The development of a Radiation Therapist led treatment delivery service for patients undergoing SABR for peripherally located lung tumours

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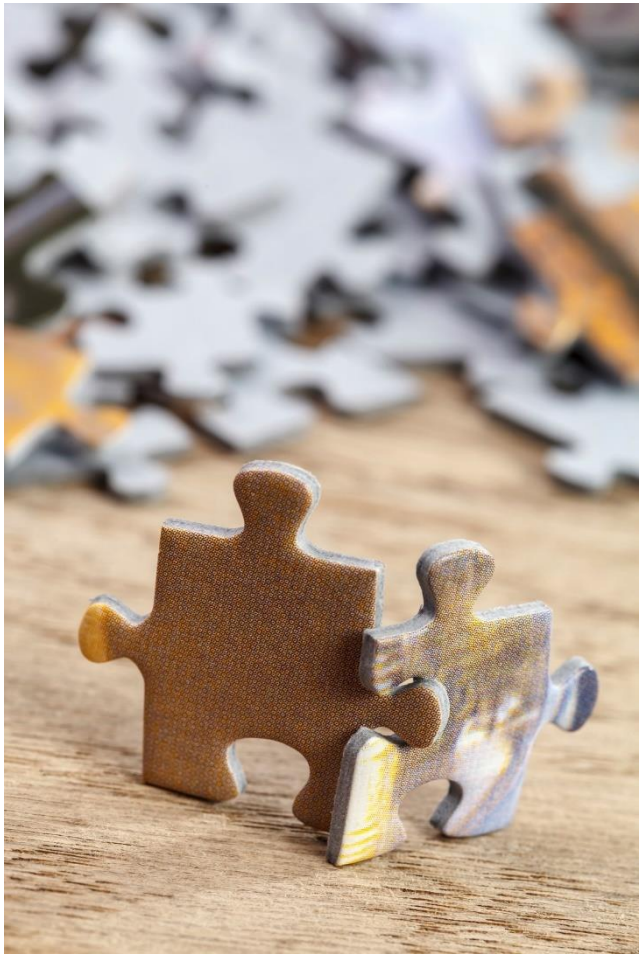
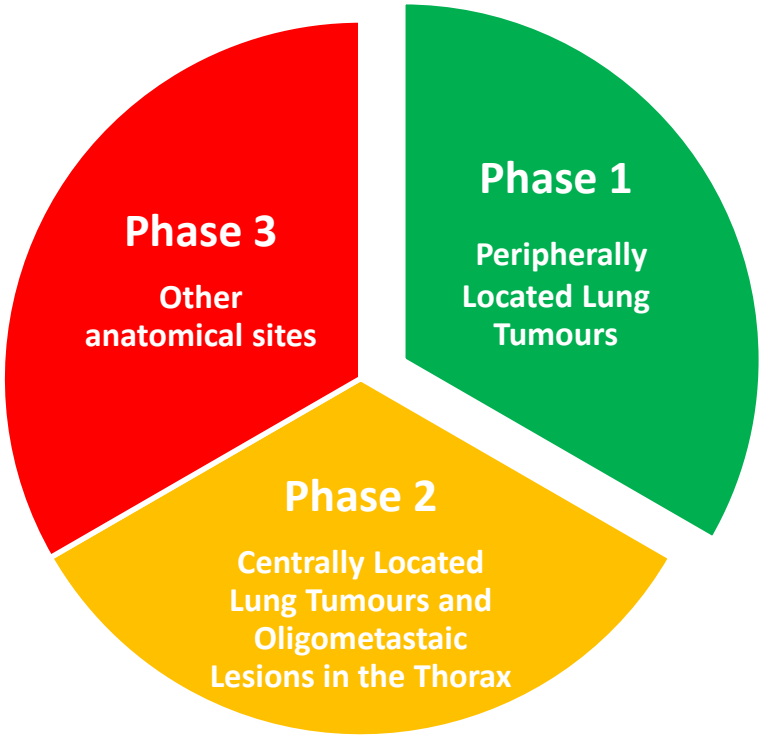
My Role

