

PARTICLE DEPOSITION

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WIDE RANGE OF AEROSOL SIZES

10 μm

1 μm

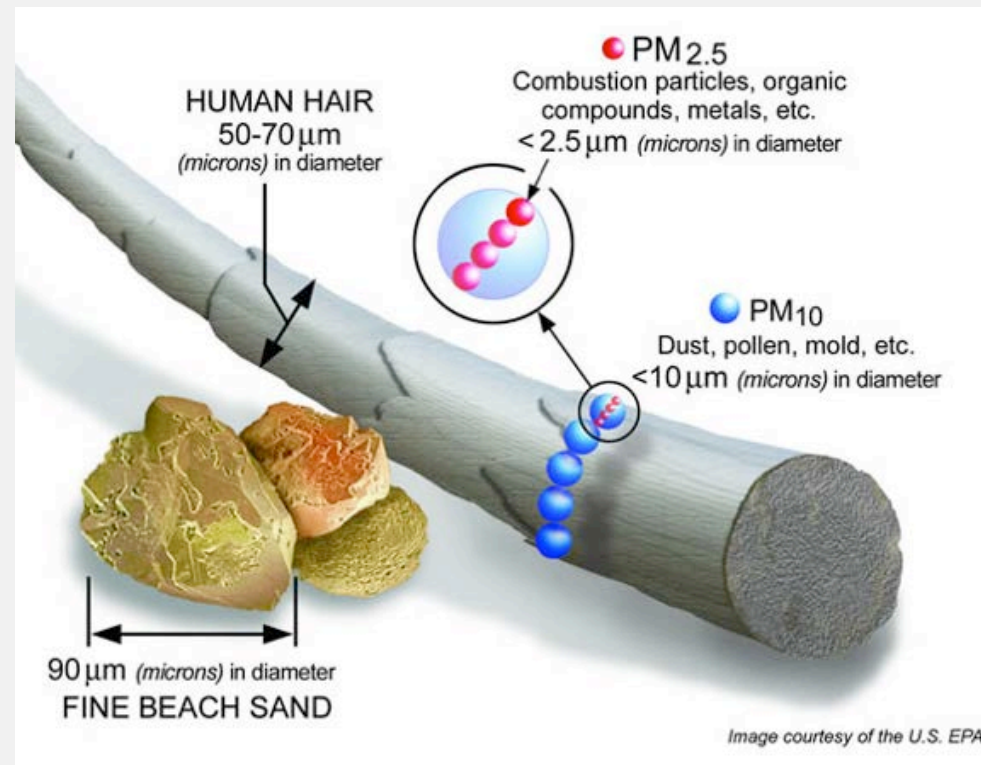
100 μm



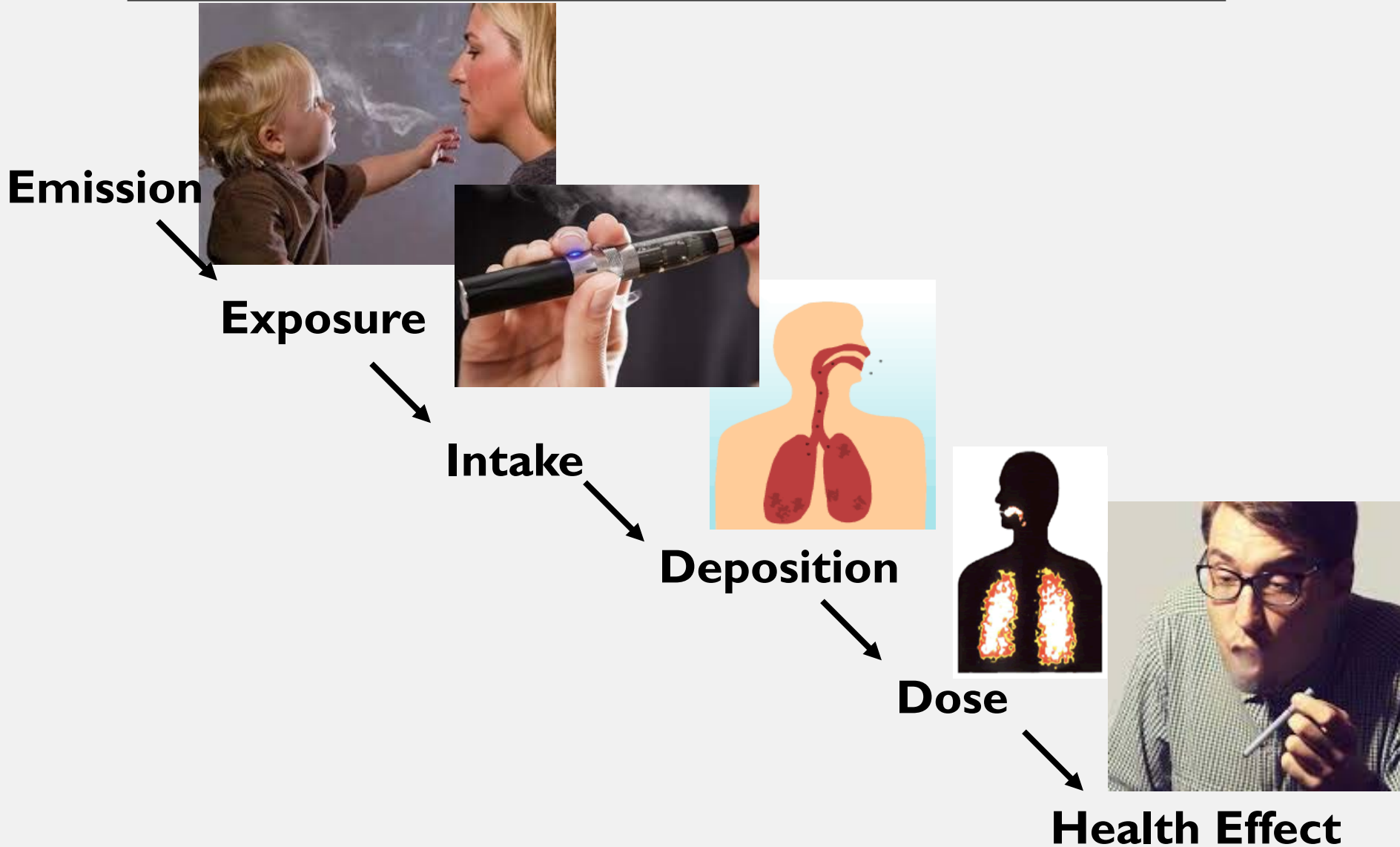
