Medical App	Usefulness	Accuracy	Authority	Objectivity	Design	Value
Figure 1[34]	Able to compare cases on placement with similar cases shared by other health professionals. 'Democratizes' medical knowledge to improve healthcare.	Cases are reviewed by a network of healthcare professionals to ensure accurate answers to cases are provided.	Chief medical officers are the authors but it wasn't possible to see how individual qualifications are validated of people that post on the app.	Has a number of links to multinational companies including pharmaceutical so some information may be biased. Adheres to strict privacy guidelines	Easy to navigate with a clear design. Very clear imaging.	Sign up is free
Epocrates[30]	Reliable, time-saving tool that keeps you focused on making the best clinical decisions possible. access information regarding prescription, OTC medications, herbals and other supplements	Evidence based specific guidelines used and collaborates with the BMJ	Founders are non-medical related with a business background but employ experts in their field to advise and verify content Uses gold standard reference partners.	After acquisition by athenahealth they look for market research and pharmaceutical advertising that could affect app content. Does have an oversight board to ensure integrity.	Easy to navigate for quick dosing and guidelines. Good layout and search options for fast paced setting	Some content is free but total access is $174.99 yearly subscription. Discounts for students
iResus[35]	Allows healthcare professionals to access the latest algorithms from the 2015 guidelines quickly and easily using mobile device	Collaborates with many professional bodies including Royal Colleges and Quality Standards to ensure accuracy	Established by medical professionals and now governed by board of trustees. A committee of reputable healthcare professionals provide advice.	Has a conflict of interest policy that requires authors to declare and sign. Charitable organisation that must show integrity.	Clear, concise algorithms that are very easy to follow. First information seen is most important and subheadings have more detail.	Free to download by anyone.
Prognosis[28]	Improves patient management skills by realistic cases. Allows to build the confidence of physicians on the go and on the ward.	Written and vetted by 120+ experienced specialists. Guidelines are referenced.	Authors are dependable with medical degrees. These include the management team and other contributors.	Difficult to discover any connections but can be assumed that individuals vetting are putting patient health as their highest priority to ensure integrity	Simple design with a stepwise structure through the cases. Screen isn't cluttered with text. Concise reasoning.	Free to download by anyone

Gestational age at birth and health and educational outcomes - a cohort study

Hutchings HA[1], Evans A[2], James-Ellison M[3], Lyons RA[4], Barnes PM[3]
[1]Patient and Population Health and Informatics (PPHI), Swansea University Medical School, Swansea; [2]Cochrane Institute of Primary Care and Public Health, School of Medicine, Cardiff; [3]Department of Child Health, Singleton Hospital, Swansea; [4]Health Data Research UK, Swansea University Medical School, Swansea

Abstract

Objective We investigated the association between gestational age and attainment at Key Stage 1 and hospitalisations up to age 5.

Design A cohort analysis of linked anonymised data of children born in Wales.

Setting We used data from the Welsh Electronic Cohort for Children, Secure Anonymised Information Linkage databank, Swansea University.

Participants All children born in Wales between April 1, 1999, and December 31, 2008.

Exposure Gestational age at birth

Main outcome measures

1) attainment at formal educational assessment at UK KS1

2) emergency inpatient hospital admissions between the age of 1 and 5 years.

Results Late preterm infants were more likely not to attain the expected level at formal KS1 educational assessments when compared to children born at full term (adjusted odds ratio (aOR) of 1.21 (95% CI 1.12. 1.31)). Late preterm birth was associated with an increased incidence risk ratio (IRR) for hospital admission when compared with infants born at full term for injuries, IRR 1.09 (95% CI 1.02, 1.18); all respiratory disease, asthma and

breathing difficulties, IRR 1.40 (95% CI 1.33, 1.47); respiratory infections, IRR 1.39 (95% CI 1.32, 1.46); whooping cough/ cough abnormalities in breathing, IRR 1.43 (95% CI 1.27, 1.60); infections, IRR 1.20 (95% CI 1.13, 1.28) and intestinal infectious disease/diarrhoeal disease, IRR 1.13 (95% CI 1.03, 1.24)).
Conclusion Late preterm birth presents an increased risk of non-attainment in KS1 educational assessments and an increased burden of hospital admission up to age 5 when compared with full-term birth.

