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CLYDE ESTUARY'S POLLUTION SECRETS AI EFFORTS TO TACKLE THE RISE OF ANTIOMICROBIAL RESISTANCE

BY JOHN BYNORTH

THE secrets of the Clyde estuary have been dredged by environmental scientists searching for a breakthrough in the fight against Antimicrobial Resistant Organisms (AMR)

Samples taken from a 30-mile stretch of the Clyde's banks from the Cuningar Loop in Rutherglen to Greenock have been analysed for levels of heavy metals (or Potentially Toxic Elements - PTE) and polycyclic aromatic hydrocarbons (PAH) to determine pollution dating back as far as the mid-19th century.

The multi-disciplinary research project has been run by the Natural Environment Research Council (NERC) over the past two years and represents a collaboration between the University of the West Scotland's (UWS) Institute of Biomedical and Environmental Health Research (IBEHR) in Paisley and Dr Charles Knapp in the University of Strathclyde's Department of Civil and Environmental Engineering.

Together, the group of microbiologists, geochemists and environmental engineers hope to establish from their samples the environmental factors behind the rapid development of AMRs and other bacteria which are not just associated with antibiotics.

The lead investigator for one of the projects is Professor Fiona Henriquez from UWS.

She explained to the EPS Newsletter how the project had evolved.


Professor Fiona Henriquez

Professor Henriquez has been working with Professor Andrew Hursthouse, Professor of Environmental Geochemistry and Head of Physical Sciences at the university, who is also a member of the EPS board of trustees. He guided his colleague in the identification of 19 sites for research, including the King George V docks in Govan and Erskine Harbour for sampling.

Professor Henriquez, who specialised in the biological side of the project, said: "We are trying to understand what environmental factors may then influence the development of AMR and bacteria that are not just associated with antibiotics. It is a misconception that AMR is solely associated with antibiotics.

"We are looking at the historical anthropogenic aspect to see how it accelerates the process.

"We've literally dug deep and we have such an interesting patch next to us with the Clyde. We thought it was a worthy place to study."

She said the Cuningar Loop, now a forestry park, was a fascinating location to begin the fieldwork due to its past history as the site of a paper mill.

In total, 150 samples were taken at field study points between Greenock and the Science Centre in Glasgow.

But other locations along the estuary also threw up specific challenges to the investigators, such as the King George V graving dock. It is no longer as busy as it was during its shipbuilding building heyday, but remains a working dock.

They found it was impossible to access for sampling purposes due to the dock's concrete base.

Other areas such as Greenock have high levels of potentially cancerous Polycyclic Aromatic Hydrocarbons (PAHs) that are typically found wherever substances such as coal have been burned in industrial heartlands.

Professor Henriquez added: "We had a list of places to conduct the fieldwork and chose them based on historical reasons such as their locations as shipyards and ports.

"Professor Hursthouse had a very clear idea of where to sample along the Clyde based on previous British geological survey data. We used that information and associated with the risk of AMR as well (to establish the best places to visit).

Samples were taken from the mud and sediment on the Clyde estuary's banks with investigators taking two approaches, one of which involved equipment previously used in Antarctica to break through ice.

Professor Henriquez added "We tried to get 50 cm (under the river bed), but the problem is the sediment at these locations is very different (to where it is shallower)

"Some areas are sandy and others consist of gravel. We cut the sediment into about 5-10cm (sized pieces) so that we could analyse their geo-chemistry. We also isolated bacteria and isolated amoebae (that can also harbour bacteria).

"We started to look outside of the bacterial realm and at other micro-organisms as well."

Professor Henriquez said the samples were carefully stored in a freezer at a laboratory and the biological and chemistry analysis was carried out separately on the items.

She added: "If we found high levels of zinc then bacteria present may be resistant to high levels of zinc.

"That association could mean they become resistant to Penicillin because they developed a resistance to metal.
"The biological samples were sent for DNA analysis to identify what antibiotic resistance gene is associated with the metal we detected."

She is grateful for the support of Dr Kiri Rodgers in UWS IBEHR, who acted as a conduit to the project's various elements.

She said Dr Rogers, Dr Iain McLellan, a lecturer in Environmental Chemistry at UWS IBEHR (who also sits on the EPS Board of Trustees), Rebecca Tonner and Tatyana Peshkur of the University of Strathclyde attended every field study during the project.

However, the group ran into problem at the King George V Docks as the graving dock had cement banking making it impossible to collect sediment from the area.

Prof Henriquez said dating the samples collected had proved a difficult process, but the teams believed the oldest could date back to 1852, although she stressed this has still to be verified.

The main task now is to ensure accurate correlation of the data before the report is published, which Professor Henriquez is hopeful will allow the study to be issued later in the summer.

She stressed that care is needed when putting such sensitive studies into the public domain to ensure its accuracy, given the current levels of concern about AMR.

The UWS and Strathclyde research teams recently presented a paper on their studies to date at a group meeting of various NERC AMR projects at the UWS in Paisley. Delegates included representatives of Health Protection Scotland, SEPA, UK-wide institutions and Professor Dame Anne Glover, the former Chief Scientist at the European Commission.

Their presentation was entitled 'Genes of past, present and future: does legacy pollution contribute to antibiotic resistance in industrialised estuaries?'

Professor Henriquez said it was a good opportunity to share details of their work. She added: ""Everyone working on AMS resistance in agriculture and the environment got together to share some of their results and data and find a way forward."

She hopes the study will feed into future policies to mitigate against AMR.

Professor Henriquez added: "There is potential for a monitoring process so we can understand the veracity of the problem.

"Our study has only looked at the Clyde estuary, but the way in which AMR accelerates may have implications in other countries and environments."

She said that although the shipyard industry has declined, it still existed on the Clyde and there may be current pollution aspects. She added that the impact of plastics and microplastics on AMRs was worth examining in the future.

Professor Henriquez added: "We hope this (the research) is an initial step in enabling surveillance and to change the policy base to influence the government to support the environmental agencies. It's about providing evidence to say we can do something about AMR…"

In April, the team won best research prize at a Scottish Universities Lifescience Alliances (SULSA) conference on AMR.

Prof Henriquez added: "The judges highlighted the link between the history and the sociological aspect and the environment, and biological side of the project. They found the inter-disciplinarily of the project intriguing which was great for us."

Researchers from the University of the West of Scotland take samples from the Clyde estuary at Erskine Harbour in Renfrewshire as part of the study into how pollution contributes to