0.1 μm

ULTRAFINE PARTICLES

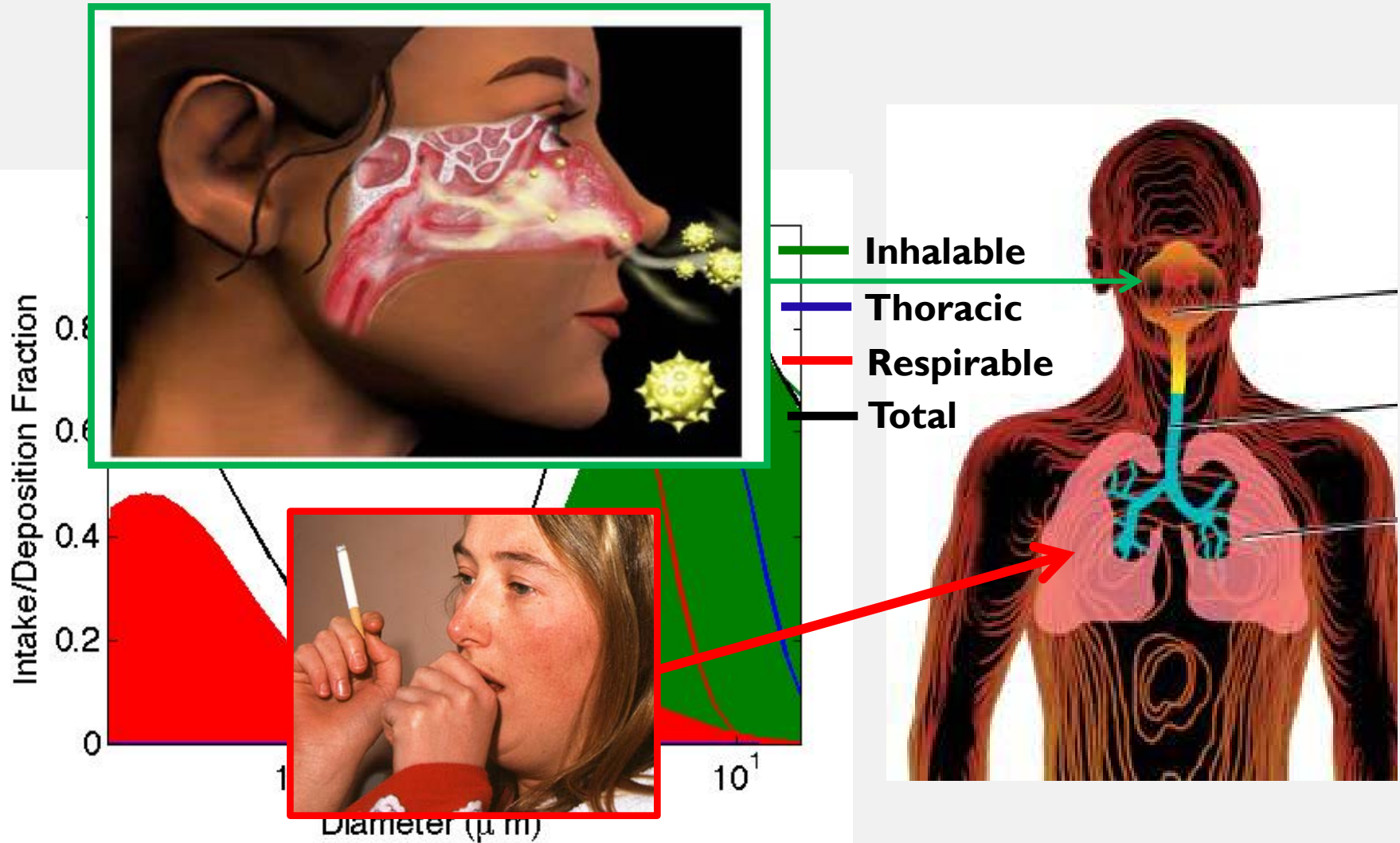
- Ultrafines ($d < 100\text{nm}$) penetrate deep into respiratory tract
- Can cross alveolar cell membranes and enter the systemic circulation and translocate to other areas of the body, including the brain
- Associated with inflammatory effects, are less well phagocytized compared to larger particles, and may inhibit phagocytosis by alveolar macrophages