Keywords late preterm, educational outcomes, hospital admissions

Introduction

Preterm birth is defined as childbirth occurring at less than 37 completed weeks or 259 days of gestation.[1] The number of preterm births across the globe is growing and presents an increasing health care burden.[1-3] There is clear evidence that infants born at extremely low birth weights (less than 1000g) or very prematurely (less than 32 weeks) are at increased risk of neurodevelopmental problems, educational difficulties and behavioural disorders.[3,4] Interventions to optimise early childhood development are largely based on supporting premature infants to improve long-term outcomes.[3]

There is a growing body of research indicating that infants born late preterm (33-36 weeks gestation) have worse outcomes when compared to their full-term counterparts (37-42 weeks) in terms of educational, health, cognitive, developmental and behavioural outcomes.[4-10] Office for National Statistics birth statistics for England and Wales for 2017 document that infants born between 33-36 weeks, 37-38 weeks and 39-42+ weeks gestation represent 6.3%, 22.6% and 69.2% respectively of the total number of live births (Birth characteristics - Office for National Statistics (ons.gov.uk)). Infants born late preterm, therefore, represent a large proportion of total births with the potential for high associated health care and educational support costs if these children have suboptimal outcomes in comparison to their full-term counterparts.[11] Most infants born late preterm appear well at birth compared with their very preterm counterparts and often do not warrant any special medical care or assessment by the medical team.[12] The current evidence however illustrates the potential for poorer outcomes in this population. It has been suggested that more research is needed to understand the mechanisms by which adverse outcomes occur and the need to develop clinical and cost-effective strategies to help improve care and subsequent outcomes for this group.[12,13]

As part of a larger study, we used a de-identified cohort of population data on people in Wales to investigate the association between gestational age at birth with hospitalisations up to age 5 years and formal educational attainment at KS 1 (now known as the Foundation Phase in Wales) undertaken in primary school year 2.

Method

Welsh Electronic Cohort for Children (WECC)

WECC was set up at Swansea University, using the Secure Anonymised Information Linkage (SAIL) databank. SAIL is a privacy-protecting system capable of linking anonymised data at the individual and household level across many health and health-related datasets for approved research projects. The Welsh Electronic Cohort for Children (WECC) consists of over 800,000 children born or living within Wales between 1990 and 2008. Individual-level de-identified data on these children were obtained from General Practice data, the Welsh Demographic Service (WDS) which is a continually updated record of children living within Wales, community child health records from the National Community and Child Health Database (NCCHD), births and deaths from the Office for National Statistics (ONS), inpatient data from the Patient Episode Database for Wales (PEDW), congenital anomalies from the Congenital Anomaly Register and Information Services (CARIS), free school meal entitlement and environmental data from the National Pupil Database (NPD) and formal educational data from the Pupil Level Annual School Census (PLASC).

We examined the impact of gestational age on health and educational outcomes as part of a larger study to explore the impact of moving in early childhood on health and educational outcomes. Further details of the original study can be found elsewhere.[14]

Gestational age

Data within SAIL on gestational age were classified into four categories: less than 28 weeks; 28-32 weeks; 33-36 weeks; and 37-40+ weeks (reference category).

Cohort eligibility criteria

We used the following eligibility criteria to develop our data cohort:

- A child must have been born in Wales between 01/01/1990 – 31/12/2008
- Individual record-linkage was possible based on an NHS number
- The child must have had a live status at birth (those with a stillbirth flag were excluded)

