

Role of medical advances in population longevity improvement. A case study on statins.

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About the speaker



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- Research Grant on the Use Of Big Health And Actuarial Data For Understanding Longevity And Morbidity Risks by the Consortium of UEA and Aviva Life Plc funded by the IFoA Actuarial Research Centre 2016-2020



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Quantifying longevity changes



- Medical advances are the major drivers in the longevity increase. But how to quantify this relationship?
- Our research uses The Health Improvement Network (THIN) primary care data, to develop statistical models of longevity.
- The advantage of using individual-level medical data is that it is possible to model both the uptake of medical treatment and the effect of that treatment on longevity conditional on the individual sociodemographic and health factors instead of the aggregated profile.

Recent changes in mortality improvements



“From 1968-2010, 70% of all mortality improvements can be attributed to the fall in deaths from circulatory diseases.

...

The period 2011-16 saw much lower mortality improvements in circulatory diseases.”

Jon Palin on behalf of the CMI Mortality Projections Committee,
Mortality improvements in decline *The Actuary*, 2017/08

Drivers of these changes



- But what were the drivers of this rapid improvement and the consequent decline in longevity improvement rates?
- We show that these developments in longevity are mainly due to statins, cholesterol lowering drugs prescribed to prevent cardiovascular disease (CVD).

Data

- The Health Improvement Network (THIN) data
 - Medical records from primary care
 - Representative of the UK when adjusted for deprivation
- All patients born before 1960 and followed to 01.01.2017, this includes 3.5 million patients
- Added various social economic status variables such as Townsend score, IMD and Mosaic



New Guidelines on Primary prevention of CVD

Primary prevention: no previous history of CVD

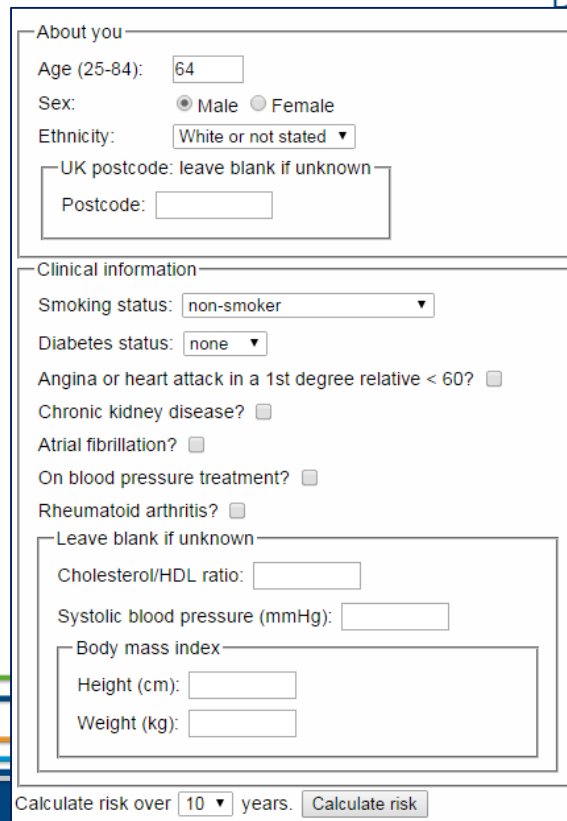
- Example: lipid-lowering therapy - statins

National Institute of Health and Clinical Excellence (NICE):

- *Offer atorvastatin 20 mg for the primary prevention of CVD to people who have a 10% or greater 10-year risk of developing CVD.*
- *Estimate the level of risk using the QRISK2 assessment tool*
- www.nice.org.uk/guidance/cg181/
- www.qrisk.org/2016/



Up to 17 million UK residents eligible for statins



The image shows a screenshot of the QRISK2 assessment tool form. It is divided into two main sections: 'About you' and 'Clinical information'. The 'About you' section includes fields for Age (25-84), Sex (Male/Female), Ethnicity (White or not stated), and UK postcode. The 'Clinical information' section includes fields for Smoking status, Diabetes status, and several checkboxes for medical conditions: Angina or heart attack in a 1st degree relative < 60?, Chronic kidney disease?, Atrial fibrillation?, On blood pressure treatment?, and Rheumatoid arthritis?. Below these are fields for Cholesterol/HDL ratio, Systolic blood pressure (mmHg), and a section for Body mass index (Height in cm and Weight in kg). At the bottom, there is a field for 'Calculate risk over' (set to 10 years) and a 'Calculate risk' button.

