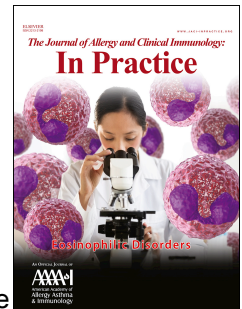


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The Impact of COVID-19 Pandemic on Adult and Pediatric Allergy & Immunology Services in the UK National Health Service

Mamidipudi Thirumala Krishna, PhD FRCP FRCPATH, Sarah Beck, MSc FRCPATH, Nathan Gribbin, IB, Shuaib Nasser, MD FRCP, Paul J. Turner, PhD FRCPCH, Sophie Hambleton, DPhil FRCPCH, Ravishankar Sargur, MD FRCP FRCPATH, Andrew Whyte, MBBS FRACP FRCPA, Claire Bethune, MBBChir FRCP FRCPATH



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The Impact of COVID-19 Pandemic on Adult and Pediatric Allergy & Immunology Services in the UK National Health Service

Mamidipudi Thirumala Krishna^{*+~} PhD FRCP FRCPATH, Sarah Beck^{*} MSc FRCPATH, Nathan Gribbin IB[~], Shuaib Nasser[#] MD FRCP, Paul J Turner^{##} PhD FRCPCH, Sophie Hambleton[@] DPhil FRCPCH, Ravishankar Sargur[£] MD FRCP FRCPATH, Andrew Whyte^{###} MBBS FRACP FRCPA, Claire Bethune^{###~} MBBChir FRCP FRCPATH

^{*}Department of Allergy and Immunology, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

⁺Institute of Immunology & Immunotherapy and Institute of Clinical Sciences, University of Birmingham, UK

[~]Accreditation unit, The Royal College of Physicians, London, UK

^{###}Department of Allergy and Immunology, University Hospitals Plymouth NHS Trust, Plymouth, UK

[@]Newcastle University and Great North Children's Hospital, Newcastle, UK

[£]Department of Allergy and Immunology, Sheffield Teaching Hospitals NHS Trust, Sheffield, UK

[#]Department of Allergy, Cambridge University Hospital NHS Trust, UK

^{##}National Heart & Lung Institute, Imperial College London, London, UK

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Address for correspondence:

Professor M. T. Krishna
Department of Allergy and Immunology
Birmingham Heartlands Hospital
University Hospitals Birmingham NHS Foundation Trust
Bordesley Green East
Birmingham B9 5SS
Tel: +44 1214241807
Email: mtkrishna@yahoo.com

Abstract

Background: The COVID-19 pandemic imposed multiple restrictions on healthcare services.

Objective: To investigate the impact of the pandemic on Allergy & Immunology (A&I) services in the UK.

Methods: National survey of all A&I services registered with the Royal College of Physicians and/or British Society for Allergy and Clinical Immunology. The survey covered staffing, facilities, personal protective equipment, appointments & patient review, investigations, treatments and research activity. Weeks commencing 03 Feb'20 (pre-COVID), 06 April'20 and 08 May'20 were used as reference points for the dataset.

Results: 99 services participated. There was a reduction in nursing, medical, administrative and allied health professional staff during pandemic; 86% and 92% of A&I services continued to accept non-urgent and urgent referrals respectively during the pandemic. There were changes in immunoglobulin (Ig) dose and infusion regimen in 67% and 14% of adult and pediatric services respectively; 30% discontinued immunoglobulin replacement in some patients. There was a significant (all variables, $p \leq 0.0001$) reduction in the following: face-to-face consultations (increase in telephone consultations), initiation of venom immunotherapy, sublingual and subcutaneous injection immunotherapy, anesthetic allergy testing and hospital procedures (food challenges, immunoglobulin and omalizumab administration); and a significant increase ($p \leq 0.0001$) in home therapy for immunoglobulin and omalizumab. Adverse clinical outcomes were reported, but none were serious.

Conclusion: The pandemic had significant impact on A&I services leading to multiple unplanned pragmatic amendments in service delivery. There is an urgent need for prospective audits and strategic planning in the medium and long term to achieve equitable, safe and standardised healthcare.

Key words: COVID-19, Allergy, Immunology, human immunoglobulin, service, impact, immunodeficiency.

Highlights box:

1. **What is already known about this topic?** There are no published data regarding the impact of COVID-19 pandemic on Allergy & Immunology services in the UK National Health Service.
2. **What does this article add to our knowledge?** Data showed reduction in face-to-face consultations, increase in remote consultations, reduced access to allergy testing, and increase in self-administration of omalizumab and immunoglobulin replacement therapy.
3. **How does this study impact current management guidelines?** These findings will shape new guidelines regarding delivery of an equitable, safe and standardized Allergy & Immunology service and governance framework in the post-pandemic recovery phase.

72 **Abbreviations**

73 A&I: Allergy and Immunology

74 AAAAI: American Academy of Asthma Allergy and Immunology

75 BAME: Black, Asian and Minority Ethnic

76 BSACI: British Society for Allergy and Clinical Immunology

77 COVID: Coronavirus Disease

78 CSU/A: Chronic Spontaneous Urticaria and Angioedema

79 EAACI: European Academy of Allergy and Clinical Immunology

80 IGRT: Immunoglobulin Replacement Therapy

81 IQAS: Improving Quality in Allergy Services

82 IVIg: Intravenous Immunoglobulin

83 NHS: National Health Service

84 OFC: Oral Food Challenge

85 QPIDS: Quality in Primary Immunodeficiency Service

86 RCP: Royal College of Physicians

87 SCIg: Subcutaneous Immunoglobulin

88 SCIT: Subcutaneous Injection Immunotherapy

89 SLIT: Sublingual Immunotherapy

90 UK PIN: United Kingdom Primary Immunodeficiency Network

91 VIT: Venom Immunotherapy

92

93 Introduction

94 The coronavirus disease 2019 (COVID-19) pandemic has presented unique and
95 unprecedented challenges to health service delivery globally. Health services have had to
96 rapidly implement measures to reduce virus transmission rates, which has involved risk
97 stratification and service prioritisation to focus on emergency care and where feasible,
98 cancer care – the aim being to reduce patient volumes in clinical areas and limit potential
99 exposure for patients, their caregivers, and healthcare professionals.

100 Allergic disorders such as allergic rhinitis, asthma and food allergy are among the most
101 common non-communicable diseases worldwide¹, and the UK has one of the highest
102 prevalence rates in the world. Health service delivery for these conditions is primarily
103 outpatient-based. There is a huge unmet demand for allergy services globally, and
104 specifically there is inadequate and uneven distribution of specialist allergy services across
105 the UK¹⁻³.

106 The National Health Service (NHS) in the UK offers specialist Allergy and Immunology (A&I)
107 services for children and adults in secondary care, with some heterogeneity with respect to
108 the professional background and training of clinicians involved in service delivery, and the
109 repertoire of services within each centre^{2,4}. Adult allergy services are delivered by
110 specialists in allergy and/or clinical immunology, and organ-based specialists such as
111 respiratory physicians. Pediatric allergy services are delivered by pediatric allergists and
112 general pediatricians with an interest in allergy. Some services provide only allergy *or*
113 immunology services, and others offer joint services including A&I within adult or pediatric
114 departments.

115 Several recent publications have described the restrictions imposed by COVID-19 alongside
116 prioritisation and newer models of care in A&I and other medical and surgical specialties⁵⁻⁹.
117 Specifically, the British Society for Allergy and Clinical Immunology (BSACI), European
118 Academy of Allergy and Clinical Immunology (EAACI) and American Academy of Allergy

Asthma and Immunology (AAAAI) issued expert/consensus guidance regarding safe and strategic delivery of specialist A&I services during the pandemic¹⁰⁻¹².

We sought to assess the impact of COVID-19 pandemic on A&I services within secondary healthcare NHS facilities in the UK. This was a collaborative project involving the accreditation unit of the Royal College of Physicians (RCP) of London, BSACI and the UK Primary Immunodeficiency Network (UKPIN). As this was a national A&I services survey without patient involvement, ethics committee approval was not sought. This survey generated baseline data to shape national policy for A&I services during the recovery phase of the pandemic.

Methods

Questions relating to allergy and immunodeficiency service delivery were designed by an expert panel led by MTK and CB (from the RCP), and AFW (from BSACI) with administrative support from the RCP accreditation unit. A draft of the questionnaire was circulated for consultation *via* representatives of BSACI (PJT, SN) and UKPIN (RS and SH). Feedback was reviewed and the final version agreed.

Three separate questionnaires were designed using the Survey Monkey platform, for allergy, immunology and combined A&I services (online repository text; E1-3). Generic questions were common to all versions, and specific elements unrelated to the respective specialty were removed (e.g. immunology questions were removed in allergy service questionnaire and *vice versa*). The survey was launched on 30 June 2020 and was open for 4 weeks, during which two email reminders were sent. Where possible, the investigators contacted service clinical leads directly *via* telephone, email, and/or text messaging to request responses before the closing date.