Educational outcome - Key Stage 1 educational assessment

State schools in Wales have followed a national curriculum made up of specific subjects and standards used by primary and secondary schools to standardise teaching and ensure that all children have the same learning experience. It covers what subjects are taught and the standards children are expected to reach in each subject (https://www.gov.uk/national-curriculum). The national curriculum is organised into blocks called 'Key Stages' (KS), of which there are four in Wales. These are KS1 at age 4/5 to 7 (more recently referred to as the Foundation Phase), KS2 at age 7-11, KS3 at age 11-14, and KS4 at age 14-16. At the end of each KS, children are objectively assessed to determine if they have attained the expected level. KS1 in Wales has previously included teacher assessments in English (or Welsh), maths and science. Pupils are classified not by individual scores, but by 'attainment' categories. An overall score is obtained (based on the average score from the three core subjects). Children are then categorised as expected level attained (an average of level 2 or above in all three subjects) or not attained. Children can be additionally classified: disapplied (i.e. not taking the subject), not awarded level, unable to provide an assessment and working towards the level and these children are classed as not attaining the expected level at KS1. Children attaining the expected level at KS1 was used as the reference category for analyses.

Health outcomes

We investigated the association between gestational age and the number of emergency hospital (inpatient) admissions between age 1 and 5 years due to:

- Injuries
- Respiratory related disease, asthma and breathing difficulties
- Gastrointestinal disorders
- Infections including meningitis

We identified specific relevant International Classification of Diseases, 10th Revision (ICD-10) codes based on previously published research. For all codes (except for injuries), we required the appropriate code to be in the primary diagnostic position in individual-level hospital records. Causes of injury codes are usually paired with the nature of injury codes, but not always in that order, and hence the reliance on primary position will not identify all cases.

Statistical analysis

We used binary logistic regression to obtain odds ratios (and 95% confidence intervals (CIs)) for comparing different gestational ages on not attaining the overall expected level at KS1. To account for the clustering of children within schools we obtained robust standard errors in modelling.

For analysis of the number of hospital admissions, we fitted negative binomial regression models for count data. To account for differential loss to follow-up of the outcome measure (hospital admissions) from the end of the cohort (post 31/8/2008), moving out of Wales or death, we calculated person-years incidence risk ratios (IRRs) (with 95% CIs) in the regressions.

For both educational and health outcomes we adjusted for pre-defined confounding variables: academic season of birth, eligibility for free school meals, special educational needs status, gender, parity, maternal age, breastfeeding status at birth or 6-8 weeks, maternal deprivation measured by the Townsend score of first registered lower super output area (LSOA)[15] at or within 4 months of birth, and the number of residential moves. For health outcomes, we also adjusted for maternal cigarette smoking at booking appointments (first trimester). To avoid making assumptions of linearity, we categorised those variables that could take many values and treated them as categorical variables.

Variables other than breastfeeding and maternal smoking status had up to 7% missing values in the education cohort and only up to 4% in the hospital admission cohort and we therefore only included cases with complete records. We assumed thorough knowledge of the data collection of the administrative databases and cross-tabulations with other variables and across different years that cases who had missing data were missing at random. For breastfeeding and maternal smoking status that had a higher proportion of missing data (16% and 62% respectively) we imputed the missing data using methods of multiple imputation[16,17] and surmised there was sufficient data available to give precise estimates.

We analysed the data using Stata version 13 (Stata Corp, College Station, TX).

Ethical approval

Health Research Authority (HRA) guidance does not require ethical approval for anonymised databank studies. We obtained study approval to undertake the work from the independent SAIL Databank Information Governance Review Panel (IGRP) (project 0593). Data held within the SAIL Databank are made available to researchers in a strongly de-identified research database format that meets NHS Research Ethics guidance on not requiring additional ethical approval. SAIL follows all relevant legislative and regulatory frameworks in using population data for research.

Results

Educational outcomes

We identified 143,869 children in WECC who met the study criteria and for whom KS1 data on attainment available (who attended a Local Education Authority school with a KS1 attainment record), and who did not have higher levels of Special Educational Needs provision (school action plus or statemented). This number reflects the availability of datasets for linking and not the number of infants born within the 19-year period. After excluding children without a complete record, there were 121,442 children in the cohort for analysis. The number of infants within each gestational age category was: less than 28 weeks, 181 (0.15%); 28-32 weeks, 1,342 (1.1%); 33-36 weeks, 6,839 (5.6%); and 37-40+ weeks, 113,090 (93.1%). The late pre-term category of 33-36 weeks represented almost 6% of the total birth cohort.