- Triage all SABR referrals and prioritise OPD appointments
- Organise additional diagnostic imaging / tests as required through radiation oncology team
- Collate all relevant information for case discussion at weekly SABR MDM
- Chair weekly SABR MDM
- Organise simulation appointments/transport/bed requests through central bookings office and coordinate patients appointments with RO availability
- Oversee patients progress through pathway and address any delays as required
- Collate and analyse data on all patients for research and development purposes
- Sign-off on non first fraction treatment verifications



Background

- Q1 2013 SLRON initiates the extra-cranial SABR programme
- A multidisciplinary steering group was formed
  - 3 RTTs (1 pre-treatment, 1 planning & 1 treatment)
  - 1 Physicist
  - 2 Radiation Oncologists
  - 1 Nurse
- A phased based implementation strategy was chosen
  - Phase 1: Peripherally located lung tumours
- 1st patient was treated in Q1 2014
- To date 135 patients have successfully completed SABR treatment course



Development of an evidence based IGRT procedure

- Extensive literature review
- Site visits
- Published guidelines
- Subsequent data analysis has shaped the revised procedure

Challenges in image guidance in peripheral lung SABR

Table 3. Review of Published Data on Inter-fractional Baseline Target Displacement

Group	No. of patients (scans)	Respiratory Management	Method	Pop A-P Σ (σ)	Pop S-I Σ (σ)	Pop M-L Σ (σ)	3D vector 90% percentile (max)
Guckenberger et al (2006)	21 (66)	Free breathing or abdominal compression if tumour motion >5mm	kV-CBCT	3.3 (1.3)	2.1 (1.1)	2.2 (1.1)	8.0 (11.1)
Purdie et al (2007)	28 (89)	Free breathing or abdominal compression if tumour motion >10mm	kV-CBCT	N/A	N/A	N/A	13.9 (30)
Sonke et al (2008)	65 (195)	Free breathing only	4D-kV-CBCT	3.0 (2.0)	2.9 (1.5)	1.8 (1.1)	N/A
Wang et al (2010)*	7 (153)	Free breathing	kV-CBCT	3.4 (1.9)	4.3 (3.2)	2.0 (2.6)	N/A
Wang et al (2010)*	14 (133)	ABC	kV-CBCT	2.7 (3.9)	3.4 (2.9)	3.2 (2.3)	N/A
Present Study (2014)	24 (112)	Free breathing	kV-CBCT	2.9 (1.9)	2.5 (2.8)	0.8 (1.2)	7.3 (19.3)

Abbreviations: Pop Σ = Population systematic error; Pop σ = Population random error; A-P = Anterior-Posterior plane; S-I = Superior-Inferior plane; M-L = Medial-Lateral plane

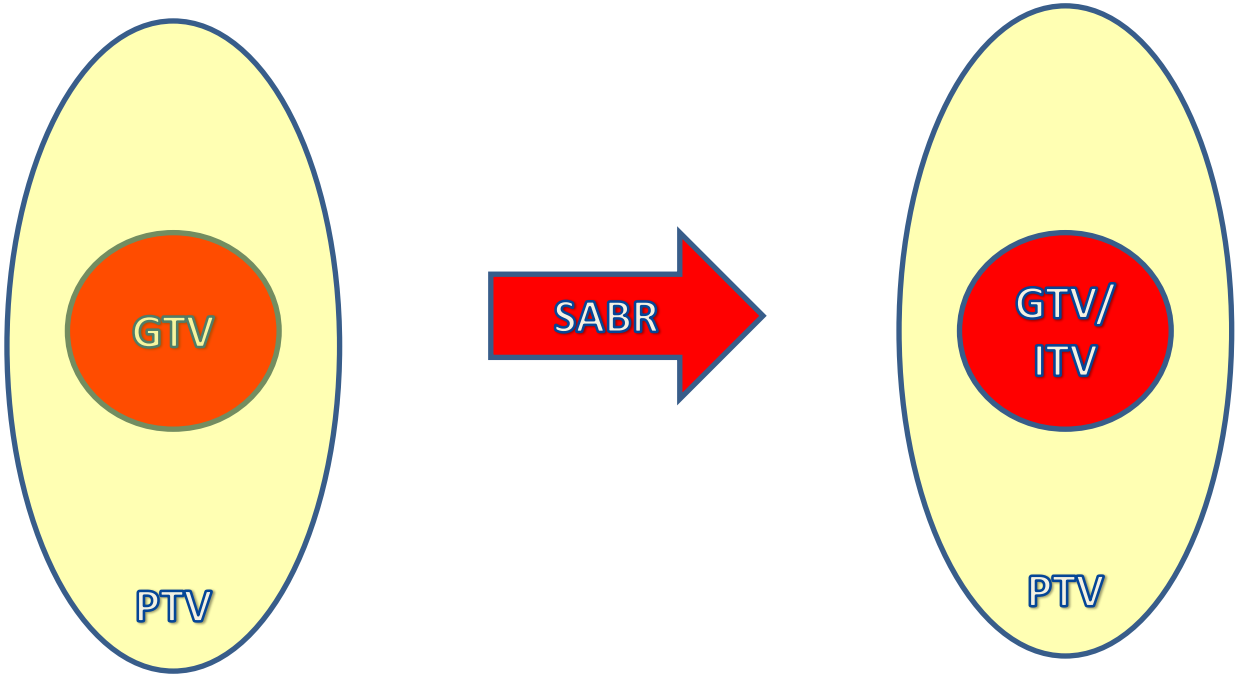
Σ = Standard deviation of each individuals' mean inter-fractional baseline shift