The first cases of COVID-19 occurred in the UK in late January 2020, with significant increase through March and a peak in mid-April. We therefore chose 3 time points to study the impact of COVID-19: the week commencing 03 Feb'20 (as a baseline dataset), and the

weeks commencing 06 Apr'20 and 08 May'20. During the study period, generic guidelines with respect to restrictions were put in place by the UK Department of Health. Hence, these regulations were common to all NHS hospitals in all geographical areas.

Briefly, questions covered generic domains including workforce, estates & facilities, referral pathways, appointment scheduling, provision of personal protective equipment (PPE) for staff, screening patients for COVID-19, perceived positive changes in clinical practice, and specialty-specific questions relating to allergy testing (e.g. drugs, venoms), open food and drug challenges (hospital and home), allergen-specific immunotherapy including venom immunotherapy (VIT), subcutaneous immunotherapy (SCIT) & sublingual immunotherapy (SLIT) for allergic rhinitis, omalizumab for chronic spontaneous urticaria and angioedema (CSU/A; hospital and home therapy), subcutaneous immunoglobulin (SCIg) and intravenous immunoglobulin (IVIg) replacement therapy (hospital and home therapy), access to laboratory investigations, and occurrence of COVID-19 cases amongst patients with immunodeficiency.

All participating services were registered with the RCP accreditation unit and/or BSACI. A link to the appropriate survey was emailed to clinical leads registered with Improving Quality in Allergy Services (IQAS accreditation program; 28 services; pediatric allergy is not currently a part of this program) and to clinical leads registered with Quality in Primary Immunodeficiency Services (QPIDS accreditation program; 39 services), both under the auspices of the RCP accreditation unit. Two additional QPIDS unregistered Immunology centres were contacted directly and the immunodeficiency survey was then forwarded. A link to the survey was also sent out to the BSACI membership to allow pediatric allergy services and other non-IQAS registered services to participate. Responses were checked to ensure that no centres completed more than one version of the relevant survey.

Data was collected in MS Excel and a descriptive analysis was performed and tabulated.

Statistical analysis was conducted using MedCalc Statistical Software version 19.4.1

(MedCalc Software Ltd, Ostend, Belgium); as data was not normally distributed, Wilcoxon's

172 matched paired sign rank test was used to compare continuous variables; a 'p' value of
173 <0.05 was considered to be statistically significant.

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Results

A total of 99 services (involving 79 centres) including adult immunology, adult allergy, pediatric immunology and paediatric allergy completed survey forms. There were 38 immunology services registered with QPIDS either as adult immunology centres, pediatric immunology centres or both. Of the 32 adult immunology services 29 (94%) completed the survey. These responses included one service with a combined adult and pediatric service. All 7 pediatric-only immunology centres (100%) completed the survey. There were 30 allergy centres registered with IQAS, of whom 26 (87%) completed the survey. There were 22 additional adult allergy services on the BSACI database, of which 6 (26%) completed the survey, giving an overall response rate of 32 out of 52 services (62%). As the IQAS accreditation scheme does not cover pediatric allergy services, they were contacted via BSACI. There are 92 pediatric allergy centres on the BSACI database, of which 30 (33%) completed the survey.

Data regarding responses to generic questions and specialty-specific questions are summarized in Tables 1-3; Table-E1; Figures 1-4 and online repository-E4.

Generic questions:

Staff: There was a 22-46%, 21-26% and 15-41% reduction in nursing, medical and secretarial & administrative staff respectively in April which remained at a similar level in May. There was a 14-21% reduction in availability of dietitians, pharmacists, physiotherapists and psychologists in April showing a modest improvement by May. Overall, 47% of personnel in services were able to work from home, with just over a third reporting that this had no impact on service delivery.

Scheduling appointments: 85% of services were triaging referrals pre-COVID and a similar proportion continued during the pandemic. 86% were still accepting 'routine' non-urgent referrals with 70% scheduling appointments as usual. The remaining services were deferring appointments until service recovery. 93% of the latter were giving 'advice and guidance', a

process involving written communication to referring physician based on the content of the referral letter. 92% were accepting urgent referrals with 77% offering face-to-face appointments for such referrals.

There was a highly significant reduction in face-to-face consultation involving adult and pediatric A&I services during the pandemic with a parallel highly significant increase in telephone consultations (Figure-1). Video consultations were rarely used. Importantly, the increase in telemedicine was insufficient to meet the reduction in face-to-face attendances, leading to an overall reduction in clinic capacity.

Facilities: >80% services reported that outpatient and day-case space availability was affected due to restriction imposed by the pandemic. Nearly a third of services were aware of specific patients with adverse clinical outcomes as a consequence of changes. All services who responded “yes” to adverse outcomes provided free text comments. Adverse outcomes relating to changes in the provision of immunoglobulin replacement therapy (IgRT) included patients who did not tolerate escalated doses, an increase in anxiety in patients who discontinued Ig infusions and some patients felt pressured to self-administer Ig infusions at home. One centre reported an increase in the rate of infection in some patients who discontinued IgRT but no further details were provided. One pediatric centre reported that lack of resources to train patients for home SCIg replacement therapy resulted in continued treatment in hospital and infections in intravenous line.

From adult allergy centres, five reported an inability to commence or to continue omalizumab injections which resulted in exacerbation of CSU/A. One patient reportedly summoned paramedic crew due to an exacerbation but was not admitted to hospital. Six pediatric centres reported inability to reintroduce foods and ongoing dietary restrictions occurring as a consequence of not undertaking food challenges. Stopping VIT before completion of a full course was reported as an adverse outcome by some centres, but none reported

anaphylaxis as a result. A number of centres reported that they thought it was too early to determine whether there had been adverse outcomes in this group.

Inadequate control of allergic rhinitis from not commencing SCIT or SLIT was described as an adverse clinical outcome by one centre. A number of centres reported that an increase in waiting times for challenge testing and SCIT/SLIT would adversely impact patients. There was no report in the free text regarding admissions to hospital (although one child described above had a line infection as a result of not having SCIg at home); specifically, there were no reports of anaphylaxis.

Screening patients for COVID-19: Screening for COVID-19 was implemented in a relatively small number of services in Feb'20, but this clearly escalated by May'20. This involved a questionnaire-based approach and temperature checks with very few (3.2% of the cohort) obtaining COVID-19 swabs by May'20. Hardly any PPE was employed in Feb'20, but by May'20, the vast majority used aprons (92%), surgical masks (99%) with a moderate proportion were using eye protection (40%).

Perceived positives from changes: The respondents reported a number of positives emerging from changes made due to the pandemic, including reductions in: perceived risk of infection to staff (57% of respondents) and patients (69.5%); travel time for patients (93%); patient non-attendance of appointments (54%); carbon footprint (88%); and financial overhead health service costs (34%). 59% reported greater flexibility of staff time. 93% and 85% of services agreed that they will not be able to return to pre-COVID service levels in outpatient and day-case units respectively due to changes imposed by the government with respect to social distancing.

Research activity: 30% of services were not involved in research; 19% reported no change during the pandemic, 9% moved to remote research activity, and of the remaining services, 38% had all activity suspended and 3% reported reduction in activity.

Allergy specific:

Specialist treatments and investigations (Table-2; Figures 2-4): VIT was discontinued in nearly 50% of services in 'vulnerable' and 'highly vulnerable' groups (as per UK government stratification) due to restrictions related to social distancing and "shielding" (a set of extra precautions advised by the UK government to protect extremely vulnerable individuals). Whilst 77% of adult services regarded investigations for general anaesthetic (GA) allergy (when surgery imminent) as urgent, only 10% of pediatric allergy services considered this as urgent. Similarly, 50% of allergy services considered antibiotic allergy (with alternatives deemed inadequate) to be urgent, as opposed to 17% of pediatric services. Idiopathic anaphylaxis was deemed as urgent by >70% of adult and pediatric allergy services. Whilst 83% of pediatric allergy services regarded food anaphylaxis as urgent, only 43% of adult allergy services classified this as urgent. Whilst >80% of adult and pediatric services could undertake urgent treatments such as desensitisation or challenges pre-COVID, only 60% and 32% of adult and pediatric services respectively could do so in May'20 during the pandemic. There was a highly significant switch from hospital-based treatment to self-administration at home for omalizumab for CSU/A during the pandemic. Similarly, there was a highly significant reduction in in-hospital food challenges, SCIT and SLIT initiation with a significant increase in appointments offered for SLIT maintenance therapy during the pandemic.

Laboratory and skin tests: Turnaround times for laboratory investigations were not affected in 75% of services. Whilst all services could continue to offer skin tests when clinically indicated, only a third could offer within 4 weeks, with the remaining deferring tests for >4weeks. The 4week time point is a watershed for urgent investigations in the UK NHS framework.

