
# Impact of air pollution on health in Beirut: BAPHE Study

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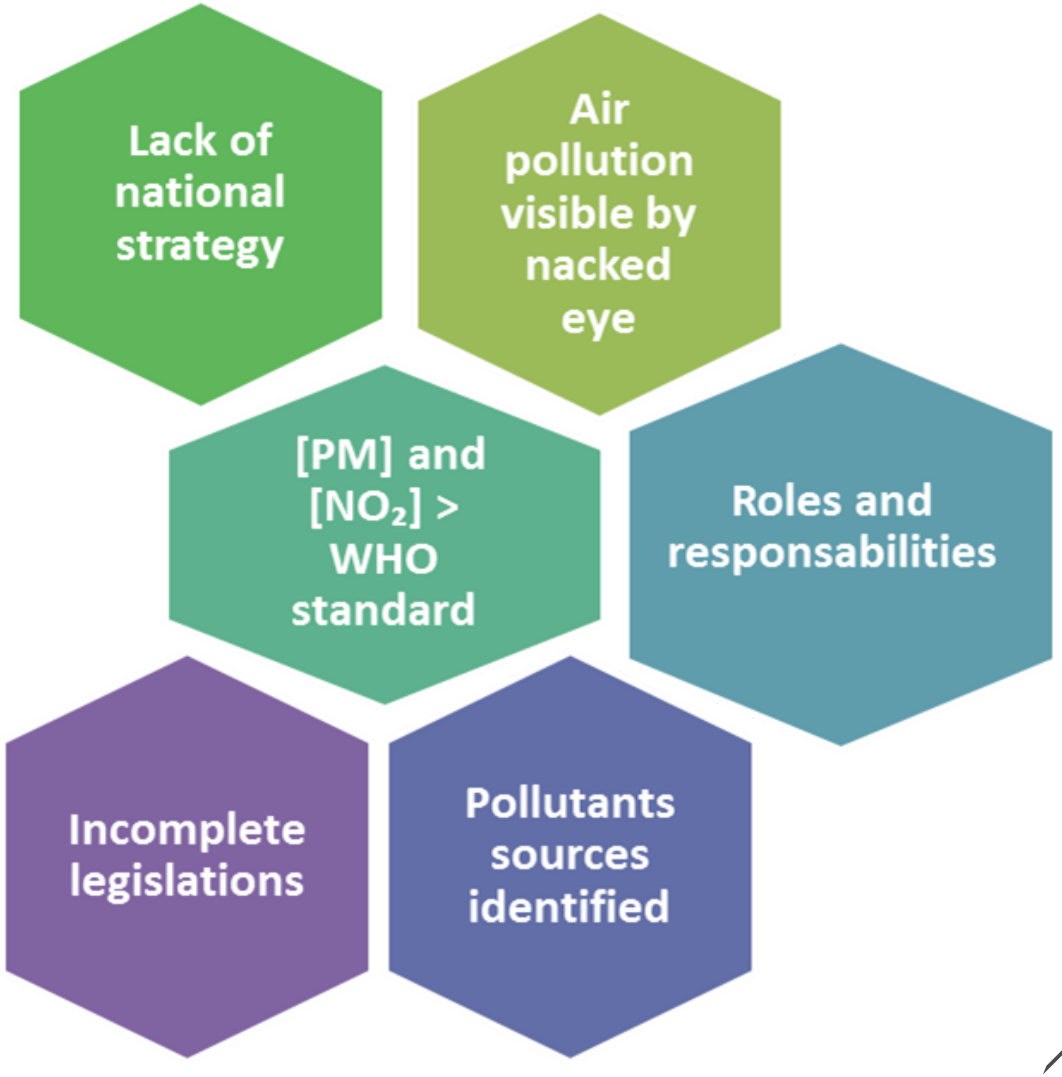
# Contents

# Background

**High levels of major outdoor air pollutants have been documented in Lebanon, but their health effects have remained unknown until 2012.**

# Background


Lack of national strategy
Air pollution visible by nacked eye
[PM] and [$NO_2$] > WHO standard
Roles and responsabilities
Incomplete legislations
Pollutants sources identified

# Background

## Beirut Governate

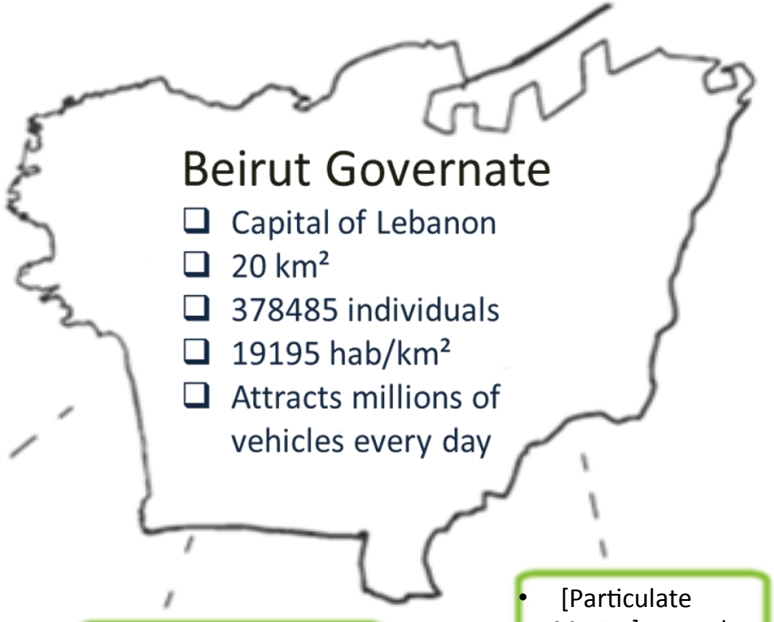
- Capital of Lebanon
- 20 km²
- 378485 individuals
- 19195 hab/km²
- Attracts millions of vehicles every day

# BAPHE study

## CITY OF BEIRUT

- Topography of Beirut
- Mediterranean Climate
- High Humidity 60% average
- Street canyon
- Underdeveloped public transportation system

Air pollution recycled




- Developing Health System
- Mortality rate 5.4/1000 in 2010 and stable since 2006
- Life expectancy at birth is 74/76 years (WHO2015)
- Main cause of mortality: cardiac arrest
- Main cause of morbidity: cardiovascular diseases and then respiratory diseases

- $170 millions/ year cost of air quality degradation
- $26 millions/year Health effects

