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British American Tobacco

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Reducing smokers' exposure to cigarette smoke toxicants

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It is well established that the risks of smoking are greater in people who smoke more cigarettes per day and for longer periods. It therefore makes sense that inventing cigarettes with substantially less toxicants in the smoke might reduce some of the health risks.
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Our first clinical study results
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Here we describe the results of our first clinical study of prototype cigarettes containing several new technologies designed to reduce toxicants in smoke.
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We have tested prototype cigarettes with new technologies designed to reduce smoke toxicants

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The results show that we can reduce certain toxicant exposure levels, a crucial first step,
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but we do not know whether this is meaningful in terms of health risks.

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What's in a conventional cigarette?
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Reducing the risks of smoking is made difficult by the very complex nature of tobacco and tobacco smoke.
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A basic cigarette consists of a tobacco rod and filter.
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Burning it produces smoke, which is made up of nicotine and thousands of other combustion products, of which about 150 are thought to be toxicants.
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Although the only way to avoid these toxicants and the associated health risks is not to smoke,
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we think it might be possible to reduce some of the risks by substantially reducing levels of smoke toxicant exposure.
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Our prototype cigarettes are produced using four technologies,
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two of which are associated with the tobacco.
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The first is a process designed to remove natural tobacco proteins that become toxicants when burned.
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The tobacco is mixed with water and the resulting solids and liquid extracts separated.
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The liquid is passed through a resin to remove specific toxicant precursors in a manner similar to a water filter.
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The solid extract is treated with a proteolytic enzyme that breaks down proteins into smaller molecules that are water soluble and are washed away.
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After the enzyme has been deactivated, the liquid extract is added back to the treated tobacco fibre and dried.
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This process reduces the levels of molecules like polyphenols and proteins.
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This reduces the cigarette smoke levels of phenols, aromatic amines, hydrogen cyanide and some other nitrogenous toxicants.
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The second technology produces a non-tobacco sheet that is made from chalk and alginate, a seaweed extract, and loaded with glycerol.
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When mixed with tobacco and burned, the glycerol dilutes the resulting smoke and machine tests show that this reduces the levels of most measured tobacco smoke constituents.
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There are also two new filter technologies.
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A standard filter is made from cellulose acetate, a cotton-like material derived from wood cellulose.
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Charcoal is sometimes incorporated to improve the filter's ability to reduce certain volatile compounds. This charcoal or carbon is commonly derived from coconut shells.
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We have worked with our partners to develop an even more efficient carbon.
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This polymer-based carbon has a huge internal surface area –
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the amount used in one filter has an internal surface area equivalent to one-third of a tennis court.
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This allows for very effective trapping of certain smoke toxicants deep in the carbon pores.
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In another collaborative project, we have adapted a resin used in water filtration to reduce toxicants not efficiently captured by the carbon filter,
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such as aldehydes formed when polysaccharides in the leaf are burned and hydrogen cyanide formed when nitrogenous compounds are burned.
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These aldehydes and hydrogen cyanide, for example, stick to this resin.
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We have taken these four technologies and combined them in different ways to make three different prototype cigarettes.
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Tests in the lab using smoking machines showed that all three prototypes yielded substantially reduced levels of many volatile toxicants compared to conventional cigarettes.
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Reductions in the particulate phase toxicants were variable and depended on the tobacco technology used.
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Testing prototypes: What effect do reductions in the smoke toxicants have on smokers' exposure?
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We then conducted a clinical study to see what effect these reductions might have on smoker's exposure to toxicants.
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Of 300 volunteers, 50 were non smokers, and allowed us to assess background levels since exposure to some toxicants stems from dietary and environmental sources
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for example, exposure to pyrene from cooked meats.
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The remaining volunteers were smokers.
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150 smokers of conventional 1mg cigarettes
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100 smokers of conventional 6mg cigarettes
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They were divided into groups of 50, all of whom started the study smoking conventional cigarettes.
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Some were switched to prototype cigarettes after 14 days.
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50 non smokers
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50 smokers of conventional 1mg cigarettes
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50 smokers of Prototype A 1mg cigarettes
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50 smokers of Prototype B 1mg cigarettes
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50 smokers of conventional 6mg cigarettes
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50 smokers of Prototype C 6mg cigarettes
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We measured the levels of certain chemical compounds, called ‘biomarkers of exposure’, in urine and saliva samples collected from these participants.
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Biomarkers of exposure consist of the toxicants themselves or their metabolites.
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Generally, the higher the levels found in urine and saliva, the greater the smokers’ exposure to the toxicant, depending on individual metabolic differences.
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The results show that in comparison to smokers of conventional cigarettes those who switched to the prototypes had statistically significant reductions in exposure to certain toxicants.
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All prototypes were successful in reducing volatile toxicants such as acrolein and one, three butadiene,
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and the reductions in exposure were greater and sometimes much greater than 50 per cent.
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We found that one prototype was particularly successful at reducing tobacco-specific nitrosamines by around 90 per cent,
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as well as a significant reduction in exposure to the carcinogens 3- and 4-aminobiphenyl by around 40 per cent.
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Our first clinical study of prototype cigarettes therefore demonstrates that it is possible to reduce smokers' exposure to certain tobacco smoke toxicants,
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but we don't know whether this will lead to a reasonable expectation of reduced risk.
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Our pursuit of technologies to improve the risk profile of smoking and tools to assess them continues today.
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We are currently preparing to undertake a longer-term clinical study of our next generation of reduced toxicant prototype cigarettes.
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We hope to determine whether reductions in exposure can be sustained over a longer period of time and whether these reductions have any meaning in connection with the risk of smoking.
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Our journey is riddled with scientific uncertainties.
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While we are excited about work to date, we know that we have a tremendous amount of research and testing to do.
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