TWO COMPLEMENTARY GOVERNANCE APPROACHES TO MAXIMZING NET SOCIETAL BENEFIT FROM SYNTHETIC BIOLOGY

Adam M. Finkel, Andrew D. Maynard, Diana Bowman and Ben Trump

When policy-makers consider whether to expressly regulate, ban, or encourage a new application of synthetic biology (SynBio), the traditional risk-benefit decision paradigm poses a narrow question with a dichotomous answer: does the application create benefits in excess of any risks it also creates? In contrast, a "solution-focused" paradigm begins with the human need that a spectrum of applications can variously fulfill, and asks a broad and comparative question: does the SynBio application provide *marginal* benefits, over and above those offered by existing alternatives, that justify any marginal risks it creates? We have applied this framework to five SynBio applications: (1) field release of genetically modified mosquitoes to reduce the incidence of dengue fever: (2) producing ethanol in modified algae; (3) engineering human gastrointestinal flora to produce a biofilm that may protect against cholera; (4) creating an engineered virus as a rodenticide; and (5) producing isoprene in *E. coli*. By placing them on the spectrum containing the current approaches to a given challenge, each of these applications' effects on risk reduction, creation of new or exacerbated risks, economic development, and other human and ecological factors can be compared. In general, we see a useful analogy to previous proposals to regulate "me-too" drugs (those that differ only slightly structurally and functionally from existing drugs) differently from new molecular entities—where the SynBio application offers radically increased efficacy, our tolerance for novel downside risks might reasonably be greater than when it yields a slight variant on an existing product.

In exploring these case studies and framework, we also see a role for a "why not?" complement to the "why?" questions posed above. In addition to taking as given the roster of SynBio applications vying for market share and regulatory approval, society might ask whether there are unfulfilled human needs that cry out for a new SynBio alternative. For example, while bio-isoprene may be a minor variant on conventional isoprene chemistry, palm oil is a product with an enormous environmental and public health footprint that a SynBio substitute could displace with great marginal benefit.

This presentation will summarize the results of our solution-focused case studies, and offer several examples of "why not?" applications and governance mechanisms that might accelerate their development (e.g., grand challenge prizes, advance payments by government to become the seller of a product whose potential developers are reluctant).