World bank report, 2006

- [Particulate Matter] exceed the WHO levels

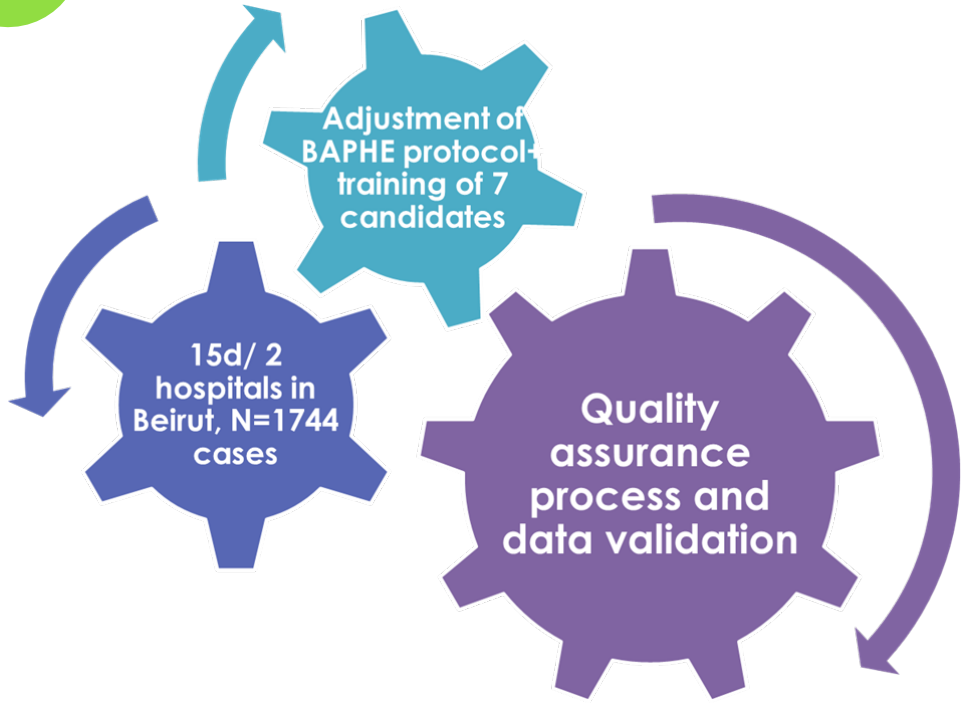
# BAPHE study

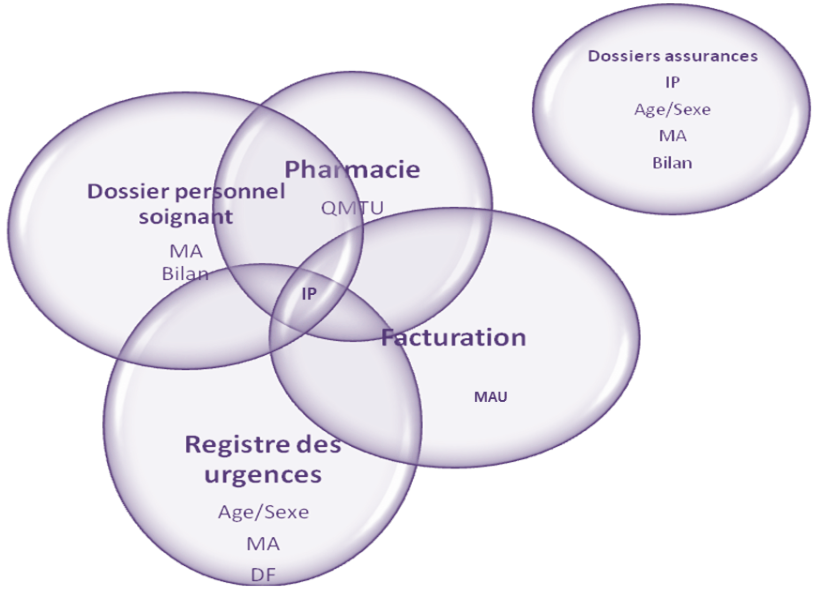
## OBJECTIVES

- Develop an adequate methodology for Beirut
- Study the relation between high levels of air pollution and daily emergency hospital admissions for specific causes
- Estimate the cost of air pollution health effects

# BAPHE study

## PILOT STUDY




Mrad Nakhle et al, 2013

**Best source of data "emergency department register". No electronic records**

# BAPHE

## PILOT STUDY

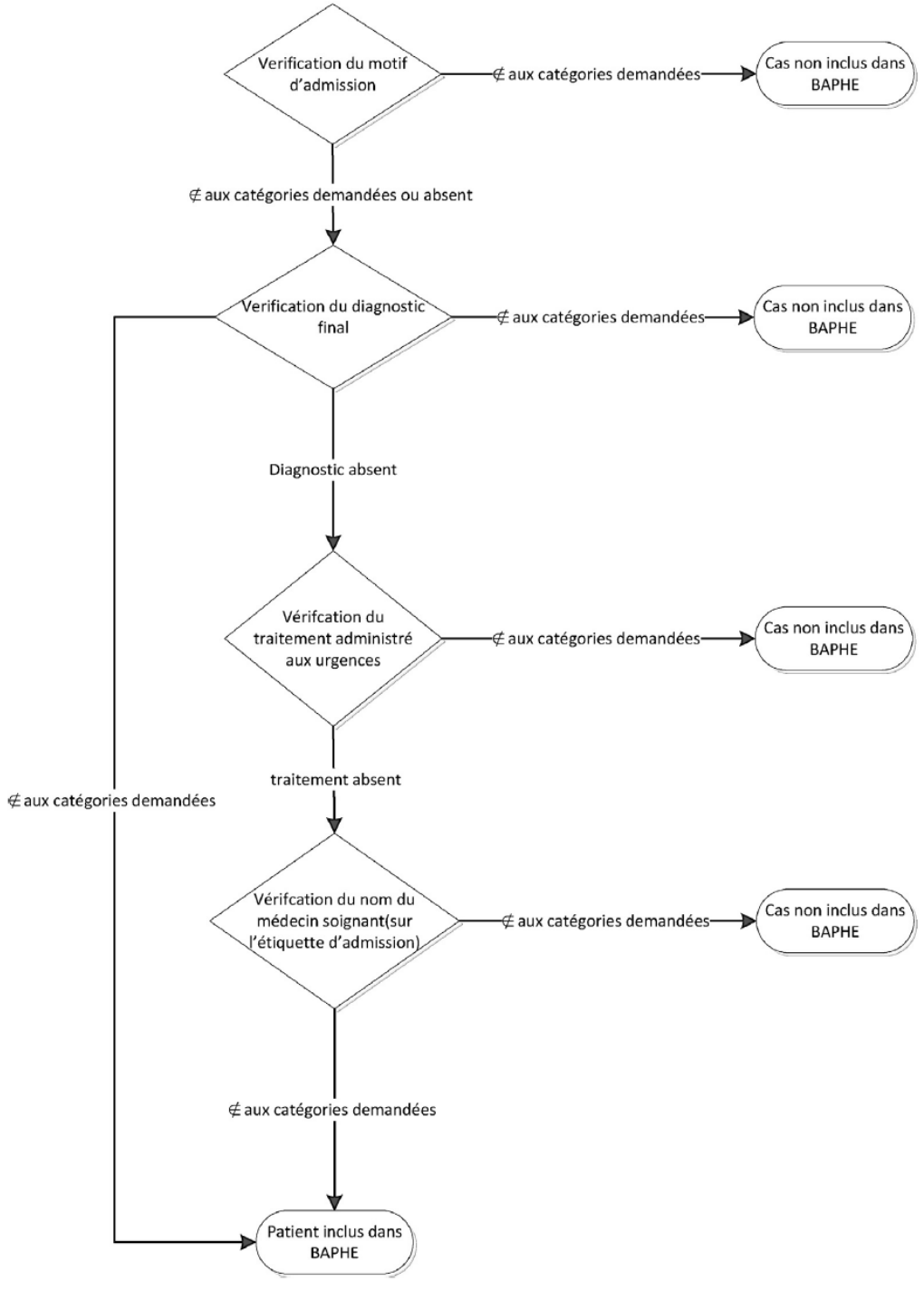
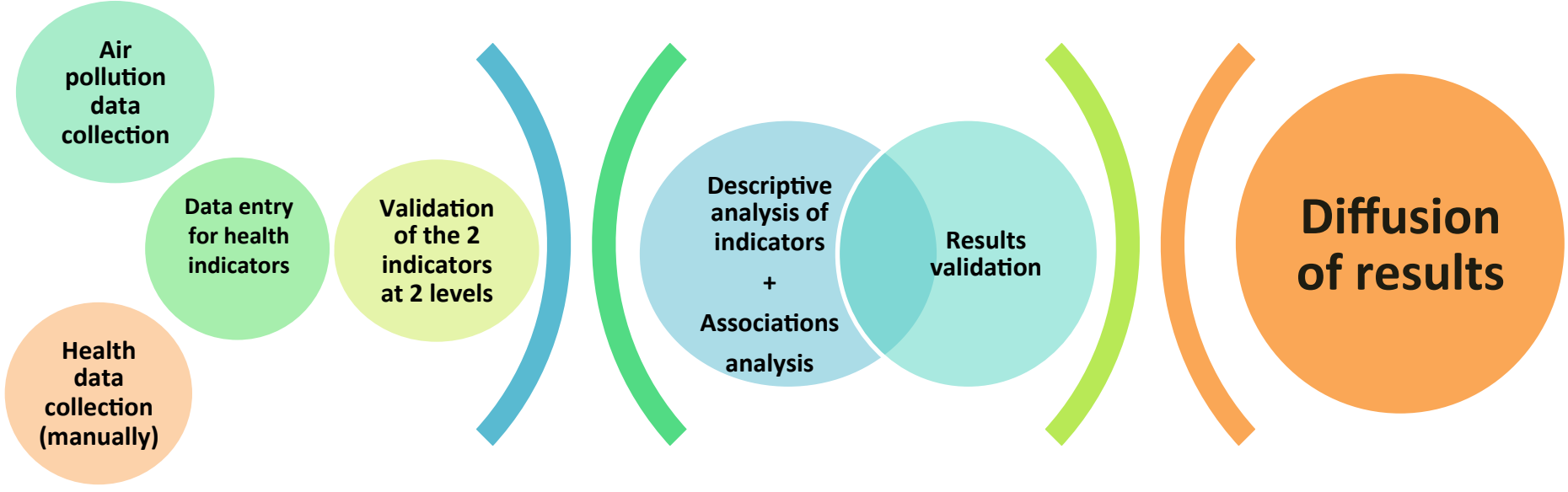



