Protozoan parasites cause multiple non-self-limiting infections and neglected diseases of high morbidity and mortality worldwide. Most parasites contain complex glycosylphosphatidylinositol glycolipids (GPIs) and GPIs anchoring (glyco)proteins to the cell membrane. All GPIs contain a glycan, a phosphoethanolamine, a phospholipid core structure, and cell-specific modifications in the glycan and lipid parts. These glycolipids play an essential role as immunomodulators of the host's immune system during infections and induce the formation of anti-GPI antibodies. To investigate the potential of GPI glycolipids in the diagnosis and development of anti-parasitic vaccines, we are establishing strategies to synthesize GPIs, GPI derivatives, and natural and non-natural GPI-protein glycoconjugates. We evaluate the application of these molecules in biomedical research. This presentation will introduce strategies for synthesizing GPIs from parasites such as Plasmodium falciparum, Trypanosoma cruzi, Toxoplasma gondii, and humans. It will cover the preparation and evaluation of GPI-glycoconjugates for determining immunogenic epitopes in P. falciparum GPIs. It will also show the evaluation of these glycolipids in the folding and activity of the naturally glypiated proteins MSP1-19 from Plasmodium falciparum and Thy-1 from humans. The presentation will include an example of the application of GPIs in a bead-based multiplex assay to detect toxoplasmosis and the progress for a microarray-based detection of trypanosomiasis.