EMISSION TO HEALTH EFFECT



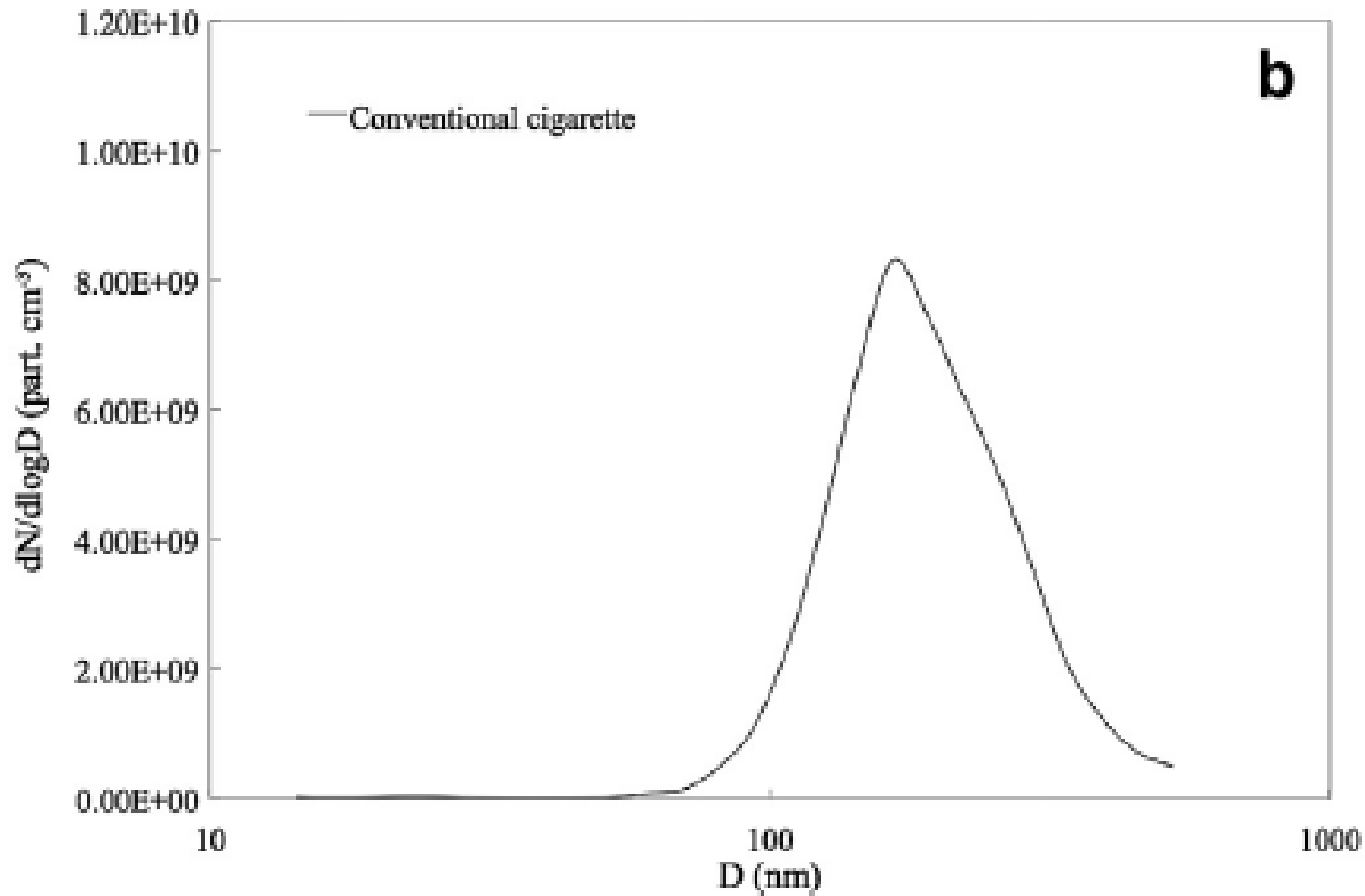
WHERE PARTICLES DEPOSIT MATTERS



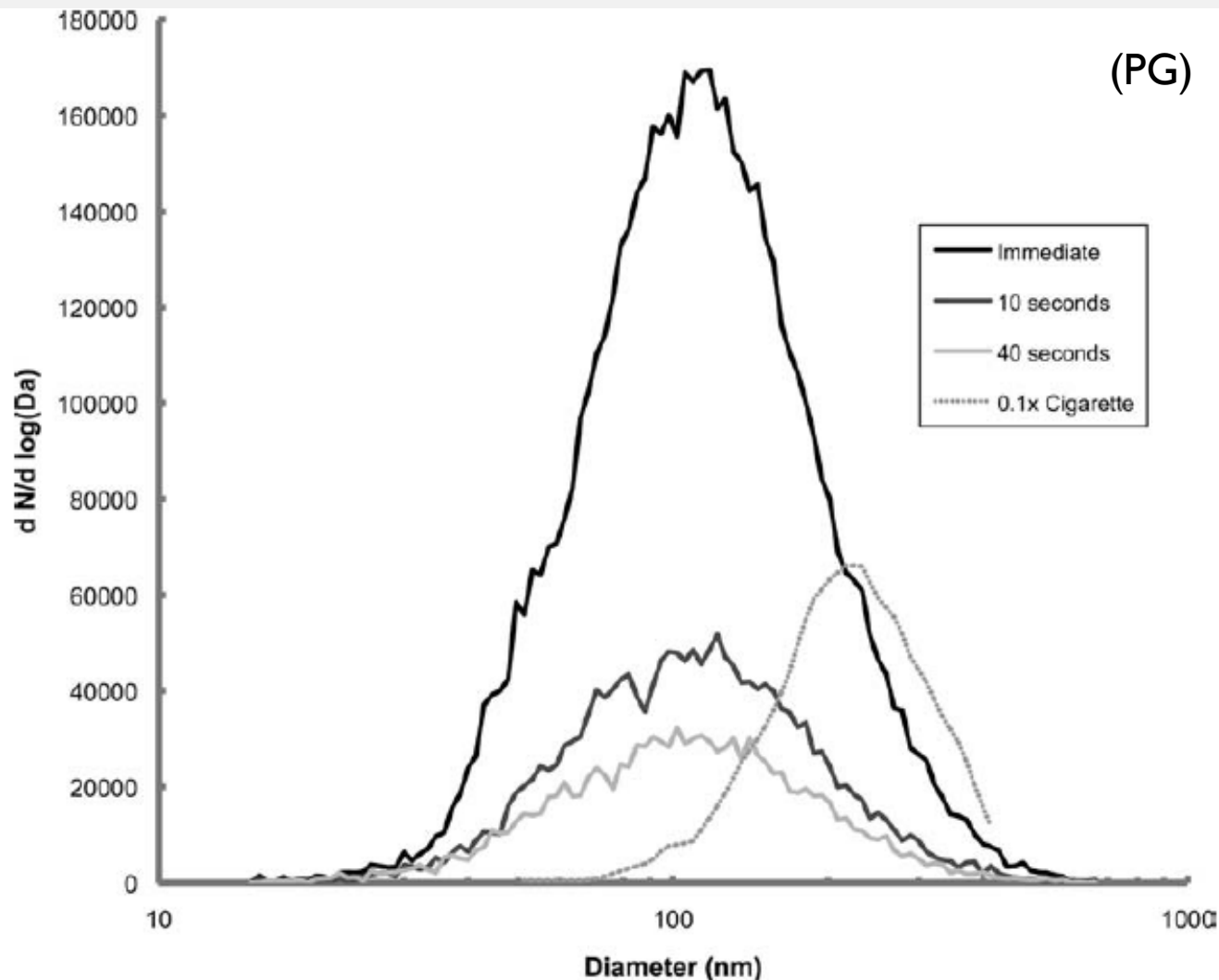
CHALLENGES MEASURING PARTICLE SIZE DISTRIBUTION

- Many differences between e-cigarettes may impact size distribution:
 - Carrier (PG or VG)
 - Nicotine content
 - Flavorings
 - Physical properties: rechargeable/disposable, Temperature, Puffing time/volume
- Experimental conditions may change the size distribution
 - Dilution and size of chamber
 - Time between puff and measurement
 - Temperature/humidity