Fig. 4. Schématisation des cas à inclure dans l'étude BAPHE (Beirut Air Pollution and Health Effects).

Mrad Nakhle et al, 2013

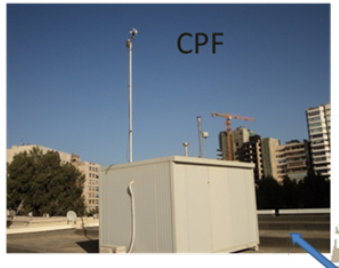
# BAPHE study

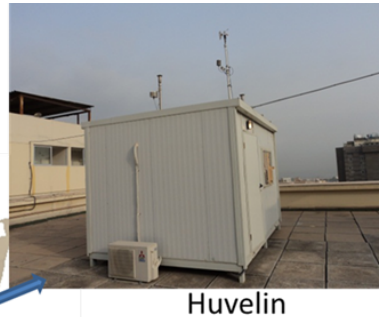
## GENERAL STUDY



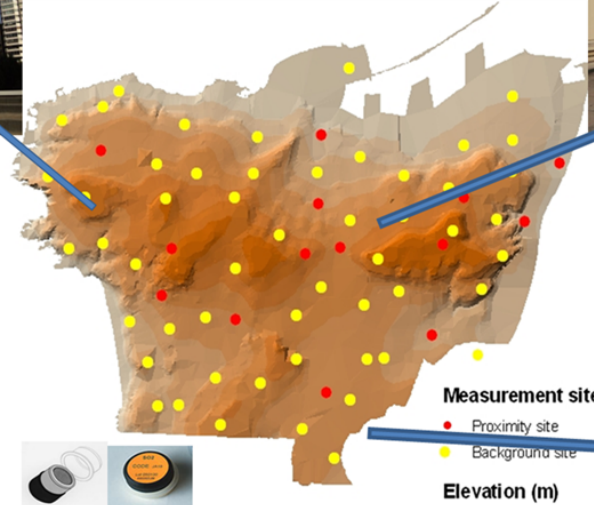
# BAPHE study

## GENERAL STUDY / Air Pollution Measurement



Huvelin




Passive network

66 $NO_2$ passive tubes :
52 for background
14 for proximity

28 $SO_2$ passive tubes:
26 for background
2 for proximity

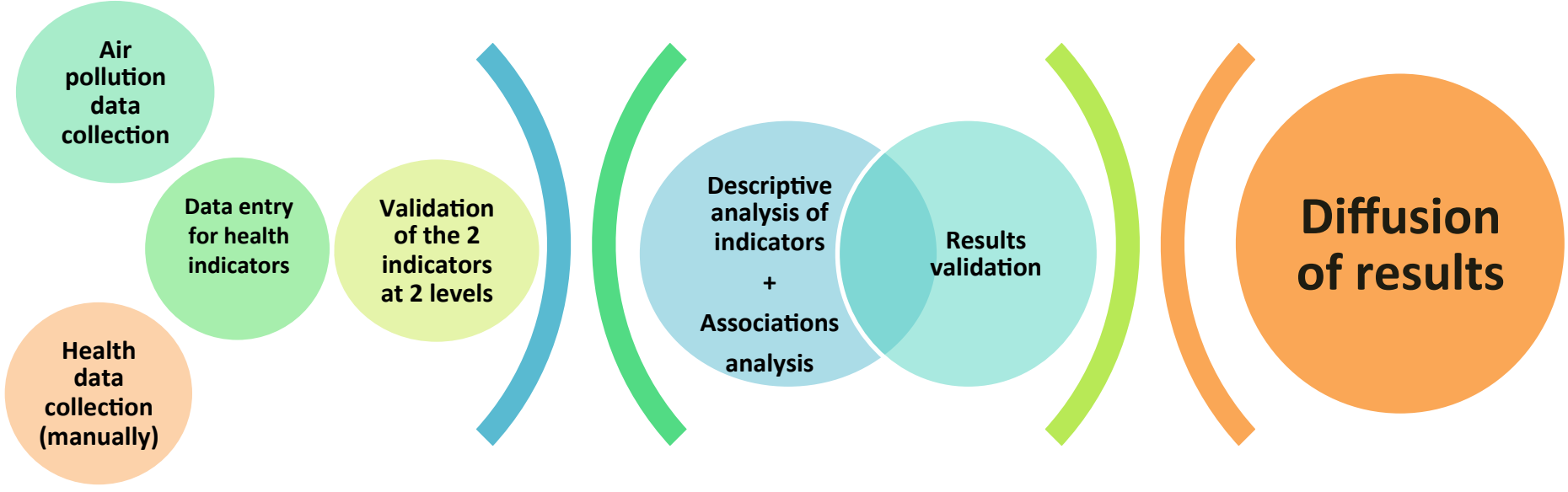
Weekly data collection

Pine wood

| Date | PM10 | PM2.5 | T | HR |
|---|---|---|---|---|
| 01/01/2012 | 37.67 | 22.75 | 11.50 | |
| 02/01/2012 | 37.67 | 22.62 | 11.50 | |
| 03/01/2012 | 37.67 | 22.89 | 11.50 | |
| 04/01/2012 | 37.67 | 22.85 | 11.50 | |
| 05/01/2012 | 37.67 | 23.26 | 11.50 | |
| 06/01/2012 | 37.67 | 23.04 | 12.46 | 37.54 |
| 07/01/2012 | 37.67 | 24.04 | 14.21 | 45.71 |
| 08/01/2012 | 37.67 | 26.36 | 14.13 | 41.71 |
