Understanding secondary droplet formation from fluid fragmentation is critical for industrial, environmental, and health processes including for predicting and controlling the transport of pathogen-bearing droplets created from contaminated fluids or surfaces. Despite the complexity and diversity of modes of unsteady fluid fragmentation into secondary droplets, universality across geometry and fluid systems emerges. We discuss results from our joint experimental and theoretical investigations elucidating the role of unsteadiness in shaping a ubiquitous, yet neglected class of fluid fragmentation problems. In particular, we revisit fundamental assumptions of hydrodynamic instability and reveal how unsteadiness and multi-scale dynamics couple to select the sizes and speeds of secondary droplets generated. Implications for human health and food safety are discussed.

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