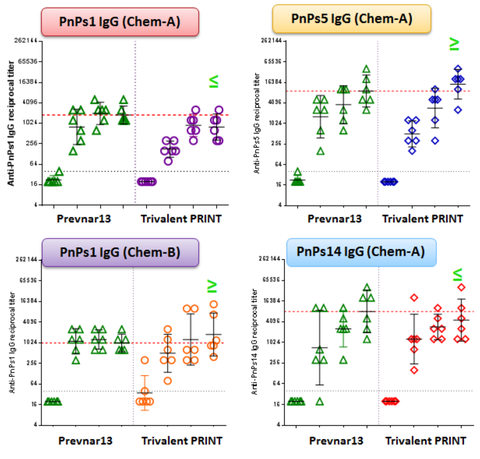
Lyophilization of PRINT formulations does not diminish the immunogenicity of antigens



- Lyophilized PRINT formulations induces strong immune response when compared to freshly prepared liquid formulation

Non-adjuvanted PRINT formulations induce eqiuivalent response to Prevnar13 in rabbits

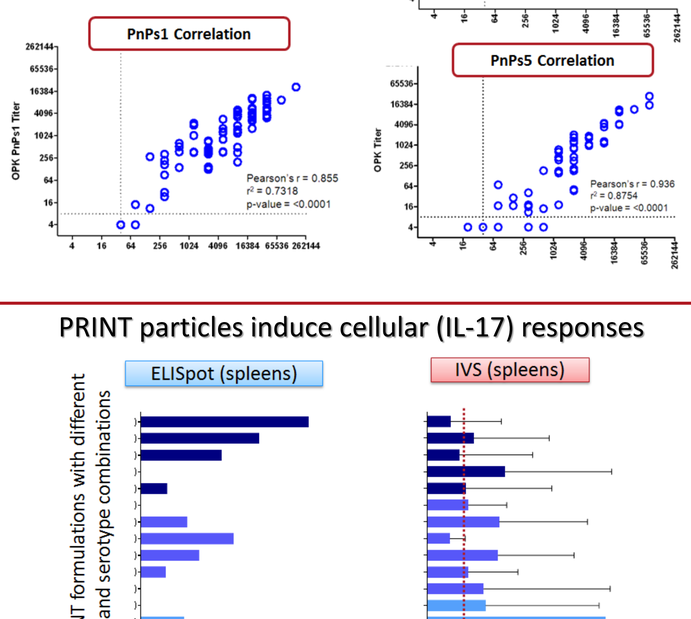
- Immunogenicity trends similar to mice
- Serotype-specific responses are chemistry independent
- IgG response correlates strongly with OPK titers



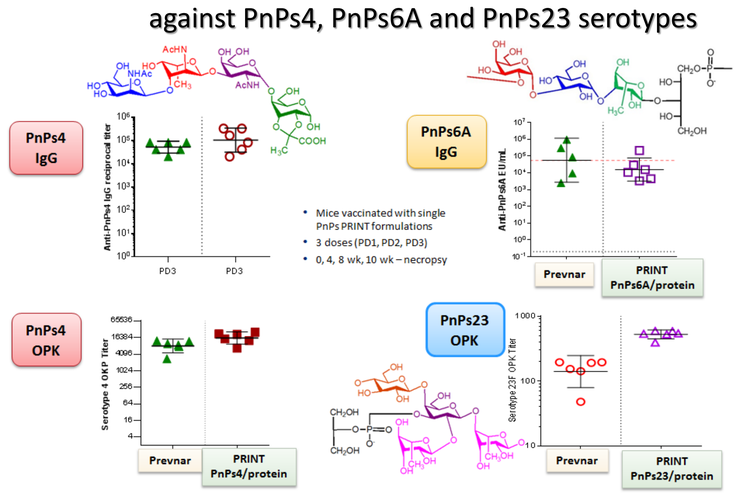
- Rabbits immunized I.M
- 3 injections, 10 wk study day1, 29, 57, 70* (term blds)
- PRINT doses: 1.1 ug of PnPs5, 14/dose 2.2 ug of PnPs1/dose

IgG response correlates strongly with OPK titers

- PRINT formulations show consistently high correlations between the IgG responses and functional OPK responses for all 3 strains

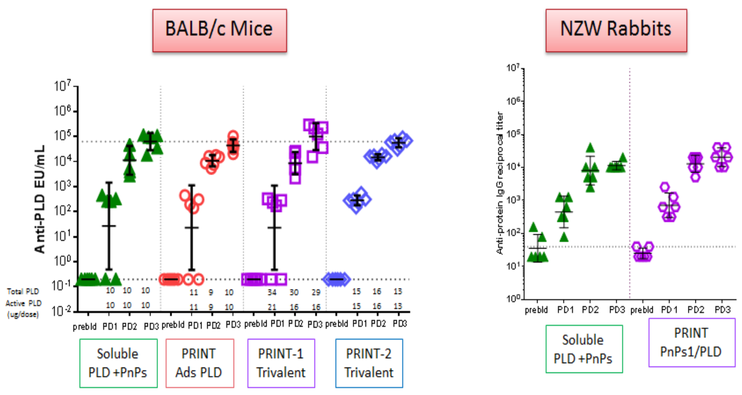


PRINT nanoparticles elicited a strong immune response against PnPs4, PnPs6A and PnPs23 serotypes



Subtle PRINT design changes results in efficient antigen presentation enhancing the PnPs response

Pneumolysoid serves as a highly functional carrier protein and immunogen in mice and rabbits