| 09/01/2012 | 37.67 | 27.96 | 12.29 | 40.29 |
| 10/01/2012 | 37.92 | 23.16 | 14.13 | 42.42 |
| 11/01/2012 | 46.71 | 19.25 | 11.67 | 39.79 |
| 12/01/2012 | 35.13 | 25.33 | 9.00 | 39.79 |
| 13/01/2012 | 28.88 | 18.38 | 9.50 | 36.50 |
| 14/01/2012 | 49.29 | 26.38 | 11.21 | 39.25 |
| 15/01/2012 | 22.33 | 18.42 | 12.79 | 42.92 |
| 16/01/2012 | 40.63 | 28.46 | 12.58 | 41.67 |
| 17/01/2012 | 36.54 | 26.38 | 10.50 | 37.71 |
| 18/01/2012 | 26.96 | 21.29 | 11.58 | 54.63 |
| 19/01/2012 | 19.38 | 14.96 | 9.63 | 59.46 |
| 20/01/2012 | 21.79 | 16.04 | 8.88 | 56.46 |
| 21/01/2012 | 27.75 | 19.54 | 10.75 | 42.08 |
| 22/01/2012 | 20.04 | 16.00 | 10.63 | 39.67 |
| 23/01/2012 | 41.63 | 23.46 | 12.21 | 47.75 |
| 24/01/2012 | 39.13 | 24.96 | 12.92 | 44.96 |

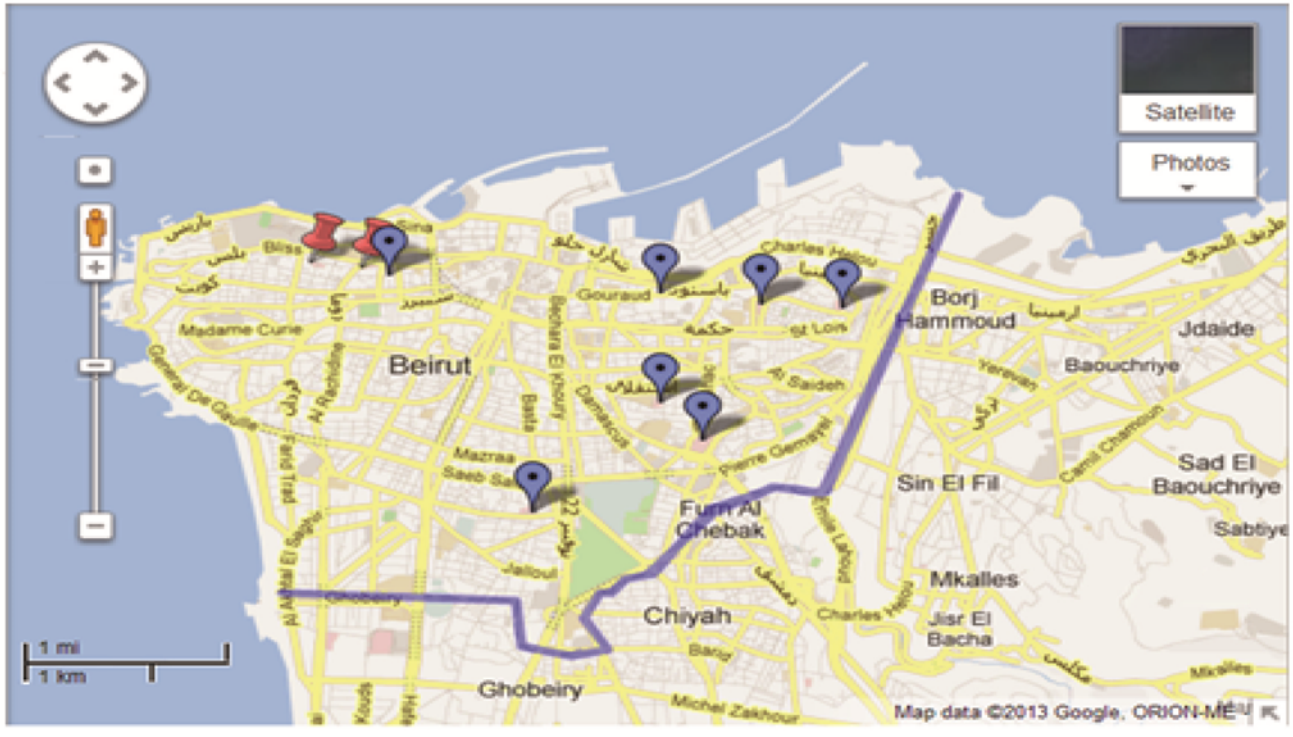
# BAPHE study

## GENERAL STUDY



# BAPHE study

## GENERAL STUDY / STUDY AREA

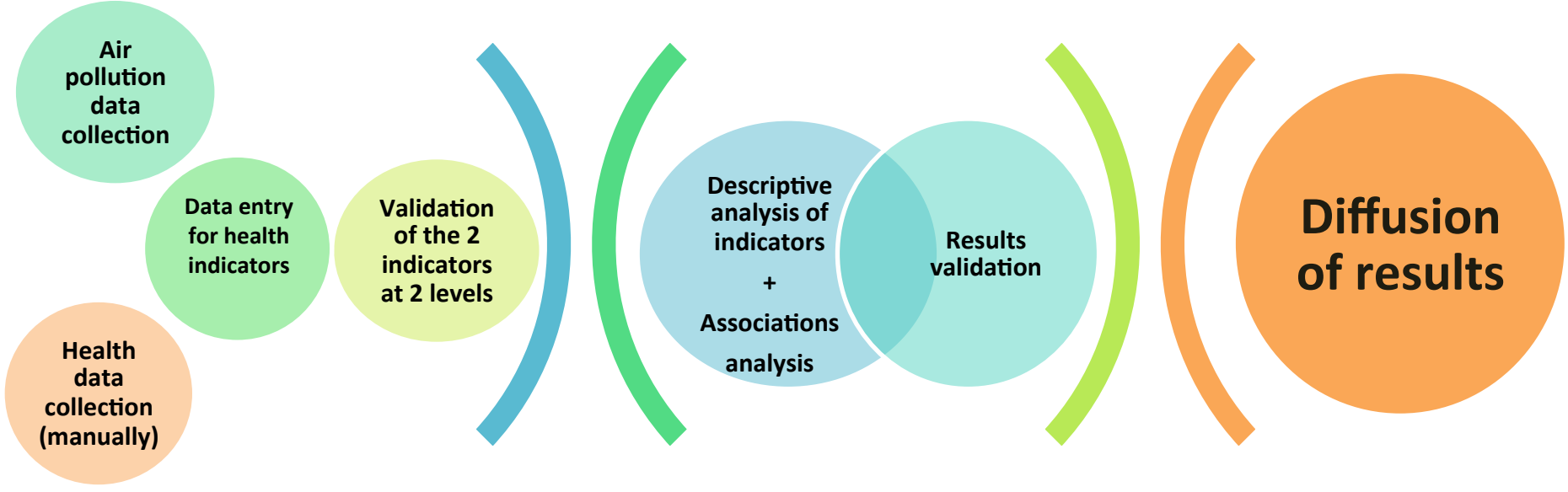



Hopitaux non participants à BAPHE (27.66% du total des lits des hopitaux de beyrouth municipe)