About you

Age (25-84): 64

Sex: ☒ Male ☐ Female

Ethnicity: White or not stated

UK postcode: leave blank if unknown

Postcode:

Clinical information

Smoking status: non-smoker

Diabetes status: none

Angina or heart attack in a 1st degree relative < 60? ☐

Chronic kidney disease? ☐

Atrial fibrillation? ☐

On blood pressure treatment? ☐

Rheumatoid arthritis? ☐

Leave blank if unknown

Cholesterol/HDL ratio:

Systolic blood pressure (mmHg):

Body mass index

Height (cm):

Weight (kg):

Calculate risk over 10 years. Calculate risk

Design and Data Selection

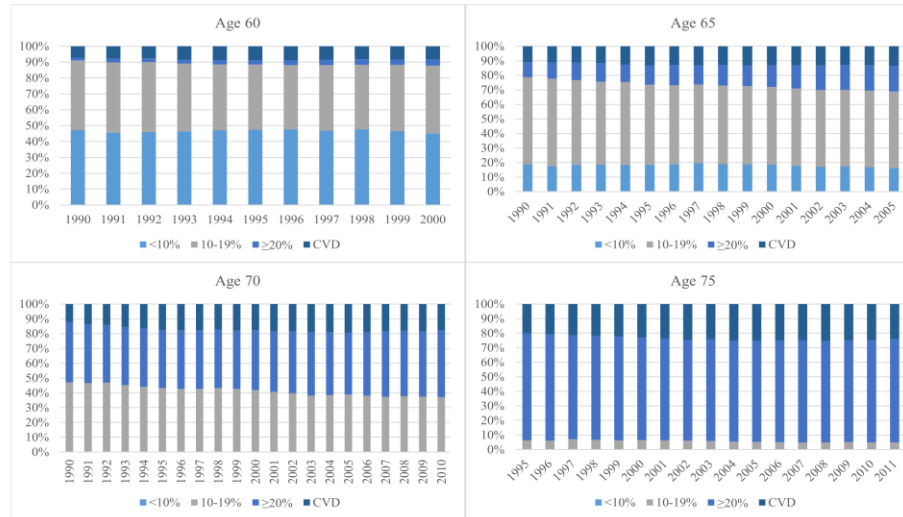


- Population-based retrospective cohort study
- Restrictions data:
 - Medical records from 1987 to 2011 of people born between 1920 and 1940
- Target ages:
 - 60, 65, 70, and 75 [between 115,000-250,000 patients, 52-58% women]
- Exclusion:
 - Patients with a history of cardiovascular disease

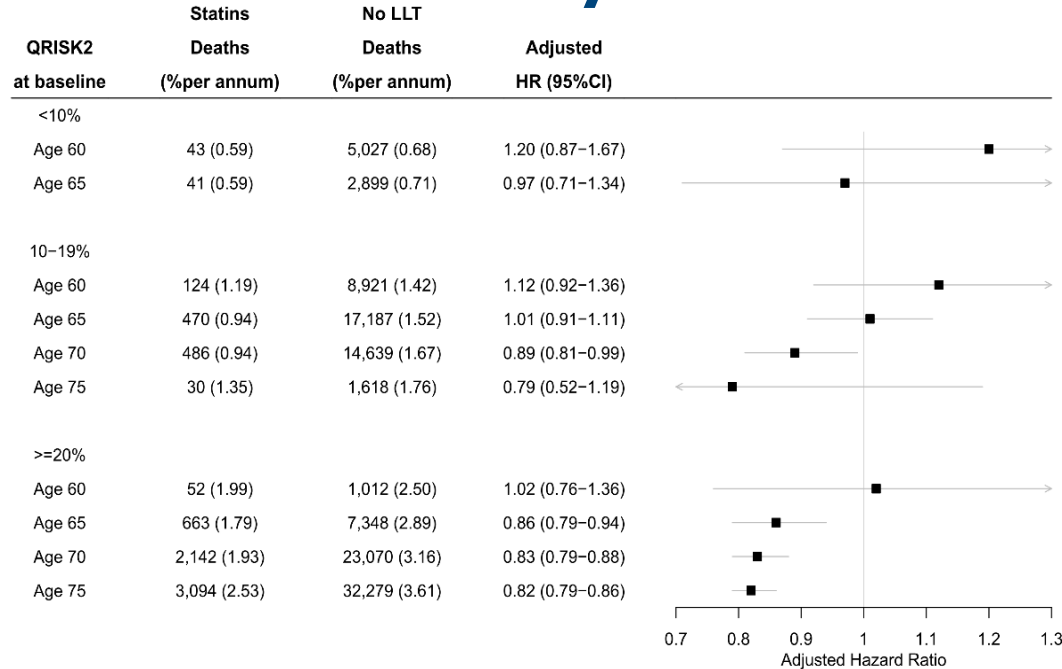
Gitlsels L.A., Kulinskaya E., Steel N. (2016) Survival Benefits of Statins for Primary Prevention: A Cohort Study. PLoS ONE **11**(11): e0166847. doi:10.1371/journal.pone.0166847