279 ***Immunology specific:***

280 Immunoglobulin replacement therapy (IgRT; Table-3; Figure-2): 57% of services made
281 changes (more frequent in adult services; 67% vs 14%) to dosing regimens for IgRT as a
282 result of restrictions imposed by the pandemic with about a third of adult and pediatric
283 services reporting that they discontinued treatment for some patients. 76% of services
284 reported switching patients from hospital-based treatment to self-administration at home;
285 more commonly in adult services than pediatrics (87% vs 29%, although pediatric sample
286 size was relatively small [n=2 out of 7]). 60% of services offered home visits by specialist
287 nursing staff pre-COVID, but this activity was reduced in May'20 in 90% of centres (94% of
288 adult centres, 67% pediatric).

289 Immunology laboratory: 76% of centres did not report any change in laboratory
290 investigations for primary immunodeficiency during the pandemic, with 13.5% either
291 reporting longer turnaround time or fewer tests.

292 COVID-19 cases: 76% of adult services and 29% (2/7) of pediatric services reported at least
293 1 patient developing COVID-19.

294 Of note, UK pediatric immunology services are centralised in the UK, thus the sample size of
295 pediatric immunology services is relatively small.

296

297

Discussion

This is the first study conducted at a national level to investigate the impact of COVID-19 pandemic on A&I services. The pandemic had a significant impact on the provision on both adult and pediatric A&I services in the UK, in multiple ways affecting staffing, facilities, the *modus operandi* of patient review, investigations & treatment pathways and clinical outcomes as perceived by services. However, we also identified some positive aspects arising from changes in practice during the pandemic which could improve service delivery once the pandemic is over.

A reduction was seen in medical and nursing staff availability during the study period, mostly reflecting redeployment of staff to frontline duties. Similar reduction was seen with secretarial & administrative and allied health professional staff during the study period. It is interesting to note that despite staff shortages, around 85% of services continued to triage referrals during the pandemic and importantly a similar proportion offered non-urgent appointments for patient review. New urgent referrals were accepted by >90% of services, with 77% able to offer face-to-face appointments, mainly focussed on urgent GA allergy tests where surgery was imminent, clinically deemed important antibiotic allergy investigations, venom anaphylaxis and food anaphylaxis. This is in keeping with recommendations recently issued by the BSACI and AAAAI.^{11,12}

UK government recommendations to NHS organisations to reduce patient volumes in hospitals led to significant reduction in face-to-face consultations with a parallel increase in telephone consultations. This was seen across both adult and pediatric A&I services and is in keeping with BSACI, EAACI and AAAAI expert panel recommendations suggesting restriction of face-to-face consultations to those with severe and uncontrolled disease and remote consultations for patients needing surveillance for mild-moderate disease¹⁰⁻¹².

Interestingly, video consultations were not employed by vast majority of services, probably due to lack of secure information technology (IT) framework with respect to clinical governance and concerns regarding use of e-devices by some patient groups. Recent

reports highlight the judicious application of telemedicine in the delivery of allergy services^{7,13,14}. It remains unclear at present how remote consultations were conducted for patients with suboptimal proficiency in English language, although NHS Trusts have access to translators. Clearly, going forward it is of paramount importance to maintain equitable access and quality of service in the Black, Asian and Minority Ethnic population¹⁵. Finally, it is important for health service planning to recognise that an increase in telemedicine consultations was insufficient to fully replace the reduction in face-to-face consultations.

Staff shielding and self-isolation had an impact on 40-57% of A&I services, with about a third reporting that it had no significant impact on service. Outpatient and day-case space availability was significantly impacted, both due to changes in the use of facilities and 67% reporting that changes in staffing was also a contributory factor. No serious adverse events were reported due to rapid unplanned changes implemented during the study period. The reported adverse clinical outcomes were surrounding IgRT, dietary restrictions due to suspension of supervised food challenges and exacerbation of CSU/A and inadequate control of allergic rhinitis due to either cessation or not commencing omalizumab and allergen-specific immunotherapy respectively. This survey did not specifically explore if and what proportion of patients required short courses of corticosteroid therapy to control exacerbations of symptoms due to CSU/A.

The adverse impact on IgRT programmes appeared greater in adult than pediatric services. One third of services discontinued IgRT in some patients, while many patients were switched to home administration, although this was associated with a reduction in home visits by immunology specialist nurses for those enrolled for the home IgRT program. The potential inconvenience caused to patients and their families due to lack of home visits by specialist nurses was not explored in depth in this study, although no serious adverse events were reported as a consequence. However, the time window for reporting such events was relatively short (~8weeks during the study period).

There was a highly significant decrease in general anaesthetic allergy (GA) testing (routine and urgent ($p<0.0001$)), VIT up-dosing ($p<0.0001$), SCIT up-dosing ($p<0.0001$ and maintenance ($p=0.0005$), hospital omalizumab administration ($p<0.001$) and hospital oral food challenges (OFCs, $p<0.0001$) during the pandemic. A significant number of patients on omalizumab therapy were rapidly trained and switched to home administration, following the recent change in marketing authorisation in the UK allowing home treatment. This is likely to be cost-effective for the NHS in the long term, although it would be prudent to seek patient feedback, so appropriate standardised support mechanisms are put in place. No changes were detected in home OFC rates between February and May. New SLIT initiation significantly decreased ($p<0.001$) between February and May and there was an increase in telephone consultations for those on maintenance treatment, although reasons for the latter are unclear.

Our dataset is generalizable for A&I in the UK, as we had a relatively large sample size with representation from both adult and pediatric services across all geographic regions. The survey response rate for adult allergy, adult immunology and pediatric immunology was excellent, although it was modest for pediatric allergy services. It was beyond the scope of this survey to address regarding potential confounders related to study period. Also, the study included a single baseline point for comparison rather than a longer time window, the latter might have potentially introduced logistic issues in data collection and compromised quality. Whilst there is heterogeneity between services as described in previous section, all UK NHS hospitals have a common generic health service framework that is set and governed centrally by the Department of Health. Although the survey was retrospective, it was launched just after the pandemic peak to maximise the quality of responses. A potential second surge¹⁶ of the pandemic during winter 2020 has been anticipated and current changes to health service delivery may remain in place during the medium and long term. Therefore, this dataset provides evidence for strategic planning and health economic projections. Specifically, the positives that emerged from changes to practice should help

shape policies going forward. In particular, remote consultations should be factored into service planning and robust standardised criteria developed with respect to patient selection for face-to-face consultations.

In conclusion, the COVID-19 pandemic had a significant adverse impact on pediatric and adult A&I services in the UK NHS. There was a significant reduction in face-to-face consultations, with a parallel increase in telephone consultation and home-administration of biologic therapies, which might offer significant benefits to patients and healthcare providers alike in the future. It is likely that some of these changes will remain, at least in the medium term, and there is an urgent need to put in place new standards and national policies to achieve equity and standardisation of care. A fit-for-purpose governance framework alongside seeking prospective feedback from patients and their caregivers regarding their perspectives should be embedded into such an approach.

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Author contributions: MTK, CB & AW designed the questionnaire. Other co-authors reviewed, commented and approved final version. NG tabulated data. NG and CB maintained quality assurance of dataset. SB performed statistical analysis with input from MTK and NG. SB constructed graphs. MTK drafted the manuscript and all authors critically reviewed and approved final version.

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Table-1: Data summarising responses to generic questions

Question number	Question	Sub-categories	Adult immunology n= (%)		Paediatric immunology n= (%)		Adult allergy n= (%)		Paediatric allergy n= (%)		Total n= (%)	
Staffing												
1	Has a requirement for staff members to shield and/or self isolate had an impact on your service?	Number of respondents	30	(100%)	7	(100%)	32	(100%)	30	(100%)	99	(100%)
		Yes, but they are generally able to work from home	18	(60%)	4	(57.1%)	13	(40.6%)	12	(40%)	47	(47.5%)
		Yes, but they are generally unable to work from home	6	(20%)	2	(28.6%)	8	(25%)	4	(13.3%)	20	(20.2%)
		No significant impact	6	(20%)	1	(14.3%)	11	(34.4%)	14	(46.7%)	32	(32.3%)
Facilities												
2a	Has the physical space available for your service been affected by changes due to the COVID-19 pandemic in day case units?	Number of respondents	30	(100%)	7	(100%)	32	(100%)	30	(100%)	99	(100%)
		Yes	25	(83.3%)	5	(71.4%)	29	(90.6%)	24	(80%)	83	(83.8%)
		No	5	(16.7%)	2	(28.6%)	3	(9.4%)	6	(20%)	16	(16.2%)
2b	Has the physical space available for your service been affected by changes due to the COVID-19 pandemic in outpatient units?	Number of respondents	30	(100%)	7	(100%)	32	(100%)	30	(100%)	99	(100%)
		Yes	24	(80%)	6	(85.7%)	28	(87.5%)	28	(93.3%)	86	(86.9%)
		No	6	(20%)	1	(14.3%)	4	(12.5%)	2	(6.7%)	13	(13.1%)
3	Are you aware of specific patients with adverse clinical outcomes resulting from changes in service provision?	Number of respondents	30	(100%)	7	(100%)	32	(100%)	30	(100%)	99	(100%)
		Yes	8	(26.7%)	1	(14.3%)	14	(43.8%)	5	(16.7%)	28	(28.3%)
		No	22	(73.3%)	6	(85.7%)	18	(56.3%)	25	(83.3%)	71	(71.7%)
Service recovery												
4	What positive impact of the adjustments to service provision due to COVID-19 have you	Number of respondents	29	(96.7%)	7	(100%)	31	(96.9%)	28	(93.3%)	95	(96%)
		Perceived reduced risk of infection by staff	20	(69%)	2	(28.6%)	20	(64.5%)	12	(42.9%)	54	(56.8%)