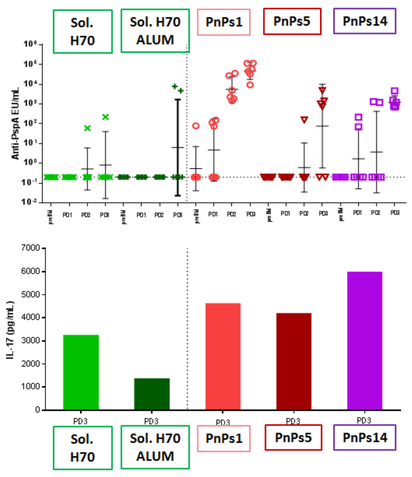


- Non-adjuvanted PRINT formulations elicit robust anti-protein response in mice and rabbits
- Immunogenicity of PLD maintained in PRINT formulations (single and trivalent)
- The protein response can be modulated, IgG response is chemistry dependent

PRINT particles induce cellular (IL-17) responses

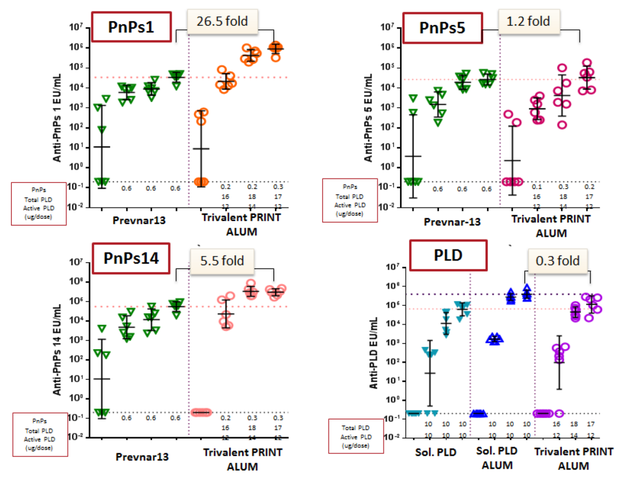
- PRINT particles with antigenic cargo (protein/PnPs) induce detectable IL-17 levels (> 250 pg/mL) following stimulation when compared to soluble protein antigen

PRINT formulations effectively drive Pneumo protein-2 specific antibody (IgG) and cellular (IL-17) response

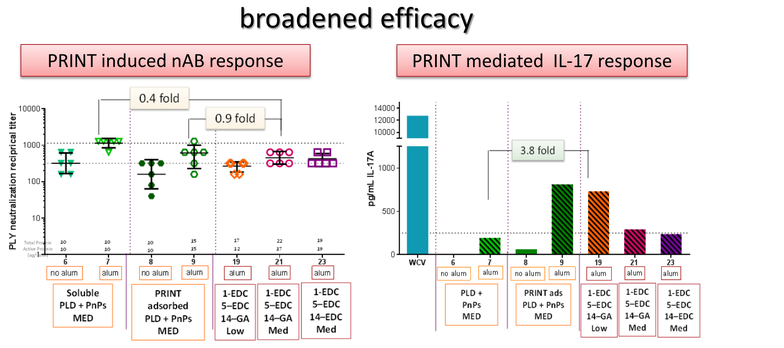


- Pneumo Protein-2 construct shows enhanced IgG in PRINT formulations vs. soluble control, immune response chemistry independent
- PRINT formulations mediate IL-17 cellular response; protein-2 may be a more effective IL-17 inducer than protein-1
- PRINT process demonstrates a wide-ranging multi-antigen formulation ability; potential for broadened efficacy

Lead PRINT trivalent formulation consistently generates enhanced antigen specific IgG response in mice



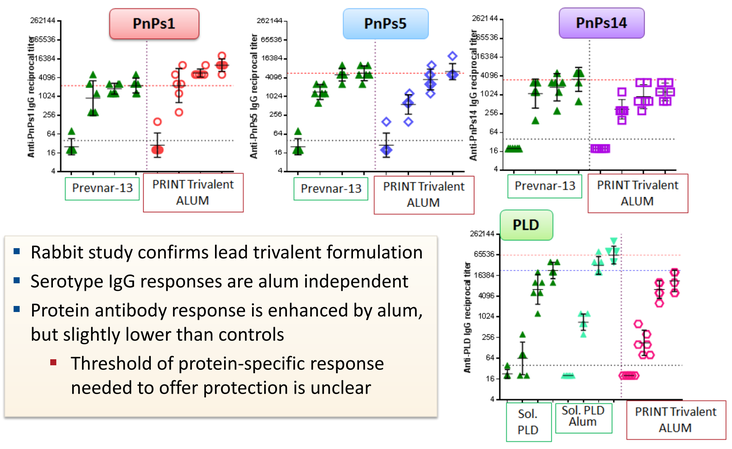
Lead PRINT formulations effectively drive protein specific neutralizing antibodies and cellular response allowing for broadened efficacy



- PRINT particles maintain most of the protective capacity of protein antigen to induce neutralizing Ab responses (neutralize the hemolytic activity)
- Alum may be a critical component in enhancing protein nAb responses

PRINT particle-mediated co-delivery of Pneumo protein(s)/TLR agonist provides additional benefit by generating enhanced IL-17 response when compared to soluble protein antigen (with/without alum)

PRINT formulations consistently elicit greater than or equal to immune responses to Prevnar13 in rabbits



- Rabbit study confirms lead trivalent formulation
- Serotype IgG responses are alum independent
- Protein antibody response is enhanced by alum, but slightly lower than controls
  - Threshold of protein-specific response needed to offer protection is unclear

80x320 nm Sterile Filterable PRINT Nanoparticle formulations

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