Gitlsels, L. A., Kulinskaya, E., & Steel, N. (2017). Survival prospects after acute myocardial infarction in the UK: A matched cohort study 1987-2011. *BMJ Open*, 7(1). <http://doi.org/10.1136/bmjopen-2016-013570>

QRISK groups by age over time



Hazard ratios of mortality with statins

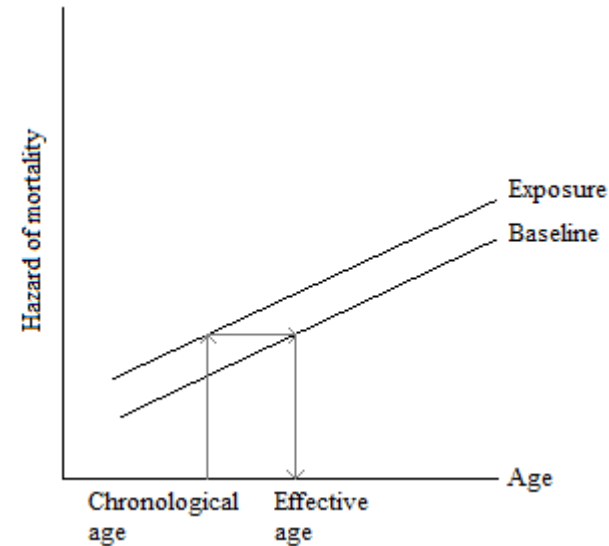


Cox regression with frailty on GP practice. HRs adjusted for sex, year of birth, deprivation, diabetes, high cholesterol, blood pressure regulating drugs, body mass index, smoking status

What does this mean for longevity

- Using Gompertz law, the increase in annual hazard of mortality associated with ageing one year is approximately constant between ages 30 and 95
- For England and Wales in 2010-2012, the increase in the hazard between those ages was approximately 1.1.
- A HR can be translated to the numbers of years gained in effective age as $\log \text{HR} / \log (1.1) \approx 10 * \log(\text{HR})$.

[Brenner, 1993; Spiegelhalter, 2016]