Hopitaux participants à BAPHE (72.33% du total des lits des hopitaux de beyrouth municipe)

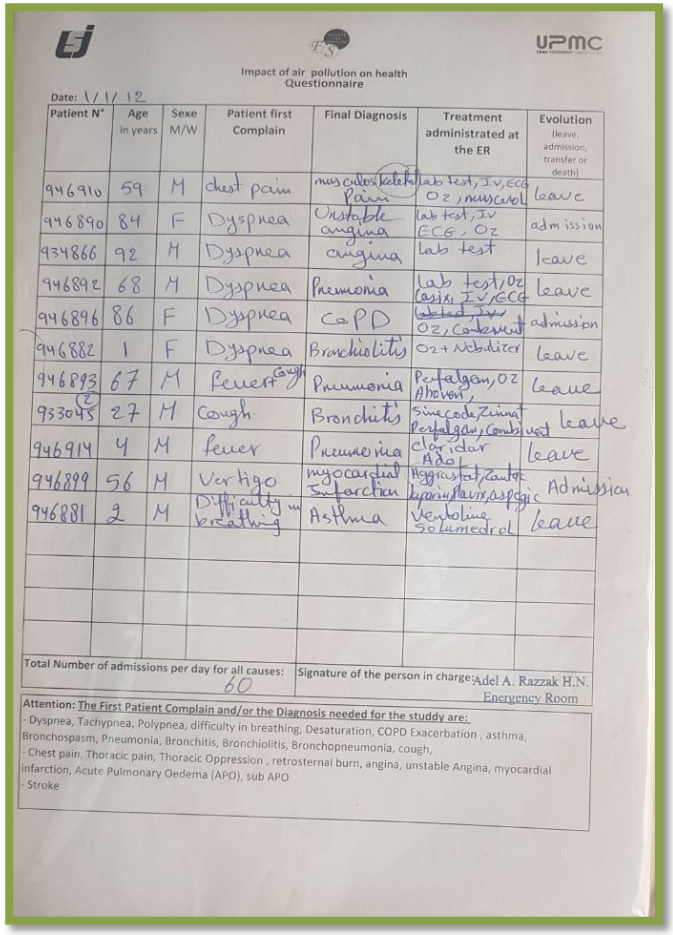
# BAPHE study

## GENERAL STUDY



# BAPHE study

## GENERAL STUDY / DATA MANAGEMENT OF HEALTH INDICATORS



Impact of air pollution on health Questionnaire

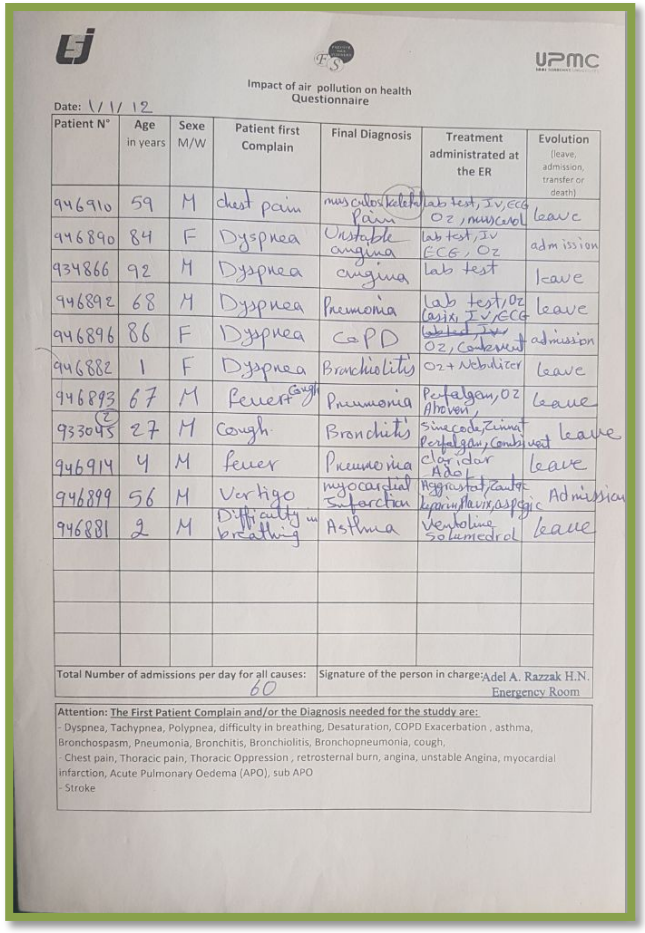
Date: 1/1/12

| Patient N° | Age in years | Sexe M/W | Patient first Complain | Final Diagnosis | Treatment administrated at the ER | Evolution (leave, admission, transfer or death) |
|---|---|---|---|---|---|---|
| 946910 | 59 | M | chest pain | musculoskeletal Pain | lab test, Iv, ECG, O2, muscolol | leave |
| 946890 | 84 | F | Dyspnea | Unstable angina | lab test, Iv, ECG, O2 | admission |
| 934866 | 92 | M | Dyspnea | angina | lab test | leave |
| 946892 | 68 | M | Dyspnea | Pneumonia | lab test, O2, Lasix, IV, ECG | leave |
| 946896 | 86 | F | Dyspnea | CoPD | lab test, Iv, O2, Conbevent | admission |
| 946882 | 1 | F | Dyspnea | Bronchiolitis | O2 + Nebulizer | leave |
| 946893 | 67 | M | Fever, Cough | Pneumonia | Perfalgan, O2, Abevon, | leave |
| 933045 (2) | 27 | M | Cough | Bronchitis | sinecode, Zinnat, Perfalgan, Combivent | leave |
| 946914 | 4 | M | fever | Pneumonia | claridar, Adol | leave |
| 946899 | 56 | M | Vertigo | myocardial Infarction | Aggrastat, Cantor, Lipanthyl, Vix, aspegic | Admission |
| 946881 | 2 | M | Difficulty in breathing | Asthma | Ventoline, Solumedrol | leave |

Total Number of admissions per day for all causes: 60

Signature of the person in charge: Adel A. Razzak H.N. Emergency Room

Attention: The First Patient Complain and/or the Diagnosis needed for the studdy are:
- Dyspnea, Tachypnea, Polypnea, difficulty in breathing, Desaturation, COPD Exacerbation , asthma, Bronchospasm, Pneumonia, Bronchitis, Bronchiolitis, Bronchopneumonia, cough,
- Chest pain, Thoracic pain, Thoracic Oppression , retrosternal burn, angina, unstable Angina, myocardial infarction, Acute Pulmonary Oedema (APO), sub APO
- Stroke