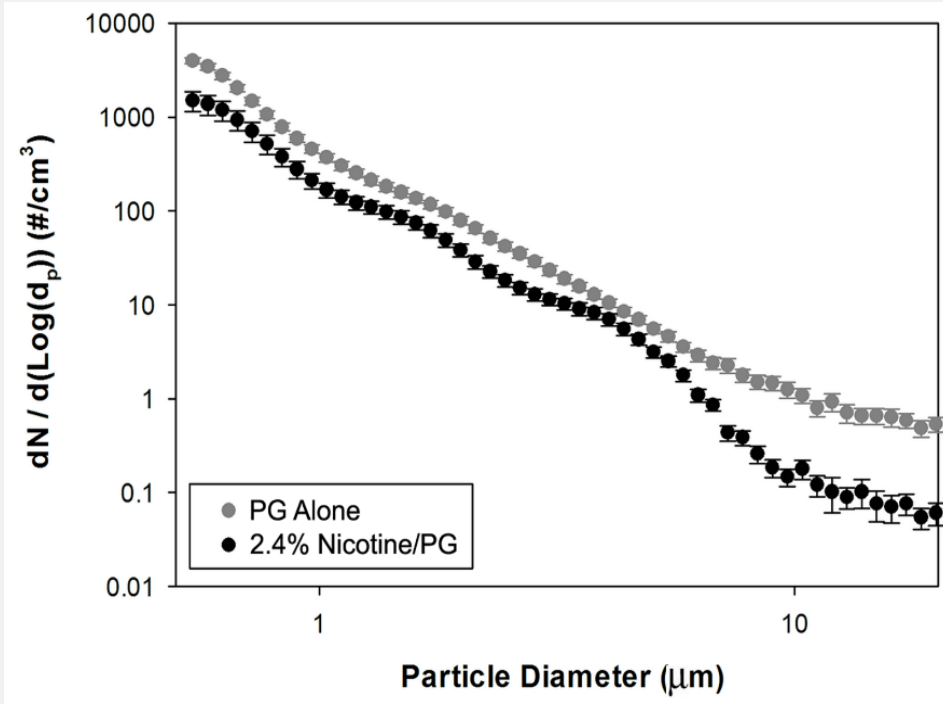
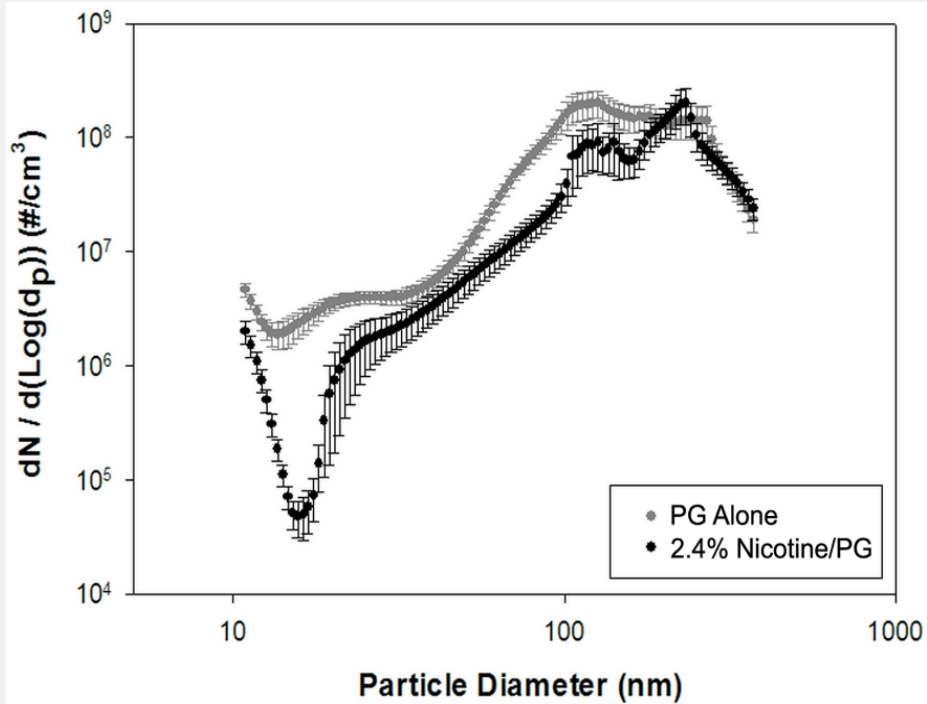
INHALED SIZE DISTRIBUTION