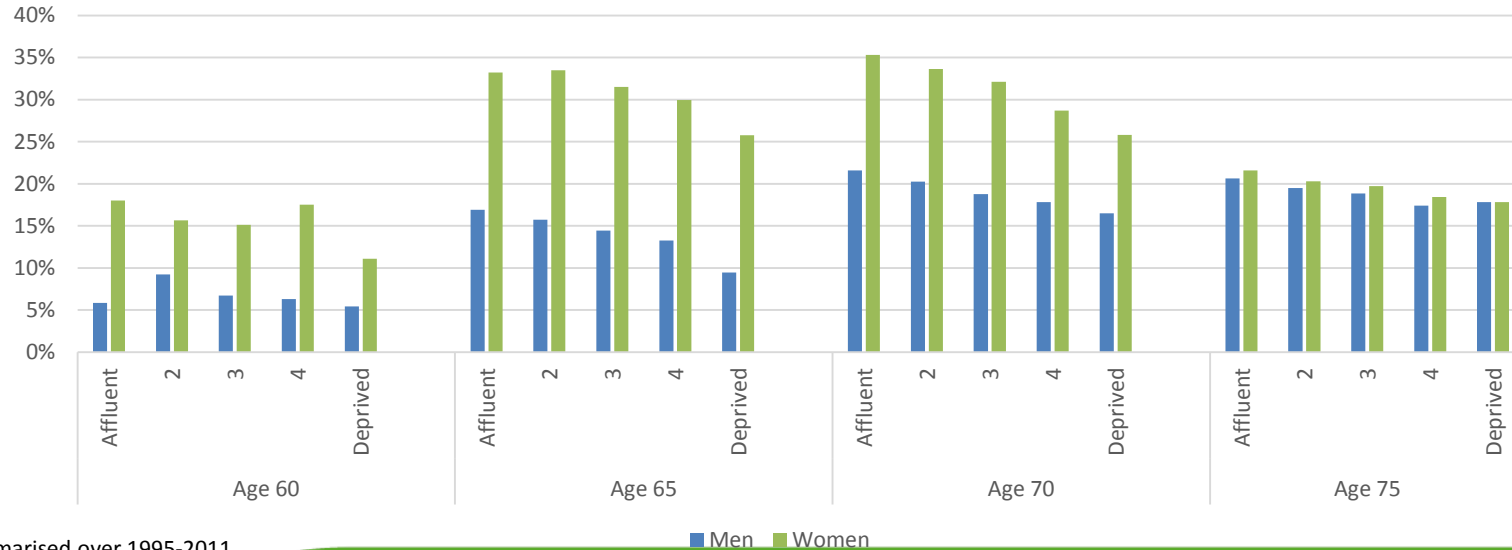
Translating to population life expectancy



- Take a period life table
- Calculate effective age changes due to a health intervention in relevant subpopulations [risk group, age, sex and deprivation status]
- The longevity improvement associated with statin prescription translates to a decrease in effective age of up to two years
- Take into account uptake rates in these subgroups
- Population LE is the weighted average of the LE in these subgroups

Prevalence of statins prescription for primary prevention of cardiovascular disease by deprivation quintiles (Townsend)

Statins prescription in people with QRISK2 \geq 20%*



*summarised over 1995-2011

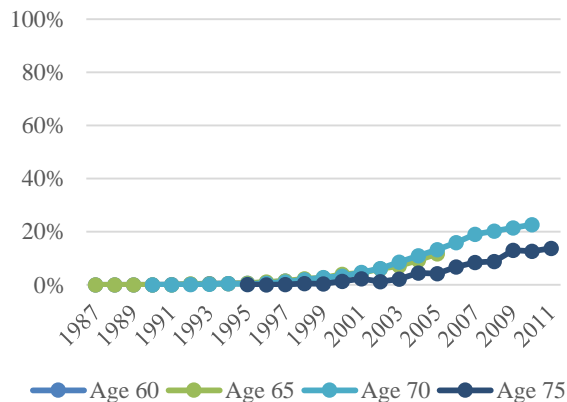
Impact of Recent changes in Guidelines:

the increase in overall life expectancy(yrs) if all eligible people were prescribed statins

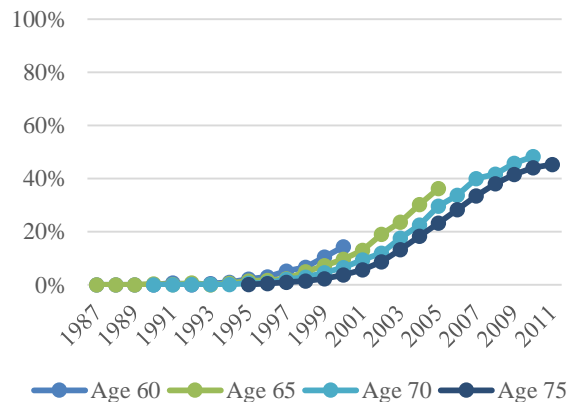
	Age 70			Age 75	
Townsend deprivation quintile	Women	Men		Women	Men
1 st (least)	0.74-0.76	0.82-0.84		1.08-1.09	0.86-0.88
2 nd	0.75-0.76	0.82-0.85		1.04-1.06	0.76-0.78
3 rd	0.74-0.76	0.81-0.84		0.92-0.94	0.78-0.80
4 th	0.70-0.72	0.77-0.80		0.89-0.90	0.80-0.82
5 th (most)	0.62-0.65	0.80-0.83		0.75-0.76	0.63-0.65
Total	0.73-0.75	0.81-0.84		0.98-0.99	0.79-0.81