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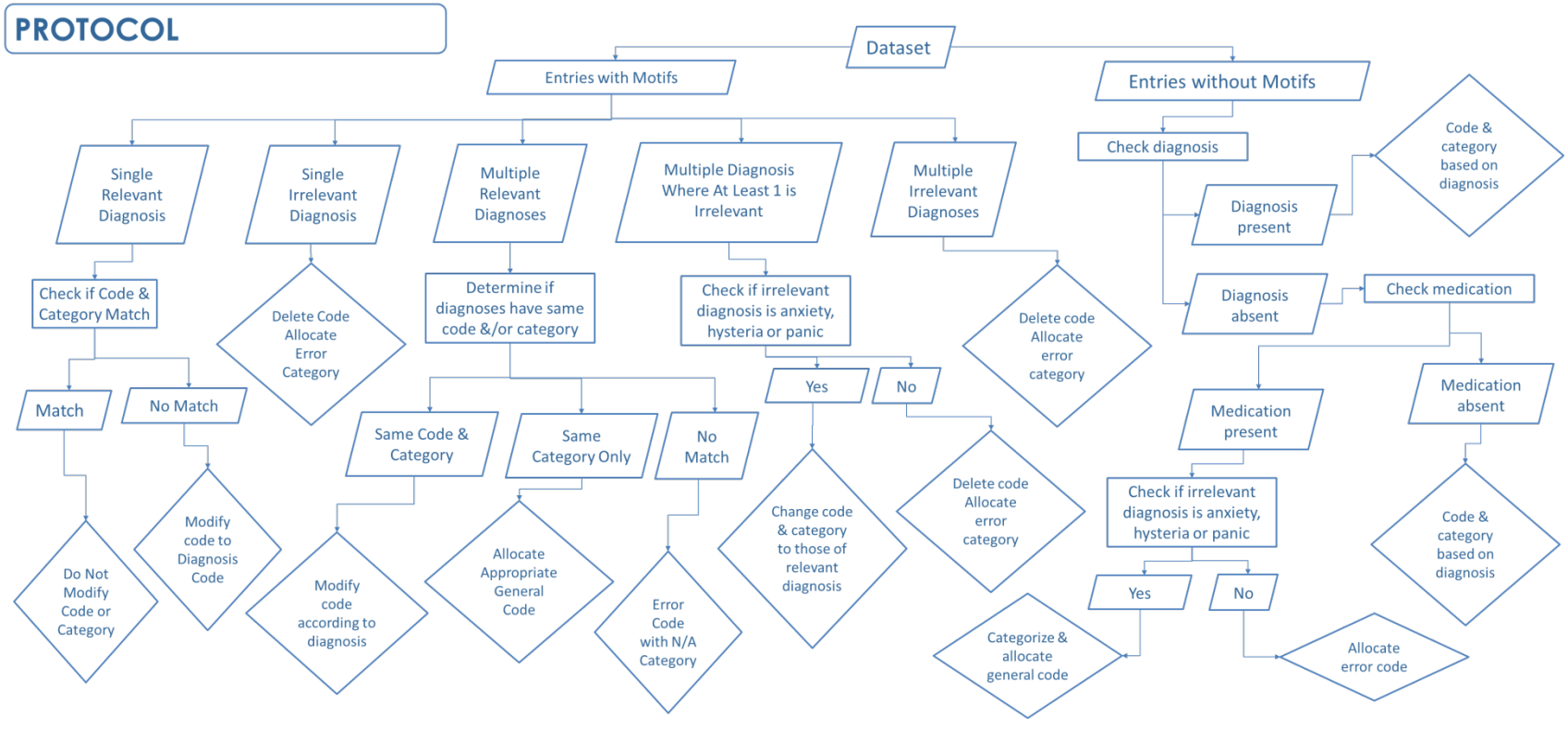

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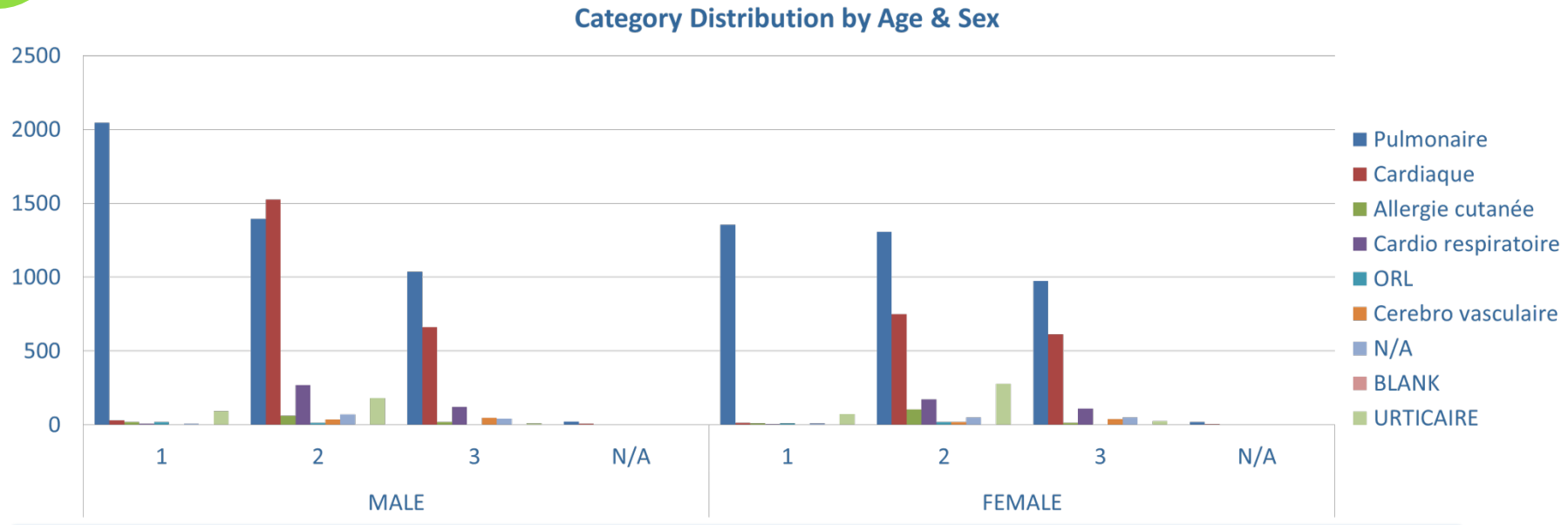


- Extract data related to date of presentation, patient demographics and heath complaints
- Sort demographic data and allocate codes to age and gender
- Analyze health complaint data and allocate the appropriate ICD10 code and category according to the sorting algorithm
- Allocate appropriate error codes to error values to allow for future error analysis