	identified?	Perceived reduced risk of infection by patients	26 (89.7%)	2 (28.6%)	23 (74.2%)	15 (53.6%)	66 (69.5%)
		Reduced carbon footprint due to less travel	26 (89.7%)	7 (100%)	28 (90.3%)	23 (82.1%)	84 (88.4%)
		Reduced health service overhead costs	13 (44.8%)	2 (28.6%)	10 (32.3%)	7 (25%)	32 (33.7%)
		Reduced patient travel time	28 (96.6%)	7 (100%)	30 (96.8%)	23 (82.1%)	88 (92.6%)
		Reduced patient non-attendance rates	15 (51.7%)	3 (42.9%)	19 (61.3%)	14 (50%)	51 (53.7%)
		Improved flexibility in healthcare professionals' time	16 (55.2%)	5 (71.4%)	15 (48.4%)	20 (71.4%)	56 (58.9%)
		Other	7 (24.1%)	3 (42.9%)	7 (22.6%)	7 (25%)	24 (25.3%)
5a	Will the requirement for social distancing in accordance to government guidelines impact your ability to deliver the pre-COVID level of service for outpatients?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Yes	27 (90%)	7 (100%)	28 (87.5%)	30 (100%)	92 (92.9%)
		No	3 (10%)	0 (0%)	4 (12.5%)	0 (0%)	7 (7.1%)
5b	Will the requirement for social distancing in accordance to government guidelines impact your ability to deliver the pre-COVID level of service for day case?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Yes	27 (90%)	5 (71.4%)	26 (81.3%)	26 (86.7%)	84 (84.8%)
		No	3 (10%)	2 (28.6%)	6 (18.8%)	4 (13.3%)	15 (15.2%)
Service provision							
6	Overall, have changes in service provision occurred as a result of changes in:	Number of respondents	29 (96.7%)	7 (100%)	30 (93.8%)	29 (96.7%)	95 (96%)
		Staffing	20 (69%)	4 (57.1%)	23 (76.7%)	17 (58.6%)	64 (67.4%)
		Facilities	27 (93.1%)	6 (85.7%)	29 (96.7%)	29 (100%)	91 (95.8%)
		Other	4 (13.8%)	0 (0%)	3 (10%)	8 (27.6%)	15 (15.8%)
Referrals							
7	Are you accepting any non-urgent	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)

(next available routine appointment) referrals?		Yes	27 (90%)	7 (100%)	26 (81.3%)	25 (83.3%)	85 (85.9%)
		No	3 (10%)	0 (0%)	6 (18.8%)	5 (16.7%)	14 (14.1%)
8	If you are accepting any non-urgent referrals are you:	Number of respondents	27 (90%)	7 (100%)	26 (81.3%)	24 (80%)	83 (84.8%)
		Scheduling appointments as normal	18 (66.7%)	5 (71.4%)	20 (76.9%)	15 (62.5%)	58 (69%)
		Deferring appointments until service recovery	9 (34.6%)	2 (28.6%)	7 (26.9%)	9 (37.5%)	27 (32.1%)
9	If you are not accepting any non-urgent referrals are you:	Number of respondents	3 (10%)	0 (0%)	7 (21.9%)	5 (16.7%)	15 (15.2%)
		Giving advice and guidance only	0 (0%)	0 (0%)	4 (57.1%)	5 (100%)	9 (60%)
		Giving advice and guidance and requesting re-referral	3 (100%)	0 (0%)	2 (28.6%)	0 (0%)	5 (33.3%)
		Automatic rejection (no advice)	0 (0%)	0 (0%)	1 (14.3%)	0 (0%)	1 (6.7%)
10	Are you any accepting urgent (see within 4 weeks) referrals?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Yes	29 (96.7%)	7 (100%)	28 (87.5%)	27 (90%)	91 (91.9%)
		No	1 (3.3%)	0 (0%)	4 (12.5%)	3 (10%)	8 (8.1%)
11	Do you have capacity to see urgent referrals face-to-face rather than remotely?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Yes	25 (83.3%)	7 (100%)	22 (68.8%)	22 (73.3%)	76 (76.8%)
		No	5 (16.7%)	0 (0%)	10 (31.3%)	8 (26.7%)	23 (23.2%)

Table-2: Data summarising impact on specialist allergy services

Question number	Question	Sub-categories	Adult allergy n= (%)	Paediatric allergy n= (%)	Total allergy n= (%)
Service provision					
1	Did you stop VIT in any particular groups of patients (see government guidelines for definitions)?	Number of respondents	30 (93.8%)	5 (16.7%)	35 (56.5%)
		No change – all patients continued	3 (10%)	4 (80%)	7 (20%)
		Stopped in the extremely vulnerable shielded groups	10 (33.3%)	0 (0%)	10 (28.6%)
		Stopped in the vulnerable stringent social distancing groups	7 (23.3%)	(0%)	7 (20%)
		Individual discussion with each patient	18 (60%)	1 (20%)	19 (54.3%)
		All patients stopped	2 (6.7%)	0 (0%)	2 (5.7%)
		Other change	4 (13.3%)	0 (0%)	4 (11.4%)
		Referrals			
2	Which groups of patients are you prioritising as urgent?	Number of respondents	30 (93.8%)	30 (100%)	60 (96.8%)
		Drug allergy - general anaesthetic allergy (surgery imminent)	23 (76.7%)	3 (10%)	26 (43.3%)
		Drug allergy - general anaesthetic allergy (future need)	5 (16.7%)	1 (3.3%)	6 (10%)

Drug allergy - antibiotic allergy (clinically required as alternatives deemed inadequate)	15 (50%)	5 (16.7%)	20 (33.3%)
Drug allergy - chemotherapy/biologics allergy	10 (33.3%)	2 (6.7%)	12 (20%)
Drug allergy - non-steroidal anti-inflammatory drug reactions	0 (0%)	2 (6.7%)	2 (3.3%)
Drug allergy - other drug allergy deemed clinically urgent	19 (63.3%)	5 (16.7%)	24 (40%)
Occupational allergy (eg latex)	2 (6.7%)	0 (0%)	2 (3.3%)
Food allergy - food-induced anaphylaxis	13 (43.3%)	25 (83.3%)	38 (63.3%)
Food allergy - nutritional concern	5 (16.7%)	25 (83.3%)	30 (50%)
Food allergy - limited diet but no nutritional concern	2 (6.7%)	7 (23.3%)	9 (15%)
Food allergy - patient choice	0 (0%)	2 (6.7%)	2 (3.3%)
Venom anaphylaxis	14 (46.7%)	7 (23.3%)	21 (35%)
Anaphylaxis, uncertain cause	22 (73.3%)	23 (76.7%)	45 (75%)

	Urticaria and angioedema - spontaneous urticaria/angioedema	6 (20%)	3 (10%)	9 (15%)
	Urticaria and angioedema - isolated angioedema	3 (10%)	4 (13.3%)	7 (11.7%)
	Aeroallergen allergy - rhinosinusitis	0 (0%)	2 (6.7%)	2 (3.3%)
	Aeroallergen allergy - rhinosinusitis with asthma	0 (0%)	3 (10%)	3 (5%)
	Other	7 (23.3%)	6 (20%)	13 (21.7%)
3a	Were/are you able to undertake urgent (within 4 weeks) treatments/procedures (eg desensitisations or challenges) week commencing 3rd February 2020	Number of respondents		
		30 (93.8%)	25 (83.3%)	55 (88.7%)
	Yes	27 (90%)	21 (84%)	48 (87.3%)
	No	3 (10%)	4 (16%)	7 (12.7%)
3b	Were/are you able to undertake urgent (within 4 weeks) treatments/procedures (eg desensitisations or challenges) week commencing 6th April 2020	Number of respondents		
		30 (93.8%)	25 (83.3%)	55 (88.7%)
	Yes	15 (50%)	7 (28%)	22 (40%)
	No	15 (50%)	18 (72%)	33 (60%)
3c	Were/are you able to undertake urgent (within 4 weeks)	Number of respondents		
		30 (93.8%)	25 (83.3%)	55 (88.7%)

	treatments/procedures (eg desensitisations or challenges) week commencing 8th May 2020	Yes	18 (60%)	8 (32%)	26 (47.3%)
		No	12 (40%)	17 (68%)	29 (52.7%)
4	Has there been a change to the available repertoire or turnaround time of specific IgE tests in your local laboratory?	Number of respondents	31 (96.9%)	29 (96.7%)	60 (96.8%)
		Yes	8 (25.8%)	7 (24.1%)	15 (25%)
		No	23 (74.2%)	22 (75.9%)	45 (75%)
5	If indicated, are you able to book skin tests for patients reviewed remotely (telephone or video consultations)?	Number of respondents	32 (100%)	29 (96.7%)	61 (98.4%)
		Less than 1 week	1 (3.1%)	4 (13.8%)	5 (8.2%)
		1-4 weeks	7 (21.9%)	6 (20.7%)	13 (21.3%)
		By deferring to subsequent appointment (>4 weeks)	24 (75%)	19 (65.5%)	43 (70.5%)