σ = Root-mean-square of each individuals' standard deviation (dispersion) of inter-fractional baseline shift

* Represents results from those immobilised with stereotactic body frame only

Uncertainty

3D Conformal **SABR**



A publication by Korreman et al (2012) found 4D image guidance defined as either fluoroscopy, 3D CBCT or respiration correlated CBCT (4D-CBCT) as the single most important factor in reducing uncertainty margins in lung patients.

Challenges in image guidance in peripheral lung SABR

- Soft tissue matching to the target was essential
- But there were concerns over this strategy:
  - Image quality (Liu et al 2013)
  - Variations in breathing pattern / irregular breathing (Clements et al 2013)
  - Dosimetric consequences soft tissue matching (Galerani et al 2010)
  - Imaging system capabilities
  - Radiation Therapist Confidence
- Decided that radiation oncologist must be present to verify the target localisation at every fraction

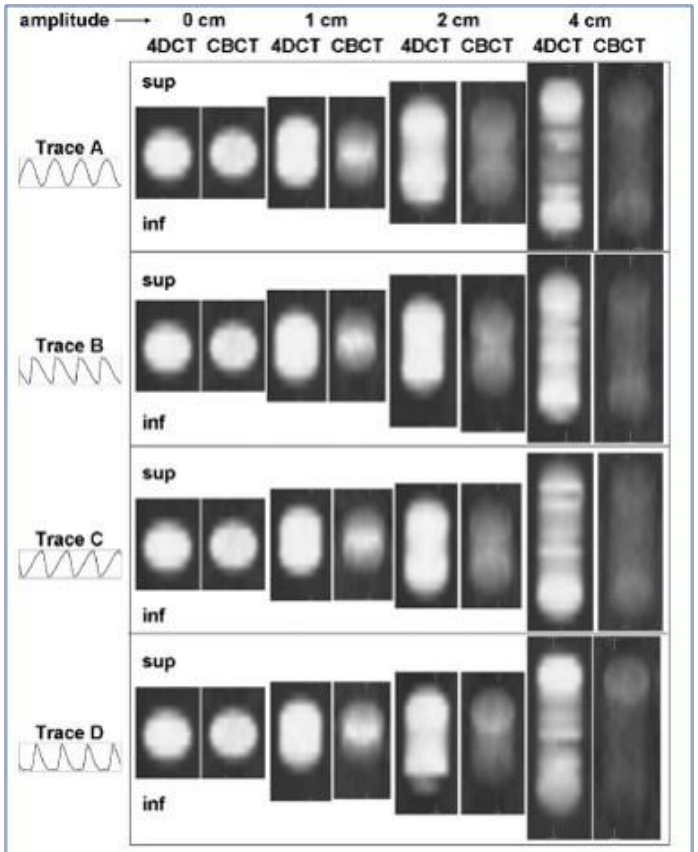


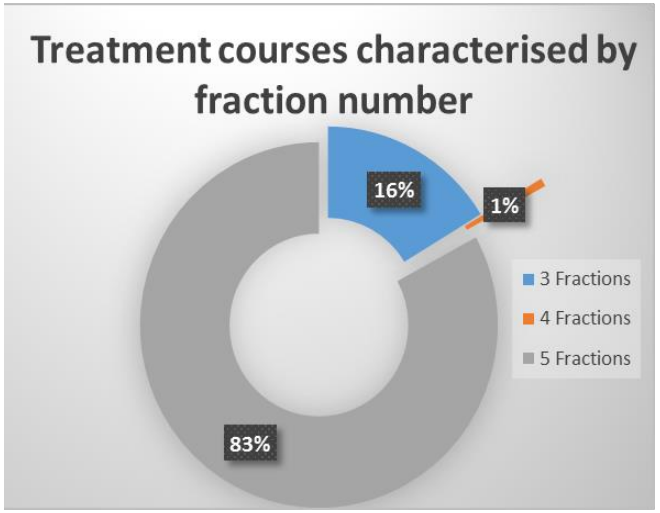
FIG. 3. The qualitative effect of amplitude on 4DCT MIP and CBCT ITVs for the small lesion moving with computer-generated breathing patterns Traces A–D.

Why do we need the radiation oncologist at verification?