Statins prescription rate by age-risk group

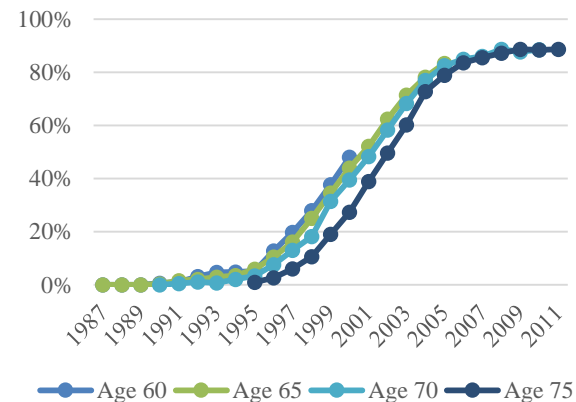
Statin prescription in patients with
QRISK2 score < 20%



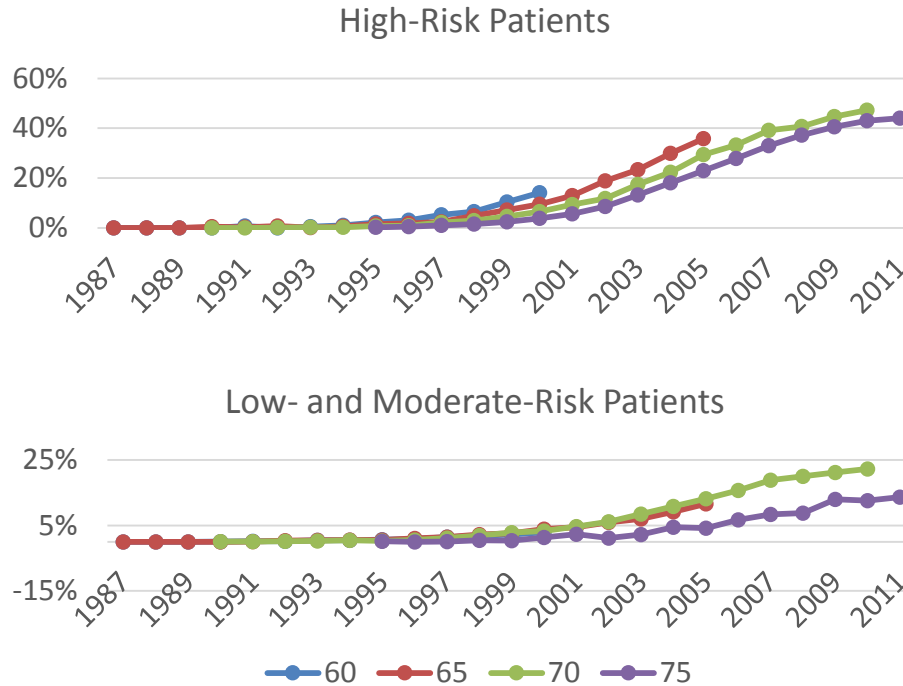
Statin prescription in patients with
QRISK2 score $\geq 20\%$



Statin prescription in patients with
CVD



Statins prescription rate by age-risk group



How much statins have already contributed to the increase in current LE?



The LE of 1987, when statins were introduced to the healthcare market, was compared to the LE of 2010 as it is and as if there was no statin prescription.

The increase in LE from 1987 to 2010 in women was 2.7 and 2.2 years at ages 70 and 75, and in men 3.7 and 2.8 years at ages 70 and 75.