Table-3: Data summarising impact on specialist immunology services

Question number	Question	Sub-categories	Adult immunology n= (%)		Paediatric immunology n= (%)		Total immunology n= (%)	
Service recovery								
1	Have you made changes to patient's immunoglobulin (Ig) dosing regimens as a result of the COVID-19 pandemic?	Number of respondents	30	(100%)	7	(100%)	37	(100%)
		Yes	20	(66.7%)	1	(14.3%)	21	(56.8%)
		No	10	(33.3%)	6	(85.7%)	16	(43.2%)
2	Have any patients discontinued Ig therapy as a result of COVID-19?	Number of respondents	30	(100%)	7	(100%)	37	(100%)
		Yes	10	(33.3%)	2	(28.6%)	12	(32.4%)
		No	20	(66.7%)	5	(71.4%)	25	(67.6%)
Service provision								
3	Have patients been switched from hospital to home Ig therapy as a result of the COVID-19 pandemic?	Number of respondents	30	(100%)	7	(100%)	37	(100%)
		Yes	26	(86.7%)	2	(28.6%)	28	(75.7%)
		No	4	(13.3%)	5	(71.4%)	9	(24.3%)
4	Are home visits normally provided for routine assessment of patients on home Ig therapy?	Number of respondents	30	(100%)	7	(100%)	37	(100%)
		Yes	18	(60%)	4	(57.1%)	22	(59.5%)
		No	12	(40%)	3	(42.9%)	15	(40.5%)
5	Has there been a reduction in home visits as a consequence of COVID-19?	Number of respondents	17	(56.7%)	3	(42.9%)	20	(54.1%)
		Yes	16	(94.1%)	2	(66.7%)	18	(90%)
		No	1	(5.9%)	1	(33.3%)	2	(10%)
Investigations								
6	Has there been a change in the availability of immunology laboratory investigations for the	Number of respondents	30	(100%)	7	(100%)	37	(100%)
		No change	24	(80%)	4	(57.1%)	28	(75.7%)

	investigation of immunodeficiency?	Longer turnaround time	4 (13.3%)	1 (14.3%)	5 (13.5%)
		Fewer tests available	2 (6.7%)	3 (42.9%)	5 (13.5%)
		Other	1 (3.3%)	2 (28.6%)	3 (8.1%)
COVID-19 in immunodeficiency					
7	Have any immunodeficiency patients from your service been diagnosed with COVID-19?	Number of respondents	29 (96.7%)	7 (100%)	36 (97.3%)
		Yes	22 (75.9%)	2 (28.6%)	24 (66.7%)
		No	7 (24.1%)	5 (71.4%)	12 (33.3%)
8	How many patients in your service have been diagnosed with COVID-19?	Number of respondents	30 (100%)	7 (100%)	37 (100%)
			73≤n≤ 84	3	76≤n≤ 87
9	How many COVID-19 positive patients have been reported to the COVID19 PID data collection?	Number of respondents	22 (73.3%)	2 (28.6%)	24
			56≤n≤ 77	1≤n≤ 3	57≤n≤ 80
Shielding advice					
10	Have all immunodeficiency patients in your department been risk stratified by your team according to need for 'shielding'?	Number of respondents	30 (100%)	7 (100%)	37 (100%)
		Yes	29 (96.7%)	7 (100%)	36 (97.3%)
		No	1 (3.3%)	0 (0%)	1 (2.7%)
11	How did you stratify these immunodeficiency patients according to need for 'shielding'?	Number of respondents	29 (96.7%)	7 (100%)	36 (97.3%)
		Using government guidelines or advice	4 (13.8%)	0 (0%)	4 (11.1%)
		No method stated	8 (27.6%)	3 (42.9%)	11 (30.6%)

		Using UKPIN guideline	17 (58.6%)	4 (57.1%)	21 (58.3%)
		Other stratifying method	4 (13.8%)	0 (0%)	4 (11.1%)
12	Did you liaise with your Trust to send out 'national' screening letters?	Number of respondents	30 (100%)	7 (100%)	37 (100%)
		Yes	15 (50%)	6 (85.7%)	21 (56.8%)
		No	15 (50%)	1 (14.3%)	16 (43.2%)
13	If 'no' did you send out independent letters from your department advising shielding?	Number of respondents	13 (43.3%)	1 (14.3%)	14 (37.8%)
		Yes	13 (100%)	0 (0%)	13 (92.9%)
		No	0 (0%)	1 (100%)	1 (7.1%)

FIGURE LEGENDS

Figure:1

- A: Comparison of face-to-face patient appointments (median [IQR]) for week commencing at 3 time points for Immunology clinics
- B: Comparison of telephone patient appointments (median [IQR]) for week commencing at 3 time points for Immunology clinics
- C: Comparison of face-to-face patient appointments (median [IQR]) for week commencing at 3 time points for Allergy clinics
- D: Comparison of telephone patient appointments (median [IQR]) for week commencing at 3 time points for Allergy clinics

Figure: 2

- A: Comparison of hospital IVIg appointments (median [IQR]) for week commencing at 3 time points
- B: Comparison of patients receiving home IVIg and SCIg (median [IQR]) for week commencing at 3 time points
- C: Comparison of general anaesthetic allergy testing numbers (median [IQR]) for week commencing at 3 time points
- D: Comparison of in-hospital open food challenges numbers (median [IQR]) for week commencing at 3 time points

Figure: 3

- A: Comparison of venom immunotherapy up dosing injection appointments (median [IQR]) for week commencing at 3 time points
- B: Comparison of venom immunotherapy maintenance injection appointments (median [IQR]) for week commencing at 3 time points
- C: Comparison of subcutaneous immunotherapy for allergic rhinitis up dosing injection appointments (median [IQR]) for week commencing at 3 time points
- D: Comparison of subcutaneous immunotherapy for allergic rhinitis maintenance injection appointments (median [IQR]) for week commencing at 3 time points

Figure: 4

- A: Comparison of in-hospital omalizumab injection appointments (median [IQR]) for chronic spontaneous urticaria for week commencing at 3 time points
- B: Comparison of patients receiving home omalizumab injection (median [IQR]) for chronic spontaneous urticaria for week commencing at 3 time points

C: Comparison of numbers of new patient appointments (median [IQR]) for sublingual immunotherapy initiation for week commencing at 3 time points

D: Comparison of patients receiving maintenance for sublingual immunotherapy (median [IQR]) for week commencing at 3 time points