Table 1 illustrates the association between gestational age at birth and *non-attainment* in the KS1 educational assessment. The proportion of children *not* attaining formal KS1 educational assessments increased with a lower gestational age. In the late preterm category (33-36 weeks) almost 18% of children did not attain in their KS1 assessment compared with 13.6% in the full-term category (37-40+). There was a statistically significant increased odds of *non-attainment* in the late preterm group when compared with the full-term group (adjusted odds ratio (aOR) of 1.21 (95% CI 1.12. 1.31)).

Table 1 Association between gestational age and educational outcome at Key Stage 1 (N= 121,442)

		Key Stage 1 assessment outcome			Odds ratio for not attaining KS1 95% CI		
Variable	**Category**	**Total (N =121,422)**	**Not attained (n)**	**Not attained (%)**	**OR**	**95% CI**	
Gestational age at birth	<28	181	38	21.0	1.30	0.86	1.96
	28-32	1342	285	21.2	1.33	1.14	1.55
	33-36	6839	1221	17.9	1.21	1.12	1.31
	37-40+ (reference)	113080	15394	13.6	1.00		

Adjusted for: frequency of residential moves; frequency of school moves from Reception to end of Year 2; Free school meals in KS1 year; gender; parity; maternal age at birth; NCCHD Breastfeeding status at birth/6-8 weeks; Townsend deprivation decile of Lower Super Output Area (LSOA) at birth/ within 4 months of birth; academic season of birth; special educational needs status.

Health outcomes

We identified 804,290 children in WECC who were born in Wales who met the study criteria. As PEDW data (containing hospital admissions) were only available from 1 April 1999 and after excluding children not born in Wales, who moved out of Wales before age 1 year, deaths, stillbirths, major congenital abnormalities, the final cohort size for analysis was 255,733 children.

In the sample of hospital admissions data, there were 13,432 late preterm infants born with a gestational age of 33-36 weeks, which represents 5.3% of the total study sample. Table 2 illustrates the association between gestational age at birth and hospital admissions for injuries; respiratory-related disease, asthma and breathing difficulties; gastrointestinal disorders; and infections including meningitis.

Late preterm birth was associated with an increase in the expected number of inpatient hospital admissions when compared with infants born at full term in adjusted models, with person-years incidence risk ratio (aIRR) for injuries, aIRR 1.09 (95% CI 1.02, 1.18); all respiratory disease, asthma and breathing difficulties, aIRR 1.40 (95% CI 1.33, 1.47); respiratory infections, aIRR 1.39 (95% CI 1.32, 1.46); whooping cough/cough abnormalities in breathing, aIRR 1.43 (95% CI 1.27, 1.60); infections, aIRR 1.20 (95% CI 1.13, 1.28) and intestinal infectious disease/diarrhoeal disease, aIRR 1.13 (95% CI 1.03, 1.24)).

Regression analysis on the datasets including no answer categories for missing data gave the same results (see supplementary file). In addition, analysis without imputation of missing data in the breastfeeding and maternal smoking status variables (complete case analysis) gave similar results. Data with and without imputation for hospital admissions are presented in Table 2.

Table 2 Risk of hospital admissions between the ages of 1 and 5 years (n=255,733)