# BAPHE study

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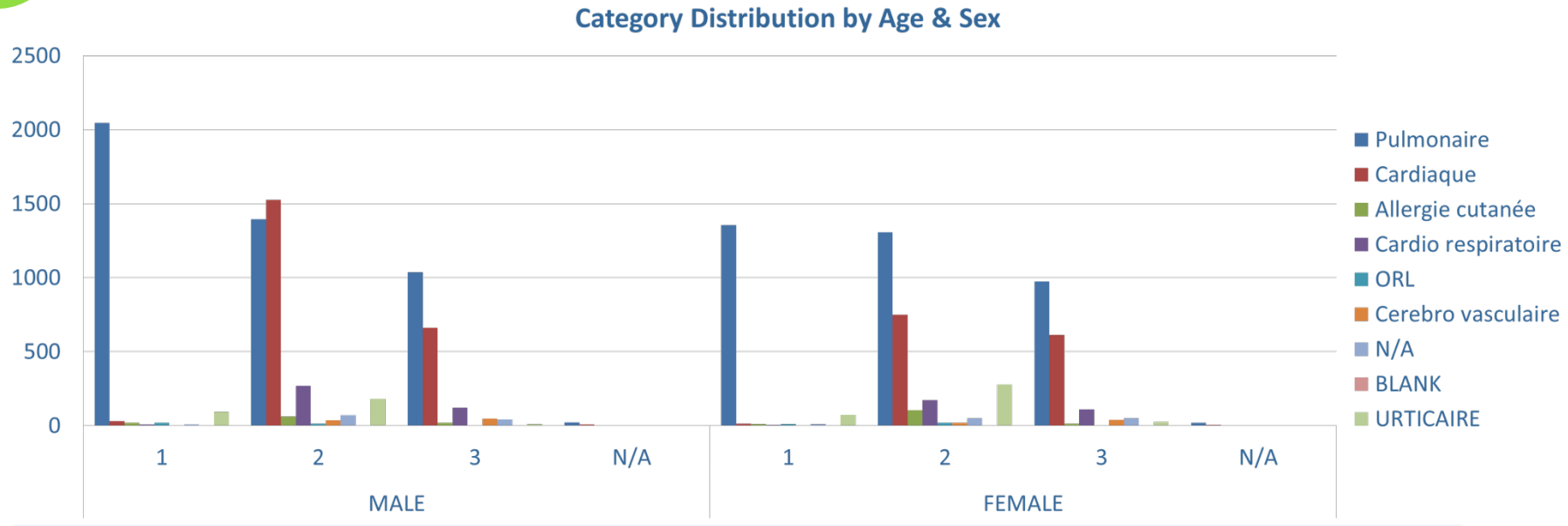


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# BAPHE study

## GENERAL STUDY/ DATA MANAGEMENT

| Codes | | |
|---|---|---|
| G00 à G09 | G45 à G46 | J90 à J94 |
| H60-H95 | I00 à I52 | L50 à L54 |
| I00 à I99 | I20 à I24 | T886 |
| I60 à I62 | I63 à I64 | 0 |
| J00 à J98 | J00 à J99 | L50 |
| J12 à J18 | J20 à J22 | N/A |
| J40 à J47 | J45 à J46 | BLANK |

| Categories | | | | |
|---|---|---|---|---|
| Pulmonaire | Cardiaque | Allergie cutanee | ORL | Cardio respiratoire |
| Cerebro vasculaire | Urticaire | N/A | BLANK | MISC. ACCIDENT |
| MISC. ALLERGIC | MISC. ANDRO | MISC. COMBINED | MISC. ENDO | MISC. GASTRO |
| MISC. HEMATO-ONCO | MISC. INFECTIOUS | MISC. MUSK | MISC. NEURO | MISC. OBGYN |
| MISC. PSYCH | MISC. SUBST. ABUSE | MISC. SURGICAL | MISC. UNINDENTIFIED | MISC. URO |

| | | | | | |
|---|---|---|---|---|---|
| Categories | Pulmonaire | 8770 | Codes | G00 à G09 | 0 |
| | Cardiaque | 4159 | | G45 à G46 | 10 |
| | Allergie cutanee | 369 | | H60-H95 | 83 |
| | cardio respiratoire | 729 | | I00 à I52 | 953 |
| | ORL | 83 | | I00 à I99 | 2109 |
| | cerebro vasculaire | 165 | | I20 à I24 | 1779 |
| | N/A | 240 | | I60 à I62 | 0 |
| | Blank | 0 | | I63 à I64 | 155 |
| | Urticaire | 665 | | J00 à J98 | 393 |
| | Misc. Accident | 26 | | J00 à J99 | 3775 |
| | Misc. Allergic | 30 | | J12 à J18 | 1442 |
| | Misc. Andro | 2 | | J20 à J22 | 1125 |
| | Misc. Combined | 2 | | J40 à J47 | 597 |
| | Misc. Endo | 12 | | J45 à J46 | 1416 |
| | Misc. Gastro | 171 | | J90 à J94 | 69 |
| | Misc. Hemato-Onco | 28 | | L50 à L54 | 362 |
| | Misc. Immuno | 1 | | T886 | 7 |
| | Misc. Infectious | 5 | | | |
| | Misc. Musk | 387 | | 0 | 0 |
| | Misc. Neuro | 1 | | | |
| | Misc. OBGYN | 3 | | N/A | 240 |
| | Misc. Psych | 595 | | | |
| | Misc. Subst. Abuse | 12 | | BLANK | 1357 |
| | Misc. Surgical | 3 | | | |
| | Misc. Unidentified | 69 | | L50 | 665 |
| | Misc. Uro | 10 | | | |
| Genders | H | 9175 | Age Groups | 1 | 3922 |
| | F | 7320 | | 2 | 8041 |
| | Missing | 0 | | 3 | 4473 |
| | N/A | 40 | | Blank | 101 |
| Total Number of Entries | | | | 16537 | |

- The information is categorized based on the cleaning & sorting algorithm
- Categorization was performed on a day, month, astronomical season & year basis
- Categorization by age & gender were performed by allocating the appropriate codes
- ICD10 codes & categories were allocated
- Counts were established for each variable, code & category
- The data graphed for better visualization

# BAPHE study

## GENERAL STUDY/ DATA MANAGEMENT

| | <16 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | G00 à G09 | G45 à G46 | I00 à I52 | I00 à I99 | I20 à I24 | I60 à I62 | I63 à I64 | total I00 à I99 | J00 à J99 | J12 à J18 | J20 à J22 | J40 à J47 | J45 à J46 | J90 à J94 | Total J00 à J99 | L50 à L54 | T886 | H60-H95 |
| 01/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 2 | 0 | 0 | 0 | 9 | 0 | 0 | 0 |
| 02/01/2012 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 10 | 2 | 2 | 0 | 2 | 0 | 16 | 0 | 0 | 1 |
| 03/01/2012 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 3 | 3 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 0 |
| 04/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 1 | 0 | 1 | 0 | 10 | 0 | 0 | 0 |
| 05/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 4 | 0 | 9 | 0 | 0 | 1 |
| 06/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 1 | 0 | 6 | 1 | 0 | 0 |
| 07/01/2012 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 1 | 0 | 6 | 0 | 0 | 0 |
| 08/01/2012 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 10 | 0 | 0 | 0 | 2 | 0 | 12 | 0 | 0 | 1 |
| 09/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 1 | 0 | 1 | 0 | 8 | 0 | 0 | 0 |
| 10/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 2 | 0 | 0 | 0 | 9 | 0 | 0 | 0 |
| 11/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| 12/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 3 | 0 | 0 | 0 | 8 | 0 | 0 | 0 |
| 13/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| 14/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| 15/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 |
| 16/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| 17/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 2 | 0 | 6 | 0 | 0 | 0 |
| 18/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 1 | 0 | 9 | 0 | 0 | 0 |
| 19/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 1 | 1 | 0 | 1 | 0 | 12 | 0 | 0 | 0 |
| 20/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 0 |
| 21/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 1 |
| 22/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 0 |
| 23/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 0 | 9 | 0 | 0 | 1 |
| 24/01/2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 1 | 0 | 1 | 0 | 7 | 0 | 0 | 0 |