Personal Protective Equipment (PPE) and screening												
1	Screening	Number of respondents	30	(100%)	7	(100%)	30	(93.8%)	27	(90%)	94	(94.9%)
1a	When patients arrive for appointments or procedures, were/are you screening for COVID-19 infection- week commencing 3rd February 2020	No screening	14	(46.7%)	2	(28.6%)	14	(46.7%)	13	(48.1%)	43	(45.7%)
		Screening questionnaire (e.g. cough, fevers)	9	(30%)	2	(28.6%)	8	(26.7%)	4	(14.8%)	23	(24.5%)
		Temperature measurements	4	(13.3%)	1	(14.3%)	3	(10%)	0	(0%)	8	(8.5%)
		COVID-19 swab	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)
1b	When patients arrive for appointments or procedures, were/are you screening for COVID-19 infection- week commencing 6th April 2020	No screening	10	(33.3%)	0	(0%)	11	(36.7%)	10	(37%)	31	(33%)
		Screening questionnaire (e.g. cough, fevers)	24	(80%)	5	(71.4%)	25	(83.3%)	17	(63%)	71	(75.5%)
		Temperature measurements	18	(60%)	2	(28.6%)	21	(70%)	6	(22.2%)	47	(50%)
		COVID-19 swab	1	(3.3%)	0	(0%)	0	(0%)	0	(0%)	1	(1.1%)
1c	When patients arrive for appointments or procedures, were/are you screening for COVID-19 infection- week commencing 8th May 2020	No screening	6	(20%)	0	(0%)	10	(33.3%)	10	(37%)	26	(27.7%)
		Screening questionnaire (e.g. cough, fevers)	25	(83.3%)	4	(57.1%)	26	(86.7%)	19	(70.4%)	74	(78.7%)
		Temperature measurements	19	(63.3%)	3	(42.9%)	21	(70%)	7	(25.9%)	50	(53.2%)
		COVID-19 swab	1	(3.3%)	2	(28.6%)	0	(0%)	0	(0%)	3	(3.2%)
2	PPE	Number of respondents	30	(100%)	7	(100%)	31	(96.9%)	21	(70%)	89	(89.9%)
2a	For procedures with asymptomatic patients (eg skin testing, venom immunotherapy, omalizumab, challenges, immunoglobulin) were you using the following PPE week commencing 3rd February 2020:	Surgical mask (fluid resistant)	0	(0%)	1	(14.3%)	0	(0%)	3	(14.3%)	4	(4.5%)
		Filtering Facepiece 3 mask	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)
		Single use plastic apron	3	(10%)	2	(28.6%)	4	(12.9%)	6	(28.6%)	15	(16.9%)
		Long sleeved gown	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)
		Eye protection	0	(0%)	0	(0%)	0	(0%)	1	(4.8%)	1	(1.1%)
2b	For procedures with asymptomatic patients (eg skin testing, venom immunotherapy, omalizumab, challenges, immunoglobulin) were you using the following PPE week commencing 6th April 2020:	Surgical mask (fluid resistant)	28	(93.3%)	5	(71.4%)	27	(87.1%)	17	(81%)	77	(86.5%)
		Filtering Facepiece 3 mask	2	(6.7%)	0	(0%)	1	(3.2%)	0	(0%)	3	(3.4%)
		Single use plastic apron	27	(90%)	5	(71.4%)	26	(83.9%)	17	(81%)	75	(84.3%)
		Long sleeved gown	1	(3.3%)	0	(0%)	1	(3.2%)	1	(4.8%)	3	(3.4%)
		Eye protection	13	(43.3%)	0	(0%)	13	(41.9%)	2	(9.5%)	28	(31.5%)

2c	For procedures with asymptomatic patients (eg skin testing, venom immunotherapy, omalizumab, challenges, immunoglobulin) were you using the following PPE week commencing 8th May 2020:	Surgical mask (fluid resistant)	30 (100%)	7 (100%)	31 (100%)	20 (95.2%)	88 (98.9%)
		Filtering Facepiece 3 mask	3 (10%)	0 (0%)	2 (6.5%)	0 (0%)	5 (5.6%)
		Single use plastic apron	28 (93.3%)	6 (85.7%)	30 (96.8%)	18 (85.7%)	82 (92.1%)
		Long sleeved gown	1 (3.3%)	0 (0%)	1 (3.2%)	1 (4.8%)	3 (3.4%)
		Eye protection	14 (46.7%)	2 (28.6%)	16 (51.6%)	4 (19%)	36 (40.4%)
Service provision							
3	Has there been a change to out-of-hours (outside of 9am to 5pm, weekends and public holidays) provision?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Not applicable; no out of hours provision pre-COVID-19	18 (60%)	4 (57.1%)	26 (81.3%)	22 (73.3%)	70 (70.7%)
		No change (out-of-hours service continues)	12 (40%)	3 (42.9%)	6 (18.8%)	8 (26.7%)	29 (29.3%)
		Out of hours service withdrawn as a result of COVID-19	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Research							
4	Have there been changes in your research activity?	Number of respondents	30 (100%)	7 (100%)	32 (100%)	30 (100%)	99 (100%)
		Not applicable; not involved in research pre-COVID-19	5 (16.7%)	0 (0%)	7 (21.9%)	18 (60%)	30 (30.3%)
		No change	8 (26.7%)	2 (28.6%)	6 (18.8%)	3 (10%)	19 (19.2%)
		Yes, moved to remote research	2 (6.7%)	3 (42.9%)	1 (3.1%)	3 (10%)	9 (9.1%)
		Yes, all research suspended	14 (46.7%)	2 (28.6%)	17 (53.1%)	5 (16.7%)	38 (38.4%)
		Reduced numbers or other	1 (3.3%)	0 (0%)	1 (3.1%)	1 (3.3%)	3 (3%)
Referrals							
5	Referrals	Number of respondents	30 (100%)	7 (100%)	31 (96.9%)	29 (96.7%)	97 (98%)
5a	Did you triage referrals pre-COVID-19?	Yes, all	27 (90%)	6 (85.7%)	27 (87.1%)	22 (75.9%)	82 (84.5%)
		Some	3 (10%)	1 (14.3%)	3 (9.7%)	7 (24.1%)	14 (14.4%)
		No, none	0 (0%)	0 (0%)	1 (3.2%)	0 (0%)	1 (1%)
5b	Do you triage referrals since COVID-19?	Yes, all	27 (90%)	6 (85.7%)	29 (93.5%)	25 (86.2%)	87 (89.7%)
		Some	2 (6.7%)	1 (14.3%)	1 (3.2%)	4 (13.8%)	8 (8.2%)
		No, none	1 (3.3%)	0 (0%)	1 (3.2%)	0 (0%)	2 (2.1%)

FIGURE-1 (A-D)