Hospital Admission Outcome[a]		Negative Binomial Regression[a] Univariate			Negative Binomial Regression[a] Adjusted[b] and Imputed[c]		
		IRRd	95% CI		IRRd	95% CI	
Injury admissions	<28	1.19	0.83	1.71	1.17	0.81	1.67
Gestational age at birth (weeks)	28-32	1.10	0.94	1.29	1.09	0.93	1.27
	33-36	1.12	1.04	1.21	1.09	1.02	1.18
	37-40+	1.00			1.00		
All Respiratory Disease, Asthma and Breathing Difficulties admissions	<28	4.80	3.96	5.82	4.85	4.00	5.87
	28-32	2.27	2.07	2.50	2.26	2.06	2.48
	33-36	1.41	1.34	1.48	1.40	1.33	1.47
Gestational age at birth (weeks)	37-40+	1.00			1.00		
Respiratory Infections admissions	<28	4.57	3.75	5.57	4.65	3.83	5.66
Gestational age at birth (weeks)	28-32	2.19	1.98	2.41	2.18	1.98	2.40
	33-36	1.40	1.33	1.47	1.39	1.32	1.46
	37-40+	1.00			1.00		
Whooping cough/cough abnormalities in breathing	<28	5.85	3.89	8.80	5.74	3.83	8.59
	28-32	2.7	2.24	3.35	2.66	2.18	3.26
Gestational age at birth (weeks)	33-36	1.46	1.30	1.64	1.43	1.27	1.60
	37-40+	1.00			1.00		
Infections admissions	<28	2.49	1.97	3.16	2.56	2.03	3.25
Gestational age at birth (weeks)	28-32	1.48	1.31	1.67	1.50	1.33	1.69
	33-36	1.21	1.13	1.28	1.20	1.13	1.28
	37-40+	1.00			1.00		
Intestinal Infectious Disease/ Diarrhoeal Disease admissions	<28	2.64	1.87	3.74	2.64	1.87	3.72
	28-32	1.67	1.41	1.98	1.62	1.37	1.92
Gestational age at birth (weeks)	33-36	1.15	1.05	1.26	1.13	1.03	1.24
	37-40+	1.00			1.00		
Meningitis admissions	<28	4.24	0.85	21.16	4.07	0.86	19.29
Gestational age at birth (weeks	28-32	2.02	0.90	4.54	1.80	0.80	4.06
	33-36	1.21	0.77	1.91	1.18	0.75	1.87
	37-40+	1.00			1.00		

[a]*Negative binomial model used with person years to account for differential loss to follow-up of the outcome measure from End of WECC cohort (post 31/8/2008), House move out of Wales and Death.*

[b]*Adjusted for: frequency of residential moves; frequency of school moves from Reception to end of Year 2; Free school meals in KS1 year; gender; parity; maternal age at birth; NCCHD Breastfeeding status at birth/6-8 weeks; maternal smoking status; Townsend deprivation decile of Lower Super Output Area (LSOA) at birth/ within 4 months of birth; academic season of birth; special educational needs status*

[c]*Breastfeeding and maternal cigarette smoking imputed*

[d]*IRR = Person-years Incidence Rate Ratio*

Discussion

Our study illustrated that late preterm infants represented over 5% of our total Welsh birth cohort and that these children had an increased risk of non-attainment in their first formal educational assessment at KS1 and an increased risk of hospital admissions for injuries, respiratory problems and infections when compared to infants born at term. Our findings concur with other published literature that has utilised large cohorts and demonstrates that decreasing gestational age is associated with an increased risk of non-attainment in educational assessments.[4-6,18,19] Similarly, our findings support the growing body of literature that demonstrates a small but persistent detrimental effect of late preterm birth on a variety of health outcomes.[7,10]

Anecdotally, many infants born late preterm appear well at birth and may not be subject to further investigation or monitoring.[10,12] Our findings however, indicate that a significantly higher proportion of these infants experience hospital admissions and poorer educational outcomes compared with full-term infants. The number of infants born late preterm is around 6% which represents a substantial portion of the overall birth cohort. Not all of this group will go on to experience poorer educational and health outcomes, and those that do will generally experience less severe outcomes than those born very preterm; however, the number that do still represent a significant and costly burden to health and educational services.[11,20] We feel that more research is needed to understand whether certain children in this group can be identified as being more at risk than others, of going on to having less favourable outcomes, the reasons why they might be more susceptible and in turn to develop interventions to help support these children.[10,12]

The main strength of our study is that we used a large, prospective population-based cohort to undertake the work. The five year follow up included sufficient numbers to examine our defined outcomes. The data were collected in a standardised way, blinded to exposure status, thus allowing a rigorous comparison of the data.[14]

A limitation of this study is that our category for late preterm was defined as 33-36 weeks gestation. This work was conducted as part of a larger piece of work where the birth categories were already fixed. Late preterm is normally defined as 34-36 weeks. Our results may therefore have overestimated any effects due to the inclusion of infants born at 33 weeks, approximately 0.6% of infants in the education cohort. A more detailed exploration of the effects of an additional week's gestation needs to be examined in future studies. Further work to examine the detailed effects of each week of gestation on these outcomes would also be useful. We did not examine whether late preterm infants had more medical problems around the time of their birth or had more hospital admissions in the first year of life. Further exploration of this would be useful, particularly in relation to different conditions.