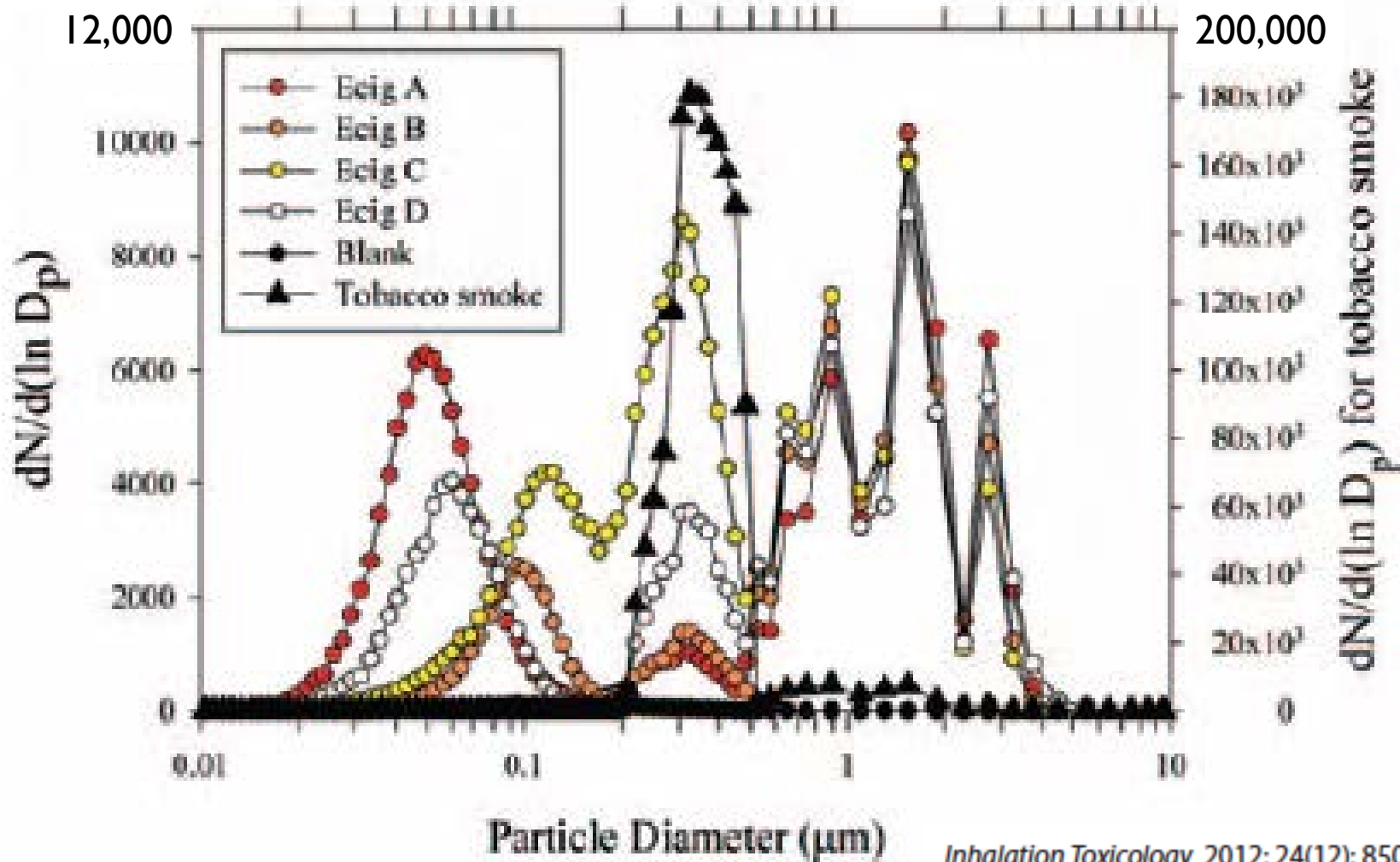
INHALED SIZE DISTRIBUTION



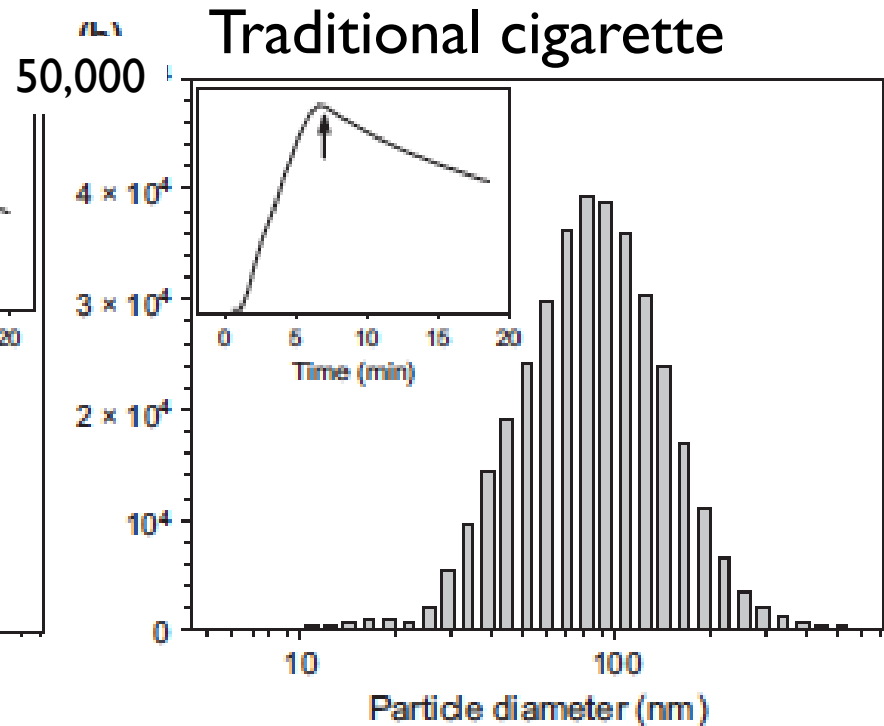
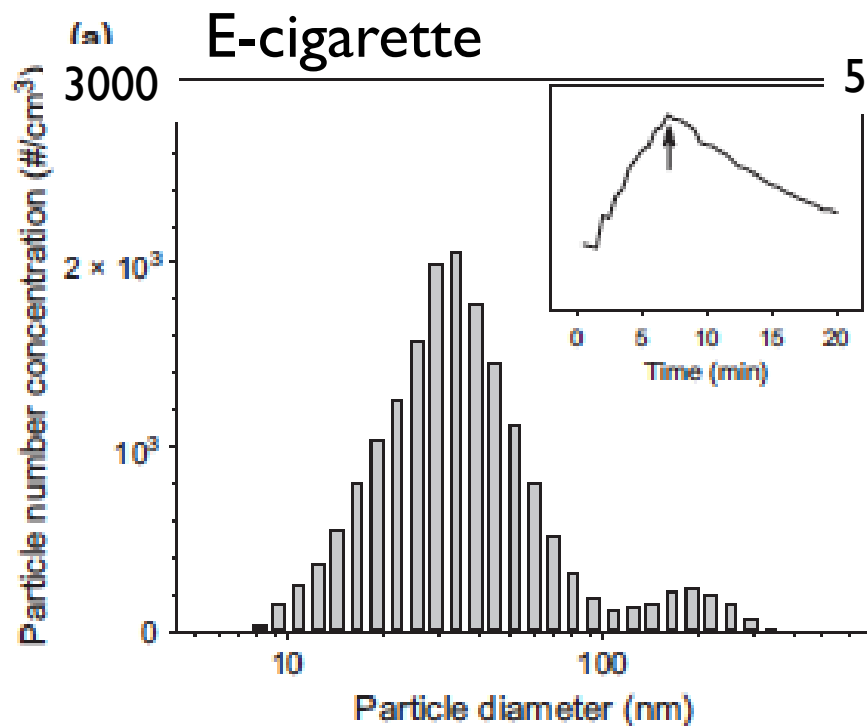
SIZE DISTRIBUTION IN SMALL EXPOSURE CHAMBER (IL)



SIZE DISTRIBUTIONS IN A MID-SIZED CHAMBER (~500L)



IMPACTS ON INDOOR AIR (8 M³)



PARTICLE DEPOSITION

Vehicle	Condition	Head	TB	Alv	Exhaled
PG	Single puff	9	3	12	75
	Steady-state	13	2	10	74
VG	Single puff	15	2	10	74
	Steady-state	15	2	9	74
Tobacco cigarette	Single puff	18	2	11	69
	Steady-state	22	2	11	65

CHALLENGES ESTIMATING PARTICLE DEPOSITION

- Most models (e.g. ICRP) based on deposition in healthy adults. Majority of data for healthy men.
- Deposition may be different for those with respiratory conditions.
- Uncertainties related to size distribution

CONCLUSIONS

- Large proportion of particles from e-cigarettes will be exhaled (~75%)
- Inconsistencies between existing studies:
 - Some studies find total number concentrations for e-cigarettes are comparable to tobacco cigarettes, Other studies have found much lower concentrations (10%), especially when measuring in larger volumes
 - Variable changes in size with nicotine content and other device differences
- Few studies have characterized many products using the same setup.