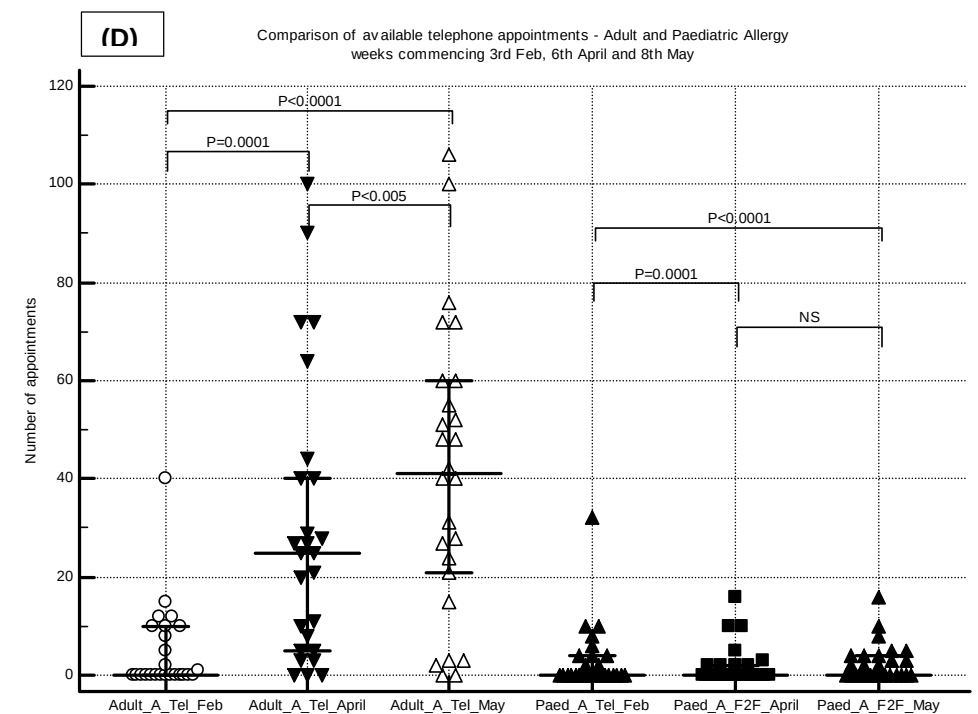
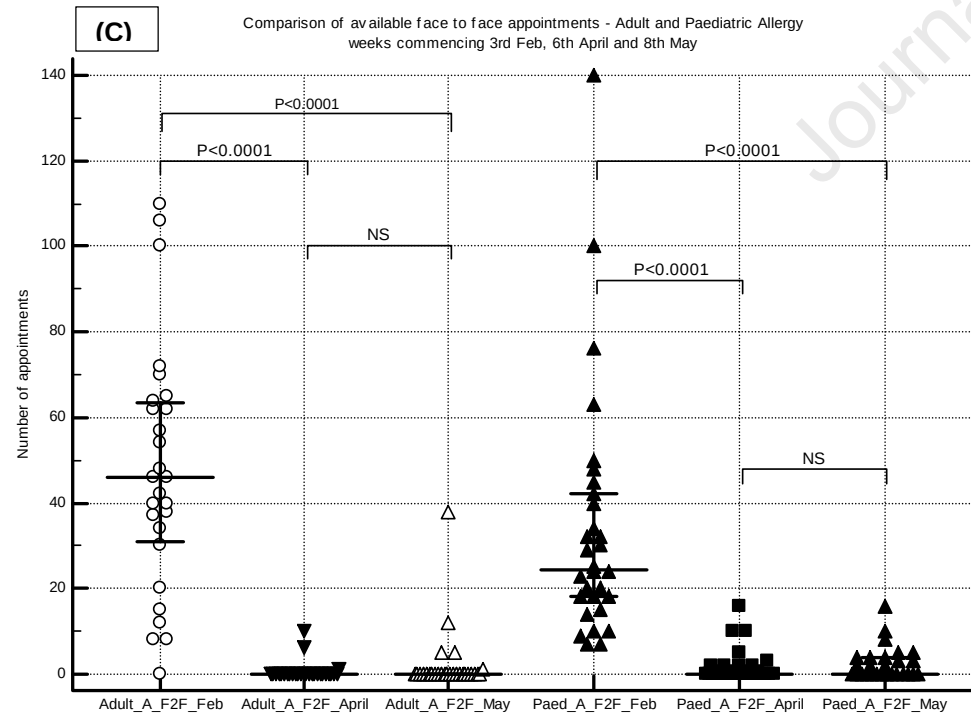
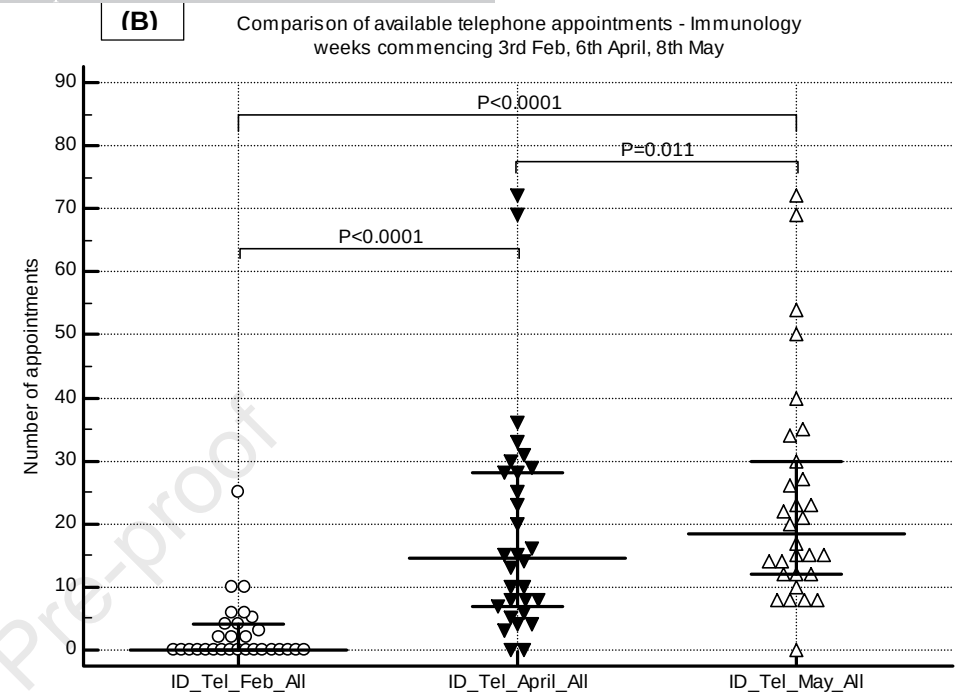
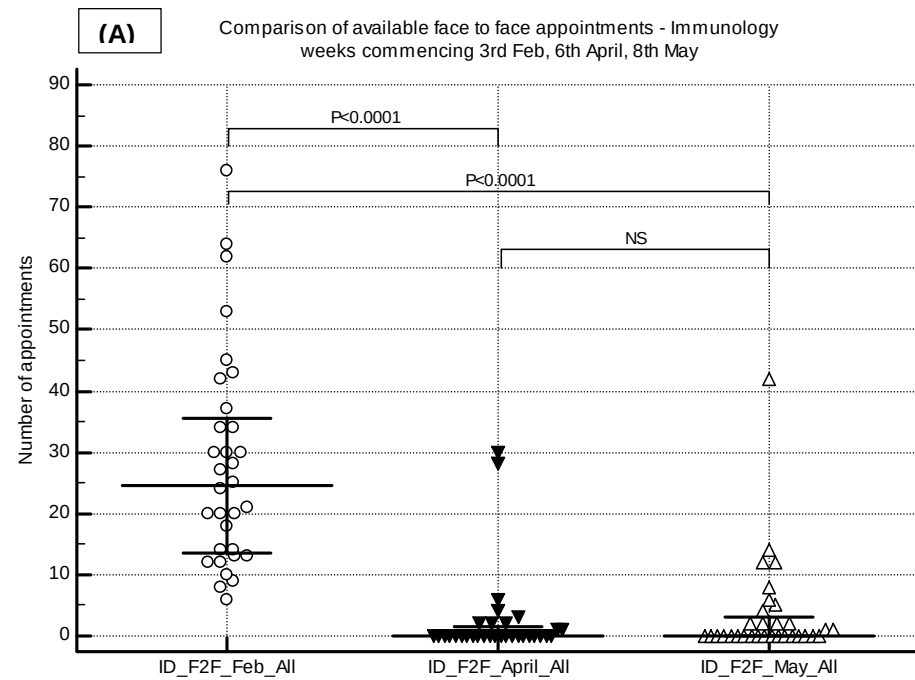


FIGURE-2(A-D)