Our results suggest that those born late preterm are at greater risk of poorer health and/or educational outcomes in early childhood. We propose that such infants should be more closely monitored by professionals through to early childhood so as to ensure that any issues are identified at an early stage, and if necessary that appropriate support be provided, including through the existing and well-established Child Health Surveillance Programme and contact with Health Visitors, as well as school staff, when their formal education begins. Further research may help stratify the late preterm children most at risk, as they comprise a large population in their entirety, including the reasons why certain groups might be more susceptible to going on to experience difficulties from the perspective of their health and educational outcomes. Future interventional studies are required to explore whether any identified factors that might be contributory can be modified to improve outcomes. Whether the effects on health and educational outcomes seen persist beyond early childhood is an important consideration which we feel warrants further exploration.

Funding

This study was supported by a grant from the Welsh Government, New Ideas Social Research Fund.

This study makes use of the Secure Anonymised Information Linkage (SAIL) Databank. We would like to acknowledge all the data providers who make anonymised data available for research.

This work was supported by Health Data Research UK, which receives its funding from HDR UK Ltd (grant ref:NIWA1) funded by the UK Medical Research Council, Engineering and Physical Sciences Research Council, Economic and Social Research Council, Department of Health and Social Care (England), Chief Scientist Office of the Scottish Government Health and Social Care Directorates, Health and Social Care Research and Development Division (Welsh Government), Public Health Agency (Northern Ireland), British Heart Foundation (BHF) and the Wellcome Trust.

This work was also supported by an ESRC award establishing the Administrative Data Research Centre Wales (ES/L007444/1).

References

1. Beck S, Wojdyla D, Say L, *et al*. The worldwide incidence of preterm birth: a systematic review of maternal mortality and morbidity. *Bull World Health Organ* 2010;**88**(1):31-38. doi: 10.2471/BLT.08.062554
2. Blencowe H, Cousens S, Oestergaard MZ, *et al*. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. *Lancet* 2012;**379**(9832):2162-2172. doi: 10.1016/S0140-6736(12)60820-4
3. Sutton PS, Darmstadt GL. Preterm birth and neurodevelopment: a review of outcomes and recommendations for early identification and cost-effective interventions. *J Trop Pediatr* 2013;**59**(4):258-265. doi: 10.1093/tropej/fmt012
4. Huddy CL, Johnson A, Hope PL. Educational and behavioural problems in babies of 32-35 weeks gestation. *Arch Dis Child Fetal Neonatal Ed* 2001;**85**(1):F23-28. doi: 10.1136/fn.85.1.f23
5. Chan E, Quigley MA. School performance at age 7 years in late preterm and early term birth: a cohort study. *Arch Dis Child Fetal Neonatal Ed* 2014;**99**(6):F451-457. doi: 10.1136/archdischild-2014-306124
6. Quigley MA, Poulsen G, Boyle E, *et al*. Early term and late preterm birth are associated with poorer school performance at age 5 years: a cohort study. *Arch Dis Child Fetal Neonatal Ed* 2012;**97**(3):F167-173. doi: 10.1136/archdischild-2011-300888