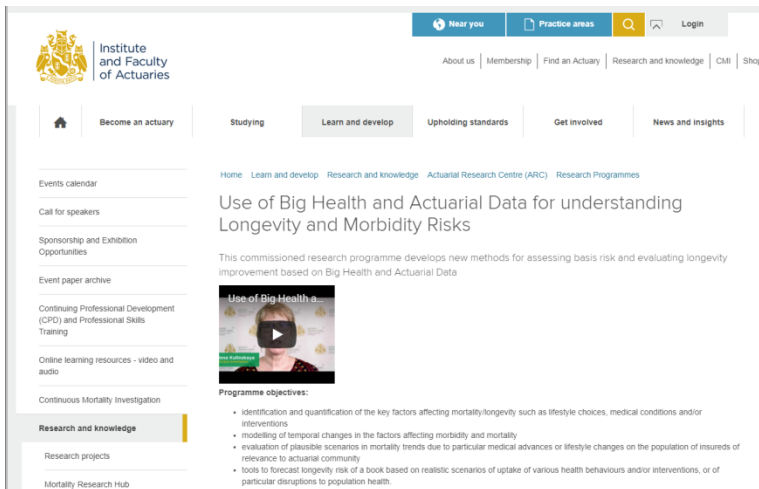
Statins contributed to 74% (60-89%) of this increase in LE at age 70 and to 57% (45-71%) of this increase at age 75.

Conclusions



- Longevity improvement due to statins is already in part incorporated in the national LE due to the 90% prescription rate in CVD survivors.
- Our results agree amazingly well with the conclusions by the CMI. However, the national LE would further increase by up to one year if all eligible people under the current guidelines would be prescribed statins.
- Methodology is easily applied to future health interventions such as newly recommended by the American Heart Association (2017) intensive blood pressure control.

Find out more



The screenshot shows the homepage of the Institute and Faculty of Actuaries. The header includes the ICA logo and navigation links: About us, Membership, Find an Actuary, Research and knowledge, CMI, and Shop. A secondary navigation bar contains: Home, Become an actuary, Studying, Learn and develop (highlighted), Upholding standards, Get involved, and News and insights. The main content area features a video titled "Use of Big Health and Actuarial Data for understanding Longevity and Morbidity Risks" with a play button icon. Below the video, the "Programme objectives" are listed. A left sidebar contains links for Events calendar, Call for speakers, Sponsorship and Exhibition Opportunities, Event paper archive, Continuing Professional Development (CPD) and Professional Skills Training, Online learning resources - video and audio, Continuous Mortality Investigation, Research and knowledge (highlighted), Research projects, and Mortality Research Hub.

Use of Big Health and Actuarial Data for understanding Longevity and Morbidity Risks

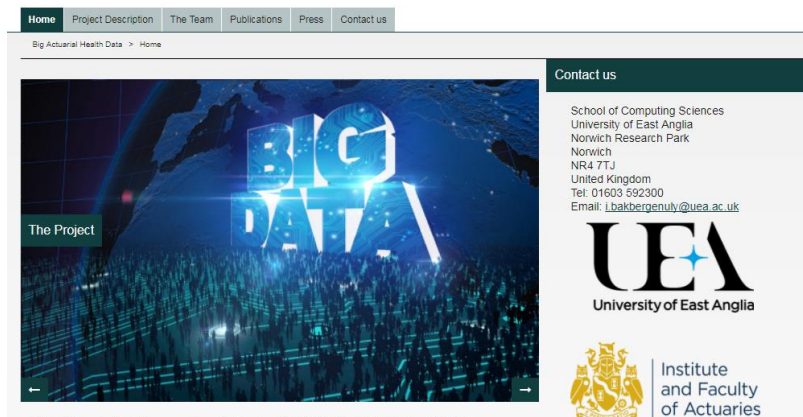
This commissioned research programme develops new methods for assessing basis risk and evaluating longevity improvement based on Big Health and Actuarial Data

Programme objectives:

- identification and quantification of the key factors affecting mortality/longevity such as lifestyle choices, medical conditions and/or interventions
- modelling of temporal changes in the factors affecting morbidity and mortality
- evaluation of plausible scenarios in mortality trends due to particular medical advances or lifestyle changes on the population of insureds of relevance to actuarial community
- tools to forecast longevity risk of a book based on realistic scenarios of uptake of various health behaviours and/or interventions, or of particular disruptions to population health

bit.ly/arc2173

Big Health Actuarial Data



The screenshot shows the homepage of the Big Health Actuarial Data website. The header includes navigation links: Home (highlighted), Project Description, The Team, Publications, Press, and Contact us. The main content area features a large graphic with the text "BIG DATA" and a play button icon. Below the graphic, the "The Project" section is visible. A right sidebar contains the "Contact us" information for the School of Computing Sciences at the University of East Anglia, including the address, phone number, and email. The UEA logo and the Institute and Faculty of Actuaries logo are also present.

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Thank you very much for your attention!



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