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The Applicability of Chemical Alternatives Assessment for Engineered Nanomaterials

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The use of alternatives assessment to substitute hazardous chemicals with inherently safer options is gaining momentum worldwide as a legislative and corporate strategy to minimize consumer, occupational, and environmental risks. Engineered nanomaterials represent an interesting case for alternatives assessment approaches as they can be considered both emerging "chemicals" of concern, as well as potentially safer alternatives to hazardous chemicals. However, comparing the hazards of nanomaterials to traditional chemicals or to other nanomaterials is challenging and critical elements in chemical hazard and exposure assessment may have to be fundamentally altered to sufficiently address nanomaterials. The aim of this study is to assess the overall applicability of alternatives assessment methods for nanomaterials and outline recommendations to enhance their use in this context. This study focuses on the adaptability of existing hazard and exposure assessment approaches to engineered nanomaterials as well as strategies to design inherently safer nanomaterials. We argue that alternatives assessment for nanomaterials is complicated by the sheer number of nanomaterials possible. As a result, the inclusion of new data tools that can efficiently and effectively evaluate nanomaterials as substitutes are needed to strengthen the alternatives assessment process. However, we conclude that with additional tools to enhance traditional hazard and exposure assessment modules of alternatives assessment, such as the use of mechanistic toxicity screens and control banding tools, alternatives assessment can be adapted to evaluate engineered nanomaterials both as potential substitutes for chemicals of concern and to ensure safer nanomaterials are incorporated in the design of new products.