7. Boyle EM, Poulsen G, Field DJ, *et al.* Effects of gestational age at birth on health outcomes at 3 and 5 years of age: population based cohort study. *BMJ* 2012;**344**:e896. doi: 10.1136/bmj.e896
8. Tripathi T, Dusing SC. Long-term neurodevelopmental outcomes of infants born late preterm: a systematic review. *Research and Reports in Neonatology* 2015;**5**:91-111. doi: https://doi.org/10.2147/RRN.S44062
9. Dueker G, Chen J, Cowling C, *et al.* Early developmental outcomes predicted by gestational age from 35 to 41 weeks. *Early Hum Dev* 2016;**103**:85-90. doi: 10.1016/j.earlhumdev.2016.07.006
10. Muganthan T, Boyle EM. Early childhood health and morbidity, including respiratory function in late preterm and early term births. *Semin Fetal Neonatal Med* 2019;**24**(1):48-53. doi: 10.1016/j.siny.2018.10.007
11. Petrou S, Yiu HH, Kwon J. Economic consequences of preterm birth: a systematic review of the recent literature (2009-2017). *Arch Dis Child* 2019;**104**(5):456-465. doi: 10.1136/archdischild-2018-315778
12. Boyle EM. Time to address the knowledge gaps for late preterm birth. *Acta Paediatr* 2018;**107**(9):1484-1485. doi: 10.1111/apa.14420
13. Sanghera RS, Boyle EM. Outcomes of infants born near term: not quite ready for the "big wide world"? *Minerva Pediatr* 2019;**71**(1):47-58. doi: 10.23736/S0026-4946.18.05406-3
14. Hutchings HA, Evans A, Barnes P, *et al.* Residential Moving and Preventable Hospitalizations. *Pediatrics* 2016;**138**(1) doi: 10.1542/peds.2015-2836
15. Townsend P, Phillimore P, Beattie A, editors. Health and deprivation. Inequality and the North. London: *Croom Helm* Ltd, 1987
16. Little RJA, Rubin DB. Statistical analysis with missing data. 2nd ed. New Jersey: *John Wiley and Sons* 2002
17. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med* 2011;**30**(4):377-399. doi: 10.1002/sim.4067
18. Lipkind HS, Slopen ME, Pfeiffer MR, *et al.* School-age outcomes of late preterm infants in New York City. *Am J Obstet Gynecol* 2012;**206**(3):222 e1-6. doi: 10.1016/j.ajog.2012.01.007
19. Noble KG, Fifer WP, Rauh VA, *et al.* Academic achievement varies with gestational age among children born at term. *Pediatrics* 2012;**130**(2):e257-264. doi: 10.1542/peds.2011-2157
20. Petrou S. Health economic aspects of late preterm and early term birth. *Semin Fetal Neonatal Med* 2019;**24**(1):18-26. doi: 10.1016/j.siny.2018.09.004

Maximising educational efficacy – a guide to facilitating teaching in virtual clinics

Sivakanthan T[1], Vallabhaneni P[2]
[1]School of Medicine, Swansea University, Swansea; [2]Morriston Hospital, Swansea

Abstract
The COVID-19 pandemic has significantly disrupted the delivery of medical education. As a result, medical schools and hospitals must adapt to equip students with adequate clinical experience with social distancing and uncertainties surrounding the nature of enforced lockdowns. Virtual clinics are an effective alternative to provide students with appropriate clinical experience whilst offering various benefits. Such benefits include individualised learning, real-time opportunities to develop professionalism and clinical reasoning, to name a few.

Several considerations must be taken into account to deliver an effective virtual clinic for students/trainees. These include the nature of the clinics, feedback given to students/trainees and opportunities for them to consolidate their knowledge and skills gained through clinics to maximise their educational efficacy.

Taking such considerations into account will provide immense learning opportunities for students/trainees to aid their overall education amid a pandemic era which has otherwise disrupted traditional learning involving direct patient contact.

Keywords Virtual clinics, feedback, COVID-19 education, clinical experience; medical education

Introduction
Owing to the COVID-19 pandemic, medical schools and hospitals have had to restructure their delivery of education unexpectedly. The pandemic has seen the implementation of social distancing, wearing facial masks and legislation enforcing lockdowns where appropriate, as per public health mandates. These have all contributed to the disruption of medical school curriculums in both pre-clinical and clinical phases. As pre-clinical students get accustomed to the delivery of lectures through popular online mediums such as Zoom or Panopto, the challenge of appropriate clinical experience delivered to clinical phase students still remains. This was especially seen when hospital trust policies decreased the number of patients seen in outpatient secondary care clinics as part of COVID-19 precautions.

Establishing virtual clinics that include students/trainees serves as an effective alternative to provide appropriate clinical experience in pandemic times. Students/trainees can take a more