- International practice - *'It is also recommended that a radiation oncologist approve the result of the image guidance and verify the port films before every fraction of the SBRT treatment'* – (Stereotactic body radiation therapy: The report of AAPM Task Group 101)
- SABR is unforgiving! Ablative doses, small safety margins, steep dose gradients and small number of fractions means no dose blurring effect
- Precise image guidance in SABR is critical to its success and it is complicated requiring image interpretation and critical decision making skills
- ? Scope of practice

Driving Force

- Extremely resource intensive pathway – additional burden on radiation oncologists in particular
- >80% of patients require 5 fractions due to chestwall proximity
- Machine spec limitations (Max dose rate 600MU/min) → slower treatment delivery → mid-treatment CBCT → 1 hour apt time



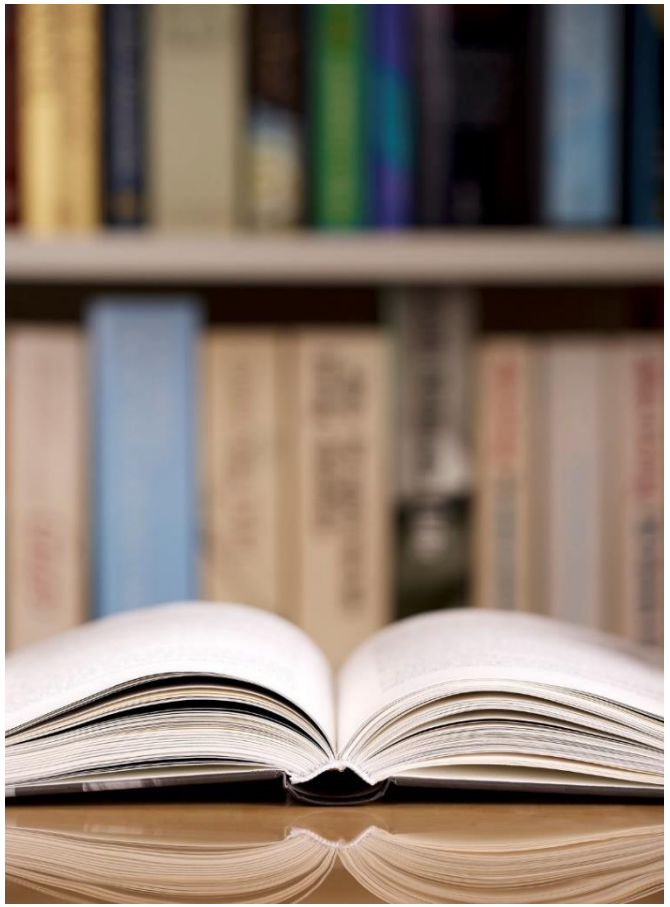
- Only 2 SABR radiation oncologists and only present at certain times/days each week
- Current workload was unsustainable
- The planned expansion of the service to include oligometastatic and centrally located lesions under this model would be impossible
- There was a clear mandate to extend the scope of practice of the SABR clinical specialist to include sign-off of target localisation

Advanced Practice - Characteristics

- Expanded knowledge base
- Increased complexity of clinical decision making skills
- Expertise
- Autonomy
- High performance
- Leadership

Expanded Knowledge Base - Theory

- Extensive literature review conducted on CBCT image guidance for SABR lung
- Undertaking a masters in radiotherapy and oncology through Sheffield Hallam University
- Organised lectures with consultant ROs on:
  - Thoracic radiological anatomy
  - Image interpretation including recognition of pleural effusion, atelectasis, bullae, pneumothorax
  - Radiological characteristics of lung tumours and their histological subtypes
  - Brachial plexus localisation
  - Proximal airway determination



Expanded Knowledge Base - Research

- Collated and analysed data on setup accuracy, target baseline change etc. to validate our PTV margin
- Conducted extensive testing on imaging systems matching capabilities
- Used thoracic phantom to simulate variation in patients breathing pattern and the consequences on system matching capabilities
- Investigated the dosimetric consequences of soft tissue matching for my research dissertation

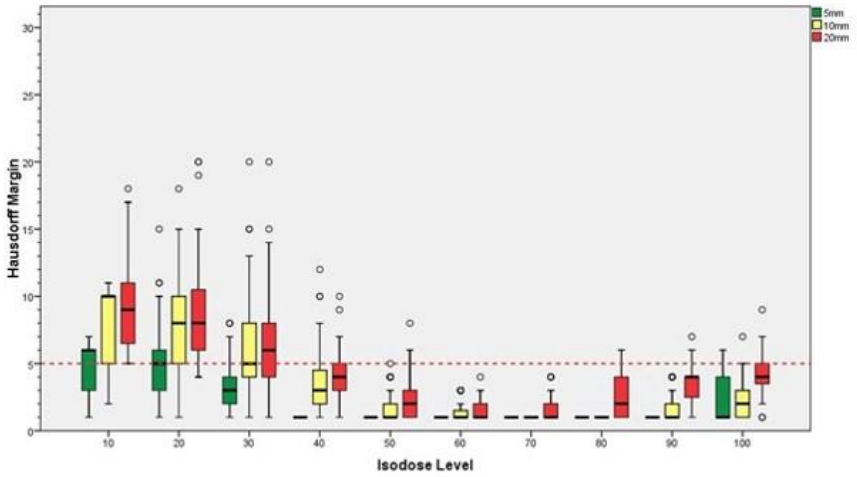
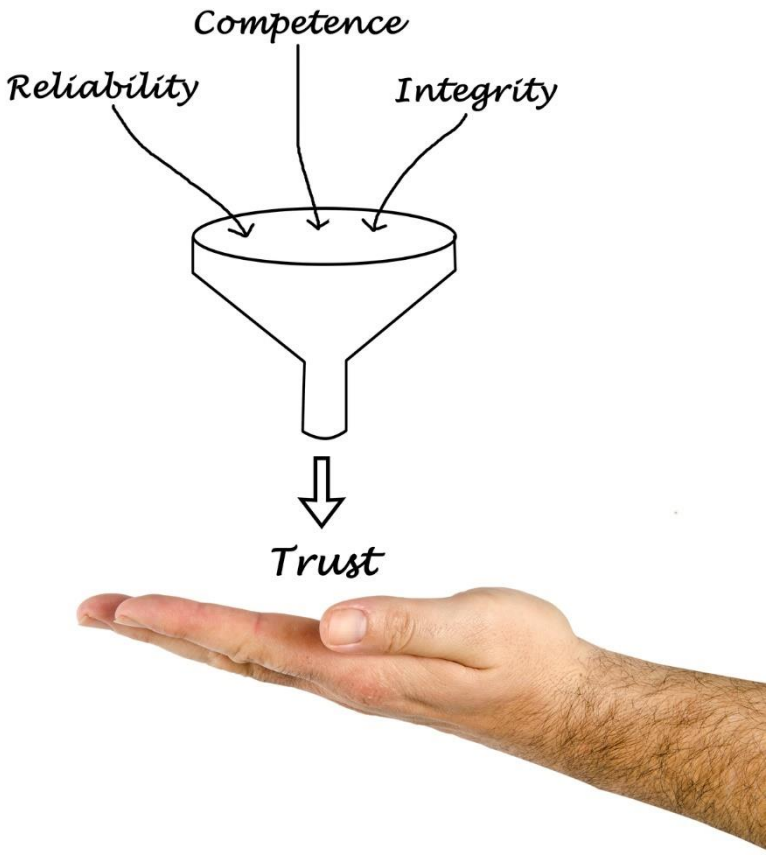


Figure 4. Box plot illustrating Hausdorff Margin requirements (Y-Axis) for each isodose level (X-Axis). Data was pooled according to simulated displacement distance i.e. 5mm (green), 10mm (yellow) and 20mm (red). The refuge offered by a 5mm margin highlighted (red dashed line).

Autonomy and Leadership

- Attended over 300 SABR treatment fractions taking the lead during the procedure prior to initiation
- Build up expertise through case discussions with RO
- Autonomy – Observe, supervision, independence
- Performance – First 10 independent cases are reviewed offline by RO – 100% concordance
- Went live with Radiation Therapist led SABR delivery in February 2016



Obstacles

- Territoriality
  - Radiation Oncologists
  - Physics
  - Planning
  - Admin
- Scope of practice
- Resistance

Benefits to a Radiation Therapist Led SABR Treatment Delivery

- In 6 months since its implementation 114 fractions have been covered through RTT led service
- This translates to a saving of approximately 57 radiation oncologist hours which equates to over 7 working days!
- The mean time (± 1SD, range) between setup and treatment completion had reduced from 33mins (9, 18-110) to 28mins (5, 20-42)
- The combination of reduced treatment time and removal of post CBCT has facilitated a reduction of 10 minutes to non first fraction treatment slots
- Base on figures for 2015 this reduction would equate to > 35 linac hour savings which would accommodate > 137 additional (standard fractionation) treatment fractions

Conclusions

- There are many opportunities out there for advancing the scope of radiation therapists practice, sometimes you just have to point them out!
- Health strategy and workforce planning will look more and more at the potential of advanced practice as a cost effective solution to the increased demands on the health services
- Postgraduate education is an excellent way to broaden your knowledge base and provide you with the critical evaluation skills which are key characteristics of an advanced practitioner
- A structured and systematic approach toward implementation with an emphasis on demonstrating competence and autonomy instils confidence in your colleagues and promotes acceptance
- The patient should be the core focus of any proposal
- Lets show them what we're made of!

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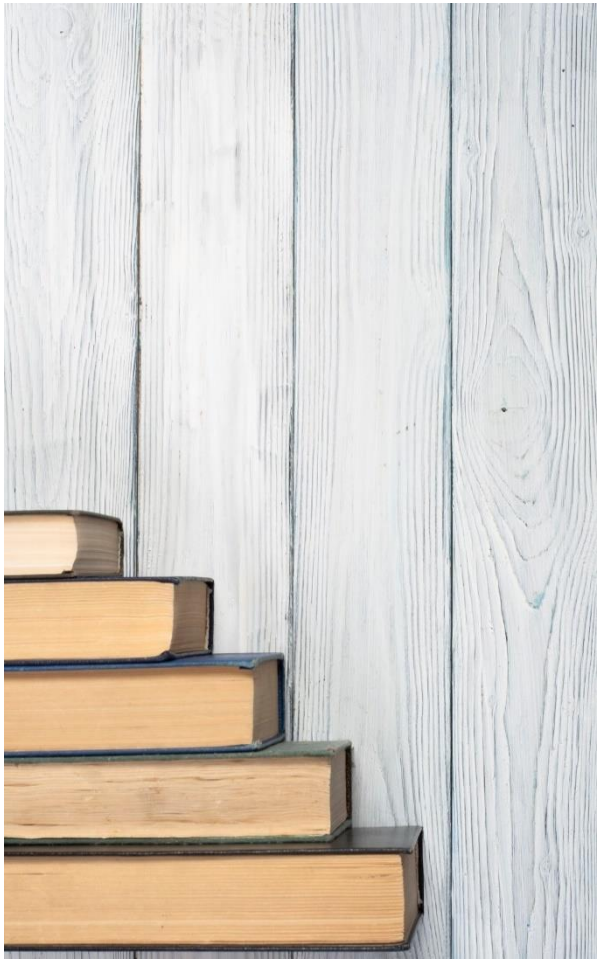

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Thank
you!