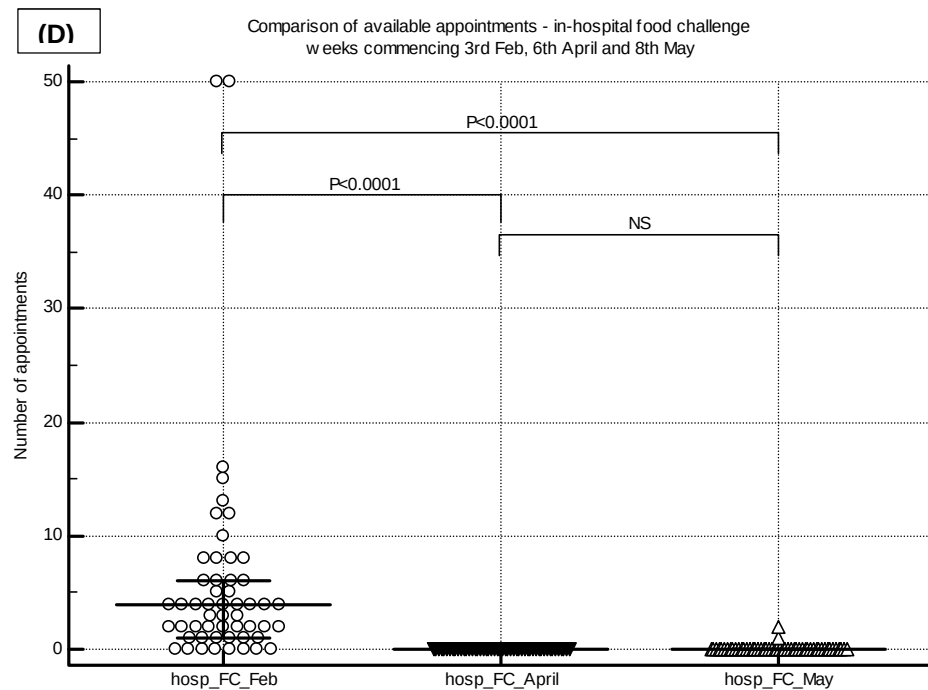
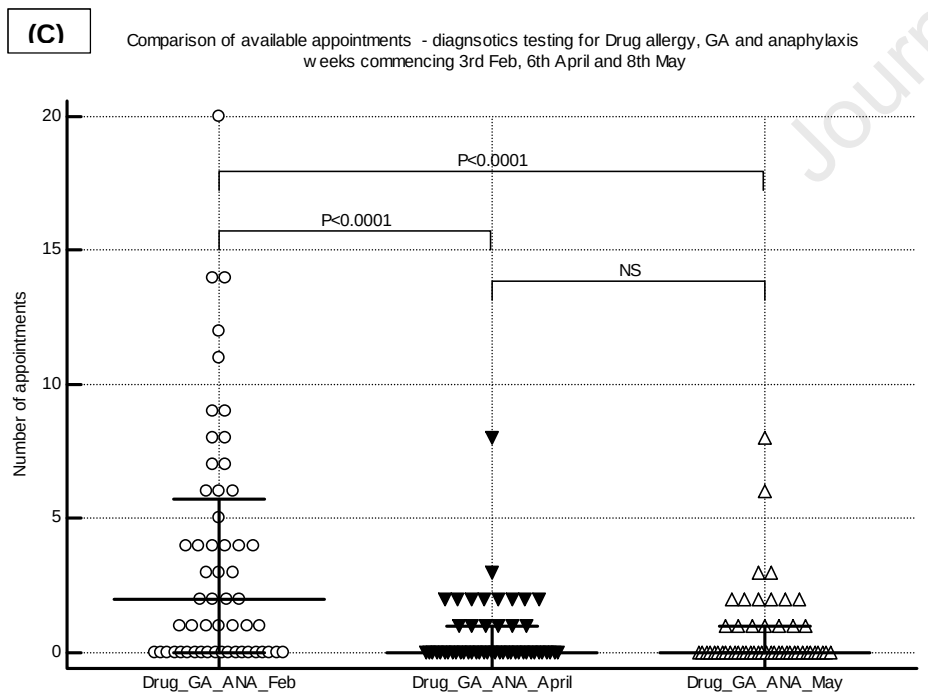
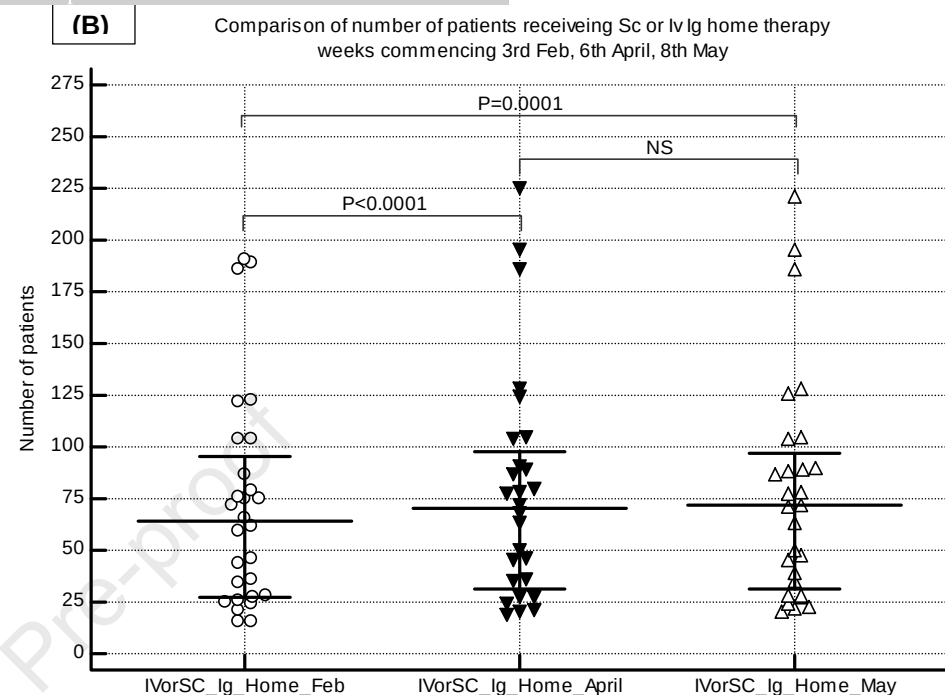
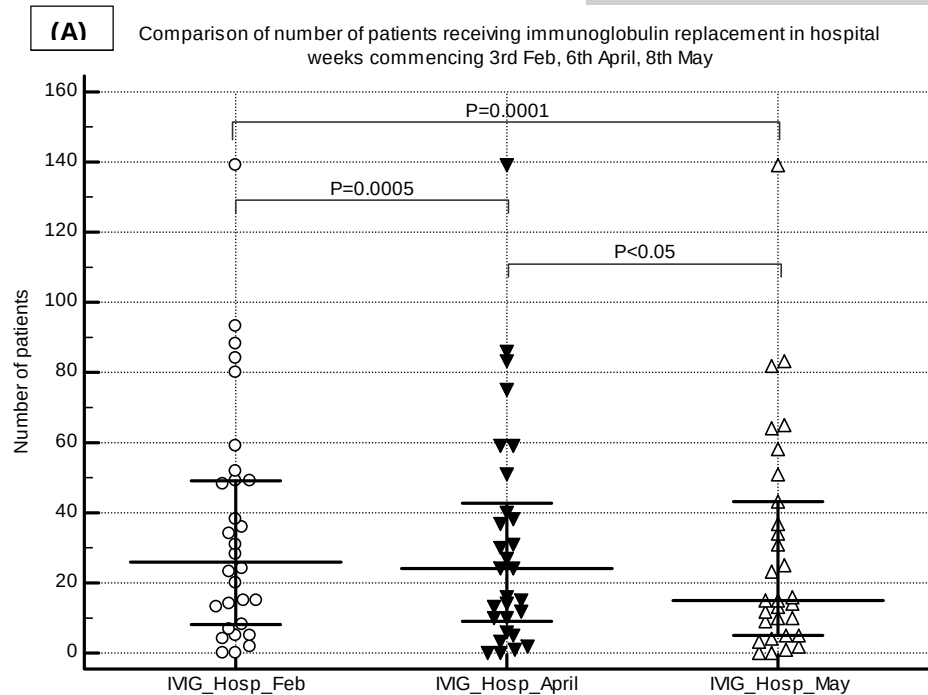


FIGURE-3 (A-D)

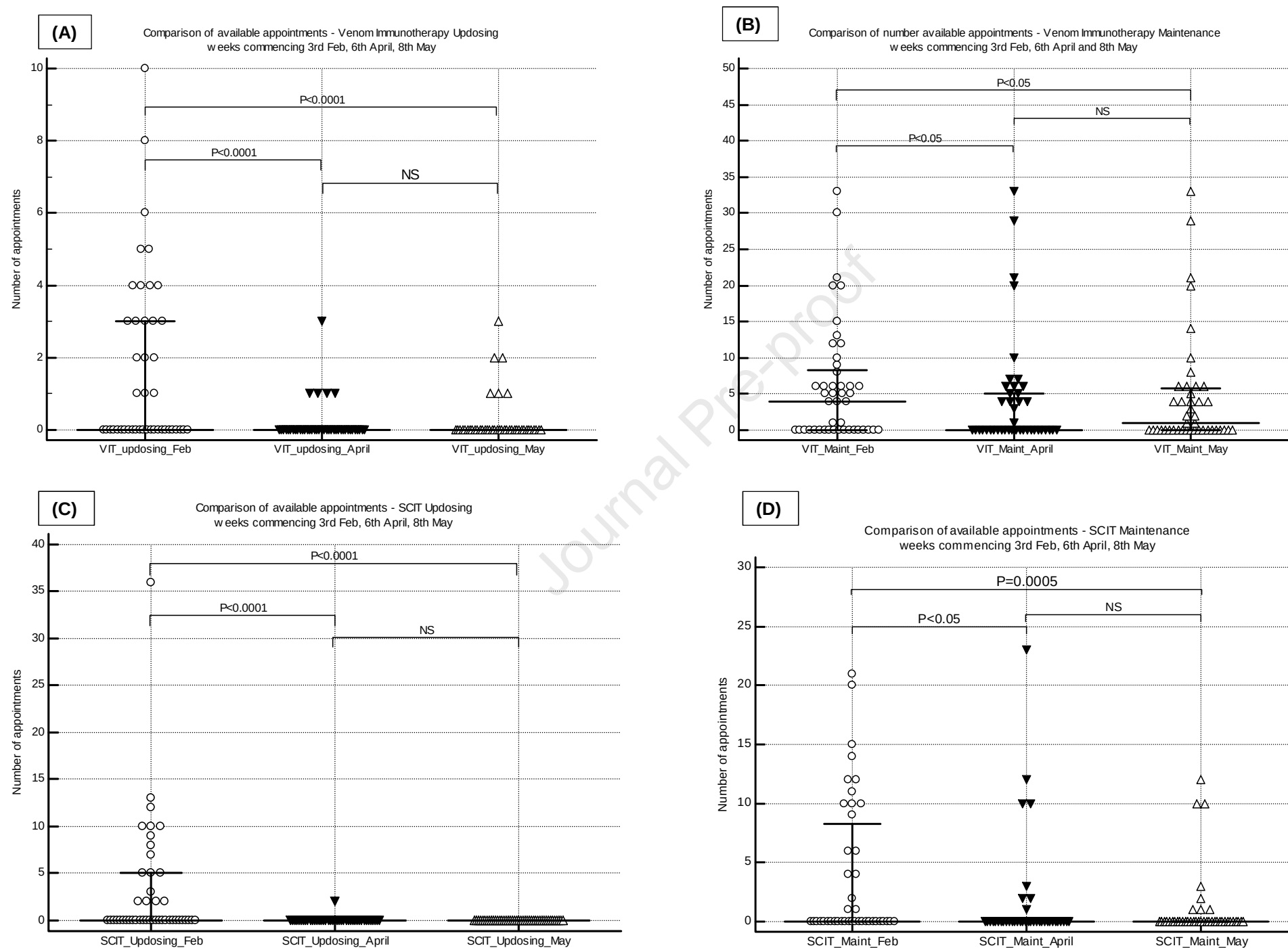


FIGURE-4 (A-D) ➔

