Summary of health effects based on studies in humans:

[Extract from a published Monash University report]

It is usual that most health risk assessment projections for humans are based on extrapolations from animal studies. The above sections highlight some of the difficulties in extrapolating such data for PFOA and PFOS, especially in a quantitative sense because of the differences in clearance kinetics.

The primary objective of this section of the report is to review the available evidence suggesting adverse health effects in humans that may be attributable to PFAS exposures. In some instances, the toxicological endpoint of interest is predicted by findings in conventional animal toxicity studies, where the exposures are substantially higher than human exposures arising from background sources (e.g. food) or point sources of pollution. In other cases, the endpoint of interest is not predicted by findings from such studies.

Since 2007-09, the publication of epidemiological studies and other surveys of human exposures have begun to shed more light on the extent to which high dose studies in conventional toxicity studies animals predict potential adverse health effects in humans. Relatively few of these human studies are conventional epidemiological studies and they are mainly of a cross-sectional nature, rather than the more robust case-control studies. However, most of the studies reviewed in this section have addressed the issues by comparing the incidence of disease, or a disease marker, between the highest and lowest quartile or tertiles of the distribution of blood concentrations of PFAS. Essentially, these studies investigate the potential for a dose-related trend in the incidence of an adverse health outcome.

The reported outcomes are therefore ‘associations’ which vary in strength, but there is often doubt as to whether the association can be deemed to be ‘causal’. A common problem with the interpretation of these studies is that, in most cases, the adverse health outcome is assessed against several congeners of the PFAS that have been measured in blood, with multiple studies often demonstrating associations with individual PFAS (e.g. PFOS, PFOA, PFHxS etc), but where the specific PFAS with the strongest associations differing from study to study. In some cases there is also inconsistency across studies with regard to either the direction of the change or the specific disease marker associated with increasing PFAS blood levels.

While these studies in humans have begun to suggest some adverse health effects in those carrying the highest body burdens of PFOS, PFOA of some other PFAS, the evidence generally falls short of proving a causal relationship (Saikat et al, 2013). In some cases, the adverse effects are consistent with those seen in

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animals (e.g. the lipid and foetal developmental effects), while other effects on serum uric acid, and possibly the neurobehavioural developmental effects (possibly mediated via disturbance of thyroid hormone functions?) have not been observed in animal studies.

Most of these human studies have assessed the health impacts of PFAS in populations with relatively low (background) blood levels. There are also a few studies where the groups studied have been exposed to point sources of pollution. For example, the C8 Health study generated a number of papers on residents who lived around the DuPont Washington Works PFAS production facility near Parkersburg, West Virginia, that contaminated water supplies with PFOA in the mid-Ohio Valley and neighbouring regions. The project enrolled around 69,030 people, and measured blood levels of PFOA were generally up to 10-100x higher than in the general U.S. population, while six other PFAS (including PFOS) were generally more towards general population levels (Frisbee et al, 2009).

In contrast, conventional epidemiological studies have often failed to demonstrate comparable health deficits in workers exposed occupationally to PFAS, despite these workers having body burdens 1-2 orders of magnitude higher than the general population (Olsen et al, 2003). In a review of the state of epidemiological knowledge at 2010, Steenland et al (2010a) acknowledged that most of the associations reported at that time were modest, inconsistent across studies and PFAS analysed, and required further confirmatory research using larger cohorts.

The full report is available at the following website: