2020 Advanced Institute on Health Investigation
and Air Sensing for Asian Pollution (AI on Hi-ASAP)
On-line, October 5, 6, 8 & 15, 2020
Academia Sinica, Taipei, Taiwan

Study design based on the aforementioned data analysis methods

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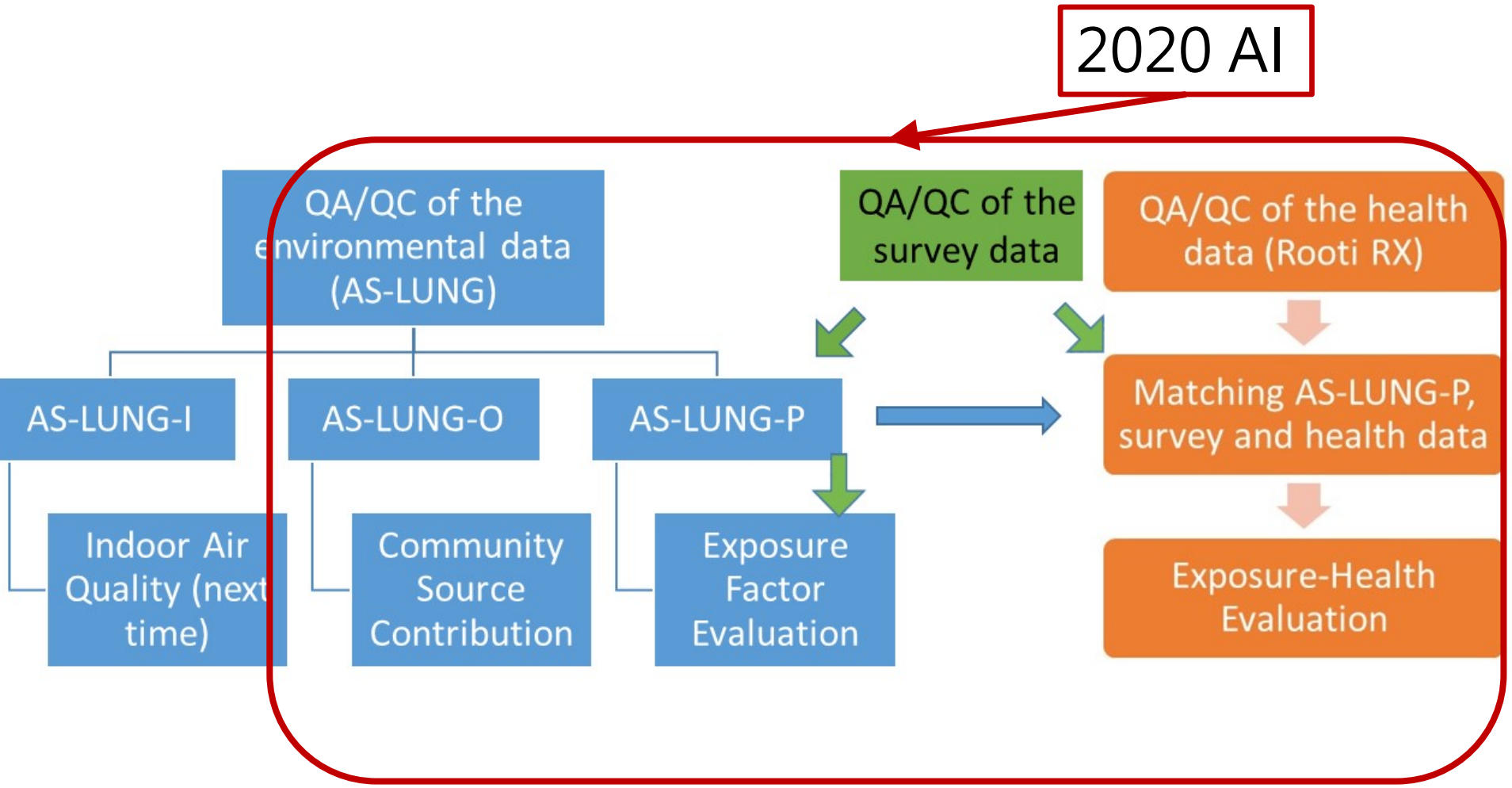
Objectives of Hi-ASAP

- To apply low-cost sensors
  - (1) to assess $PM_{2.5}$ exposure levels, patterns, behaviors, and source characteristics of short-term or peak exposures
  - (2) to evaluate the changes in health indicators of acute health effects
- in order to
  - (1) assess the short-term $PM_{2.5}$ damage coefficients of exposure-health relationship
  - (2) provide scientific evidences to set criteria or ceiling levels of $PM_{2.5}$ with shorter exposure periods (ex. seasonal, 8-hour or hourly)

Data Flow of the Environment, Survey and Health data



The focus of 2020 AI

- QA/QC of the environmental sensor data
  - Python and PyCharm
- QA/QC of the survey
  - Carefully recruit subjects and train the interviewers
- QA/QC of the health data
  - R packages
- Community Source Evaluation
  - Multiple linear regression with R package
- Exposure Factor Evaluation
  - Stepwise regression with R package
- Exposure-health evaluation
  - Generalized Additive Mixed Model (GAMM) with R package

With skills taught in 2020 AI, the initial Research Questions could be answered

- What are the peak $PM_{2.5}$ exposure levels and patterns of Asian population, especially those high-exposure or susceptible populations? YES! With conditions specified in the next two slides
- What are the sources and activities causing peak $PM_{2.5}$ exposures and the controllable factors associated with those sources and activities? YES! With exposure and survey data
- What are the $PM_{2.5}$ damage coefficients of exposure-health relationship of peak exposures for lung and heart conditions? NO! YES! AS-LUNG and Rooti RX
  - Are the damage coefficients for the same health outcome different in different $PM_{2.5}$ concentration ranges? The huge differences in $PM_{2.5}$ levels in the MANGO region provide a testbed to evaluate this question YES! With international comparison
- What are the chemical and toxicological properties of high-exposure sources, especially distinctive Asian sources? NO!
- Should there be a ceiling value or short-term standard for $PM_{2.5}$ (ex. seasonal, 8-hour or hourly)? **What other considerations** needed to be included to promote the establishment of such a standard? NO! YES!

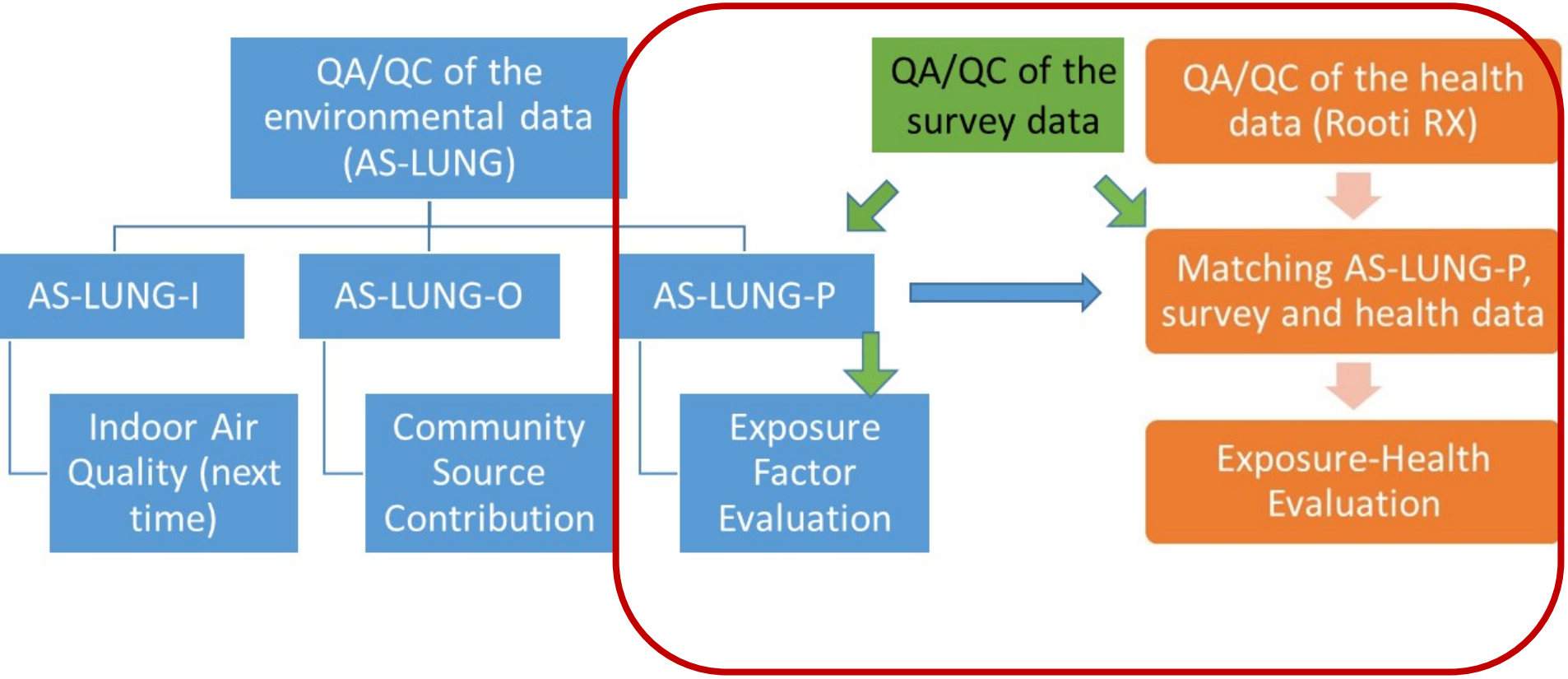
Conditions for successful subject recruitment and survey data collection (1)

- Recruit the "appropriate" subjects
  - Meet the criteria of "high-exposure" or "susceptible"
    - High exposure from certain occupational exposure or certain behaviors
    - Susceptible: the elderly, poor, …
      - No children in Hi-ASAP (difficult to get IRB approval)
      - No subjects with preexisting diseases (unless you have doctors in your group)
    - In HRV studies, please don't recruit subjects with heart diseases
  - Please email inclusion and exclusion criteria for your subjects to us before apply for IRB approval for discussion to make sure we can do international comparison in the future
- Avoid the selection bias
  - Ex. always recruit (select) college students or friends we knew (not good)
  - The subjects should cover different gender and have a variety in their characteristics unless pre-specified

Conditions for successful subject recruitment and survey data collection (2)

- Ask the subjects to follow their daily routine or typical works, do not change their behaviors because of joining this study
  - Obtain the actual exposure
- Avoid the four types of subjects we emphasized earlier
  - Extreme personality: coldness/careless, only love compensation, over enthusiasm, and professionals with his/her own agenda
- Train your interviewer (staff) well

Central Focus of Hi-ASAP



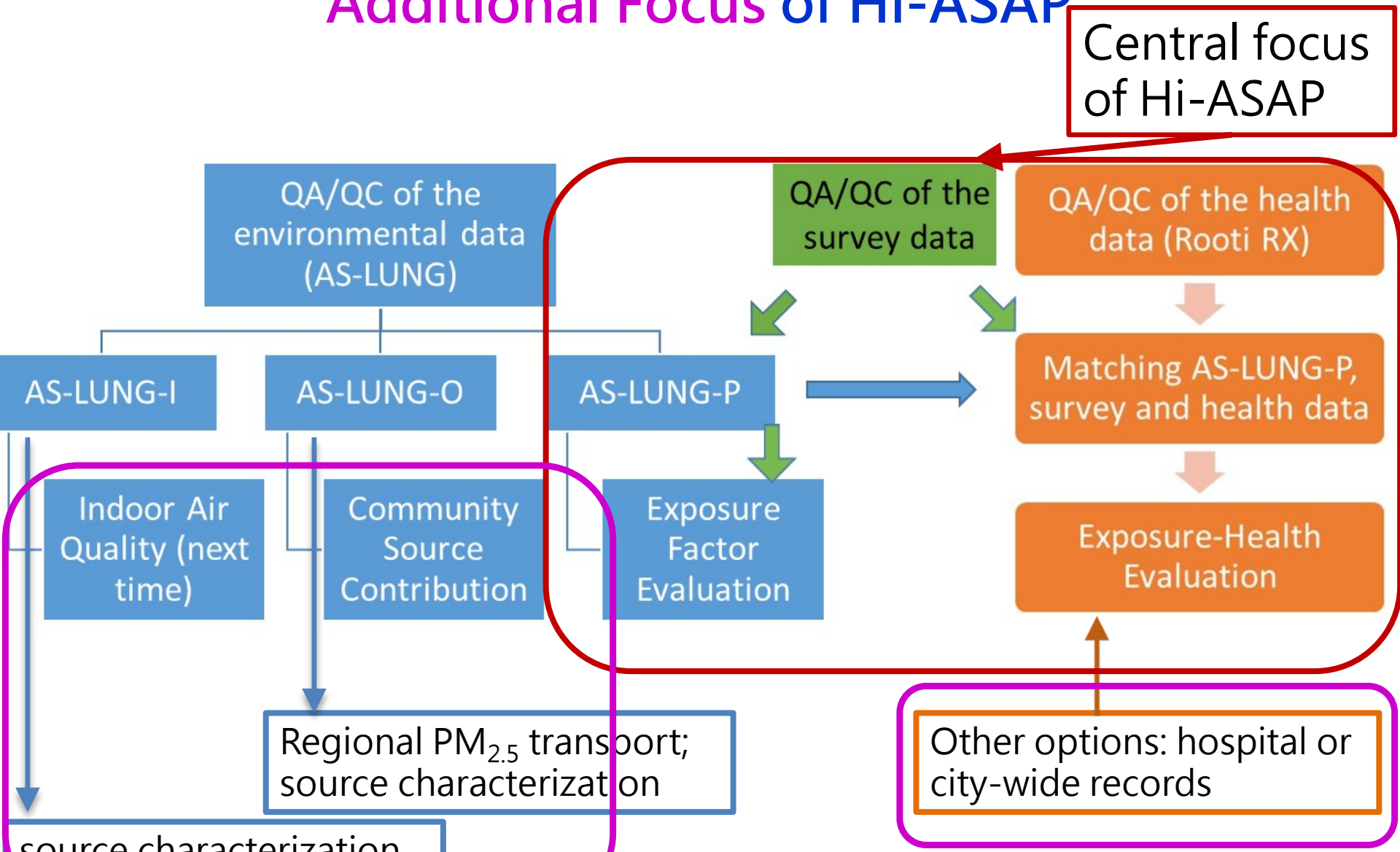
Required planning of a panel-type epidemiological study (main focus of Hi-ASAP): exposure and health relationship)

- Ambient monitoring
  - At least one sensor for ambient air monitoring near the subjects' community
- Exposure
  - continuously 7 days (168 hours) or at least 2 days (or working time of 2 working days) of personal exposure assessment for recruited subjects for at least 20 subjects
- Health
  - continuously 7 days (168 hours) or at least 2 days (or working time of 2 working days) of concurrent HRV monitoring for recruited subjects for at least 20 subjects with Rooti RX (no smart watch at this time)
- Survey
  - Questionnaire (core questions with A, B, and C sections) for the recruited subjects
  - Time-activity diary (TADs) when the subjects carrying personal sensors

Optional planning for additional focus of Hi-ASAP

- Quantification of community source contributions (ex. Asian-type transportation)
  - Several sensors for street-level air monitoring near certain community sources in the subjects' community
- Indoor air quality (ex. Asian-type cooking)
  - continuously 7 days (168 hours) or at least 2 days (or working time of 2 working days) of **concurrent** home indoor and outdoor air monitoring for recruited subjects for at least 15 subjects (if concurrent monitoring is not possible, you may do monitoring separately and focus on indoor and outdoor comparison or indoor source evaluation)
- Regional $PM_{2.5}$ transport (biomass burning, forest fire, and agricultural burning)
  - at least one sensor near the source and at least one sensor near certain community affected by the burning activities

Additional Focus of Hi-ASAP



Optional planning for additional focus of Hi-ASAP

- Exposure-health evaluations with hospital records
  - at least one sensor for ambient air near the hospital
  - Collaboration with doctors or hospitals to obtain those records
- Exposure-health evaluations with city-wide mortality records
  - at least one sensor for ambient air in the city center with higher population density
  - Collaboration with hospitals or the city government to obtain those records
- Source characterization
  - Collect filter samples near the sources for chemical and toxicological evaluations
  - Collect source materials for chemical and toxicological evaluations

Next Steps (1)

- All research groups with three AS-LUNG-O from Academia Sinica (below with priority from high to low)
  - one for ambient air near the subject' s community or workplace
  - Another one for ambient air near the city center
  - Two options for the third one
    - one near sources
      - at streets near certain community sources
      - or places near sources of regional fires
    - one for ambient air
      - near the hospital which you may have access to their records
      - or in a community potentially could be affected by regional fires
      - or in a relative rural area for comparison with that in your subjects' community (workplace) or city center
- You may practice five AS-LUNG-P sets from Academia Sinica and Rooti RX with your students and staff first and get familiar with the operation
  - these data cannot be used in your publication of panel studies (IRB will not allow it)

Next Steps (2)

- All working groups need to start discussion for coordinated planning
- For research groups with 2019 seed grants
  - Translations of questionnaires and time-activity diary into local languages
  - Applying Institutional Review Board (IRB) approval in three months
    - designing a panel-type epidemiological study with at least five AS-LUNG-P from Academia Sinica for exposure assessment and Rooti RX for HRV
    - Please indicate you will remove any identifiable personal information of those subjects before conducting data analysis
    - Please indicate the results of your work will be shared for international comparison with all research groups in Hi-ASAP
    - Please indicate Academia Sinica will assist in data analysis
    - Please be flexible about the pollutants you will assess
      - Currently $PM_{2.5}$ and PM_{1}, we may have size distribution and black carbon in the future
    - Please send us the IRB approval once it is passed

Next Steps (3)

- For research groups did not get 2019 seed grants
  - Translations of questionnaires and time-activity diary into local languages
  - Designing a panel-type epidemiological study with at least five AS-LUNG-P from Academia Sinica for personal exposure assessment and Rooti RX for HRV
  - Get ready to write your proposal for the seed grant
  - Get ready for applying Institutional Review Board (IRB) approval
    - Please indicate the results of your work will be shared for international comparison with all research groups in Hi-ASAP
    - in particular, please indicate Academia Sinica will assist in data analysis
    - Please be flexible about the pollutants you will assess
      - Currently PM2.5 and PM1, we may have size distribution and black carbon in the future
    - Please send us the IRB approval once it is passed

Next Steps (4)

- Working on collaborative paper on sensor evaluation
- Working on collaborative paper on international comparison of ambient condition, community sources, or others
- Data collection and database management
  - Start to collect data into "Hi-ASAP database" with the standardized data format
  - Standardized QA/QC criteria
- Working on sensor device advancement
  - Particle sensor with size distribution
  - Wireless transmission

Seed Grant (1)

- a "call-for-proposal" will be announced no later than 3-6 months after this AI
  - The participants will be invited to submit research proposals followed by a competitive reviewing process
  - Only limited numbers of proposals (four, based on previous experiences) will be granted for one year
  - IRDR ICoE-Taipei and the core collaborator will review and announce results no later than 3 months after the closing of the proposal submission
  - the grantees will be required to submit a report to IRDR ICoE-Taipei and the core collaborator no later than 2 months after the end of the executive period

Seed Grant (2)

- Qualification:
  - Lead PI is belong to one of the participating research groups of Hi-ASAP and from a developing country
    - The boss or advisor of the participants from 2020 AI on Hi-ASAP is eligible for applying
    - The partners of 2019 awardees are eligible for applying seed grants of 2020 AI on Hi-ASAP but you need to state clearly how your proposed project complement the awarded project; please do not propose a new project
- Award: up to USD 15,000 each project for one year
  - Up to USD 12,000 in the beginning of the project
  - Up to USD 3,000 after handing in the final report in the end of the project

Expectation on Proposals (1)

- (1) A pilot study of Hi-ASAP
  - Conduct a panel-type $PM_{2.5}$ epidemiological study with methodologies and techniques taught in this AI (recruit subjects and carry out personal exposure-health evaluation with $PM_{2.5}$ sensors and Rooti RX)
  - Specify your research questions, studied area, targeted populations, detailed exposure and health monitoring strategies, and expected outcomes and social impacts
  - Emphasize multidisciplinary collaboration (atmospheric chemistry and public health), solution-oriented, and stakeholder engagement

Expectation on Proposals (2)

- (2) Participating research groups with higher scores in the final exam of 2020 AI on Hi-ASAP will have higher ranking
  - Final exam will be given to the participants on the fourth days of the 2020 AI after the Q & A sessions (October 15, 2020)
  - Final exam are sample files for the participants to run the Python, PyCharm, and R packages
    - Please show your outputs and state the meanings of these output data
  - Participants will have one week to work and have to hand in answer sheets no later than October 22, 2020
  - Participants missed some parts of the lectures can watch the video recordings to learn and work on exams

Revised planning for Advanced Institutes for Hi-ASAP

- For international comparison, a common methodology is needed

Year	Stage	Capacity building (Advanced Institute)
2019	Preparation (apply for funding)	Training on data collection protocols for environment, exposure and health
2020	Start-up (apply for Institution Review Board's approval, IRB)	Training on data cleaning and analysis for community source, exposure factor and exposure-health evaluations
2021	Intensive monitoring	Training on data cleaning and analysis for regional transport, indoor air quality, and exposure-health evaluation
2022	Data analysis	discussion for comparing exposure patterns and exposure-health relationships
2023	Publication	discussion for chemical analysis and meta analysis

Science Steering Committee (SSC)

Study Area	Full Name	Role	Organization
Bangladesh (BD)	Abdus SALAM	Leader / AC	Department of Chemistry, University of Dhaka
	Mahbuba YESMIN	Health	Internal Medicine Department, Apollo Hospital Dhaka
Hong Kong (HK)	Kin-Fai HO	AC &Health	JC School of Public Health and Primary Care, Faculty of Medicine, The Chinese University of Hong Kong
Indonesia (ID)	Puji LESTARI	Leader / AC & Health	Faculty of Civil and Environmental Engineering, Institute Teknology Bandung
	Dwi AGUSTIAN	Health	Department of Public Health, Faculty of Medicine, Universitas Padjadjaran
Korea (KR)	Kiyoung LEE	Leader / AC & Health	Department of Environmental Health Sciences, Seoul National University
Malaysia (MY)	Mohd Talib LATIF	Leader / AC; Co-Chair of SSC	School of Environmental and Natural Resource Sciences, Universiti Kebangsaan Malaysia
	Mazrura SAHANI	Health	Center for Health and applied Sciences, National University of Malaysia
Mongolia (MN)	Chonokhuu SONOMDAGVA	Leader / AC	Department of Environmental Sciences and Forest Engineering, National University of Mongolia
	Enkhjargal ALTANGERE	Health	Public health, Ach Medical University
Myanmar (MM)	Ohnmar May Tin HLAING	Leader / AC & Health; Co-Chair of SSC	Environmental Quality Management Co., Ltd
Philippines (PH)	Maria Obiminda L. CAMBALIZA	Leader / AC	School of Science and Engineering, Ateneo de Manila University
	John Q. WONG	Health	Ateneo De Manila University
Taiwan (TW)	SC Candice LUNG	Leader / AC & Health; Chair of SSC	Research Center for Environmental Changes, Academia Sinica
	Wen-Cheng Vincent WANG	AC	Research Center for Environmental Changes, Academia Sinica
Thailand (TH)	Kim OANH	Leader / AC	School of Environment, Resources and Development, Asian Institute of Technology
	Kraichat TANTRAKARNAPA	Health	Faculty of Tropical Medicine, MAHIDOL Medicine
Vietnam (VE)	Thi Hien TO	Leader / AC	University of Science, Vietnam National University Ho Chi Minh City
	Tran Ngoc DANG	Health	University of Medicine and Pharmacy at Ho Chi Minh City (UMP HCMC)
Australia (AU)	Fabienne REISEN	Analysis	Commonwealth Scientific and Industrial Research Organisation (CSIRO)

* Dr. Ming-Chien Mark Tsou, Research Center for Environmental Changes, Academia Sinica, Taiwan, as Executive Secretary starting on March 1, 2020

Research Aspect	Working group	Participating Group	Conveners
Data	1. Data quality	All groups	Kim Oanh & WC Vincent Wang
	2. Sensor QA/QC (fixed location (f) and portable (p))	Bangladesh (f & p)	Abdus Salam & Kin Fai Ho
		Hong Kong (f & p)	
		Taiwan (f & p)	
		Malaysia (f)	
Environmental Monitoring & Chemical Analysis	3. Asian-type cooking (outdoor, indoor)	Taiwan (i & o)	Kraichat Tantrakarnapa
		Vietnam (i & o)	
		Bangladesh (i)	
		Thailand (o)	
	4. Regional $PM_{2.5}$ transport (biomass burning: forest fire, agricultural burning)	Australia	Mohd Talib Latif & Puji Lestari
		Indonesia	
		Malaysia	
		Myanmar	
		Thailand	
		Vietnam	
	5. Community source contributions (Asian-type transportation)	Bangladesh	Maria Obiminda L. Cambaliza & SC Candice Lung
		Malaysia	
		Myanmar	
		Philippines	
		Taiwan	
		Vietnam	

Research Aspect	Working group	Participating Group	Conveners
Exposure-Health Evaluation	6. Lung functions	Indonesia	Ohnmar May tin Hlaing &
		Malaysia	Mazrura Sahani
		Myanmar	
		Vietnam	
	7. Heart indicators with smart watch	Bangladesh	Mahbuba Yesmin &
		Indonesia	SC Candice Lung
		Malaysia	
		Myanmar	
		Taiwan	
		Thailand	
		Vietnam	
	8. Heart indicators with Rooti	Bangladesh	SC Candice Lung
		Indonesia	
		Korea	
		Malaysia	
		Myanmar	
		Philippines	
		Taiwan	
		Thailand	
		Vietnam	
	9. Morbidity records	Bangladeshi	Dwi Agustian
		Indonesia	
		Malaysia	
		Thailand	
		Vietnam	

Research Aspect	Working group	Participating Group	Conveners
Exposure Assessment	10. Exposure	48-hour: Bangladesh	SC Candice Lung &
		Korea	Kiyoung Lee
		Taiwan	
		Thailand	
		Vietnam	
		Shorter-term:	
		Indonesia	
		Malaysia	
		Myanmar	
		Philippines	
Source Characterization (Chemical analysis and Toxicity Evaluation)	11. Filter sample analysis	All Groups	Fabienne Reisen &
		In particular:	Kin Fai Ho
		Australia	
		Bangladeshi	
		Hong Kong	
		Indonesia	
		Malaysia	
		Thailand	
		Vietnam	

Sections of Hi-ASAP Science and Implementation Plan

- 1. Overview and Objectives
- 2. Data policy (data sharing and **quality assurance and quality control, QA/QC**)
- 3. Road map and Timetable

Key scientific focus

- 4. Exposure-Health Evaluation
- 5. Exposure Assessment
- 6. Environmental and Community Monitoring
- 7. Source Characterization

- 8. Stakeholder Engagement
- 9. Working Groups and Conveners
- 10. Path Forward

Resources

- Wang, W.C.V.; **Lung, S.C.C.***; Liu, C.H.; Shui, C. K. (2020.06) Laboratory evaluations of correction equations with multiple choices for seed low-cost particle sensing devices in sensor networks. *Sensors,* 20(13): 3661. DOI: 10.3390/s20133661. IF: 3.257 3.531 **(sensor evaluation)**
- **Lung, S. C. C.***; Wang, W.C.V.; Wen, T.Y.J.; Liu, C.H.; Hu, S.C. (2020.05) A versatile low-cost sensing device for assessing $PM_{2.5}$ spatiotemporal variation and quantifying source contribution. *Science of the Total Environment*,716. DOI: 10.1016/j.scitotenv.2020.137145. IF: 6.551 3.531 **(community source evaluation)**
- **Lung, S. C. C.***; Chen, N.; Hwang, J. S. Hu, S.C.; Wang, W.C.V.; Wen, T.Y.J.; Liu, C.H. (2020.08) Panel study using novel sensing devices to assess associations of $PM_{2.5}$ with heart rate variability and exposure sources. *Journal of Exposure Science and Environmental Epidemiology.* DOI: 10.1038/s41370-020-0254-y. IF: 3.531 **(exposure-health evaluation)**
- Sinaga, D.; Setyawati, W.; Cheng, F.Y.; **Lung, S. C. C.*** (2020.08) Investigation on daily exposure to $PM_{2.5}$ in Bandung City, Indonesia using low-cost sensor. *Journal of Exposure Science and Environmental Epidemiology*. DOI: 10.1038/s41370-020-0256-9. IF: 3.531 **(exposure factor evaluation)**

Any question?

Shih-Chun Candice LUNG 龍世俊

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- Center for Sustainability Science, Academia Sinica, Taiwan