# BAPHE study

## GENERAL STUDY/ DATA MANAGEMENT

| B | C | D | E | F | G | H | I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ndiosorigin | ndos | date | RSA | sexe | age | catage | Motif Brut | Motif | Motif par CIM | Motif/ categorie | Diagnostic brut | Diagnostic | Diagnostic/categorie | Evoluti |
| 942725 | HDF570 | 1/1/2012 | HDF | H | 30 | 2 | Douleur Thoracique | Douleur Thoracique | I00 à I99 | cardiaque | ND | ND | COMPLETER MOTIF | Decharge |
| 942727 | HDF571 | 1/1/2012 | HDF | H | 72 | 3 | Dyspnée et Douleur abdominale | Dyspnée | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Decharge |
| 942752 | HDF572 | 1/1/2012 | HDF | H | 50 | 2 | Toux , otalgie et reflexe nauseaux | Toux | J00 à J99 | pulmonaire | otite moyenne aigu (OMA | otite | ORL | Decharge |
| 942753 | HDF573 | 1/1/2012 | HDF | F | 1 | 1 | Dyspnée et fievre | bronchiolite | J20 à J22 | pulmonaire | Bronchiolite | bronchiolite | pulmonaire | Decharge |
| 942773 | HDF574 | 1/1/2012 | HDF | H | 77 | 3 | Toux et oppression thoracique | Toux, douleur thoracique | J00 à J99 | cardio respiratoire | ND | ND | COMPLETER MOTIF | Decharge |
| 942785 | HDF575 | 1/1/2012 | HDF | H | 1 | 1 | Toux et fièvre | Toux, fièvre | J00 à J99 | pulmonaire | OMA droite | otite | ORL | Decharge |
| 942790 | HDF576 | 1/1/2012 | HDF | F | 26 | 2 | Toux , dyspnée, douleur epaule et membres s | Toux, dyspnée | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Decharge |
| 942795 | HDF577 | 1/1/2012 | HDF | F | 1 | 1 | Toux et dyspnée | Toux, dyspnée | J00 à J99 | pulmonaire | Obstruction nasale | Obstruction nasale | ORL | Decharge |
| 942806 | HDF578 | 1/2/2012 | HDF | H | 1 | 1 | bronchiolite | bronchiolite | J20 à J22 | pulmonaire | bronchiolite | bronchiolite | pulmonaire | Admissio |
| 942808 | HDF579 | 1/2/2012 | HDF | F | 50 | 2 | Toux, fièvre, crachat ,cephale, rhume | Toux, fièvre | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Non disp |
| 942811 | HDF580 | 1/2/2012 | HDF | H | 82 | 3 | Dyspnée | Dyspnée | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Decharge |
| 942815 | HDF581 | 1/2/2012 | HDF | H | 1 | 1 | Dyspnée, syndrome grippal | bronchiolite | J20 à J22 | pulmonaire | bronchiolite | bronchiolite | pulmonaire | Decharge |
| 942820 | HDF582 | 1/2/2012 | HDF | H | 2 | 1 | Pneumonie basale gauche | Pneumonie | J12 à J18 | pulmonaire | ND | ND | COMPLETER MOTIF | Transfert |
| 942827 | HDF583 | 1/2/2012 | HDF | H | 86 | 3 | Hemoptysie | Hemoptysie | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Non disp |
| 942832 | HDF584 | 1/2/2012 | HDF | H | 1 | 1 | Toux grasse, dyspnée, rhinorrhe claire | Toux, dyspnée | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Transfert |
| 942843 | HDF585 | 1/2/2012 | HDF | F | 28 | 2 | AEG, vertige, toux, dyspnée, fièvre, crachat bl | toux, dyspnée | J00 à J99 | pulmonaire | Angine | angine | COMPLETER MOTIF | Non disp |
| 942845 | HDF586 | 1/2/2012 | HDF | F | 1 | 1 | Toux et fièvre | Toux, fièvre | J00 à J99 | pulmonaire | Otite moyenne aigu (OMA | otite | ORL | Non disp |
| 942852 | HDF587 | 1/2/2012 | HDF | H | 1 | 1 | Polypnee, hypotonie et baisse de l'alimentat | otite | H60-H95 | ORL | OMA bilaterale | otite | ORL | Non disp |
| 942854 | HDF588 | 1/2/2012 | HDF | H | 3 | 1 | Toux grasse | Toux | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Non disp |
| 942866 | HDF589 | 1/2/2012 | HDF | F | 79 | 3 | Dyspnée a l'effort,fievre, toux et cachat | Dyspnée | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Non disp |
| 942889 | HDF590 | 1/2/2012 | HDF | F | 84 | 3 | dyspnée, toux et crachat | dyspnée, toux | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Decharge |
| 942895 | HDF591 | 1/2/2012 | HDF | F | 5 | 1 | fièvre, asthenie, douleur articulaire, frisson, | toux | J00 à J99 | pulmonaire | Angine erythro... | angine | COMPLETER MOTIF | Non disp |
| 942897 | HDF592 | 1/2/2012 | HDF | H | 12 | 1 | Dlr thoracique et lipotemie lipothymie? | douleur thoracique | I00 à I99 | cardiaque | ND | ND | COMPLETER MOTIF | Decharge |
| 942899 | HDF593 | 1/2/2012 | HDF | H | 44 | 2 | Dlr thoracique (spasme) et fourmillement d | Douleur Thoracique | I00 à I99 | cardiaque | ND | ND | COMPLETER MOTIF | Non disp |
| 942903 | HDF594 | 1/2/2012 | HDF | H | 60 | 2 | Toux et fièvre | Toux, fièvre | J00 à J99 | pulmonaire | Bronchite | Bronchite | pulmonaire | Non disp |
| 942904 | HDF595 | 1/2/2012 | HDF | H | 52 | 2 | dyspnée, toux et crachat | dyspnée, toux | J00 à J99 | pulmonaire | Bronchospasme | pulmonaire | pulmonaire | Decharge |
| 942908 | HDF596 | 1/2/2012 | HDF | H | 1 | 1 | dyspnée et toux | dyspnée, toux | J00 à J99 | pulmonaire | ND | ND | COMPLETER MOTIF | Decharge |

| Date | PM10 | PM2.5 | T | HR | Total I00 à I99 | Total J00 à J99 |
|---|---|---|---|---|---|---|
| 1/1/2012 | 37.67 | 22.75 | 11.50 | 44.27 | 6 | 23 |
| 1/2/2012 | 37.67 | 22.62 | 11.50 | 44.27 | 8 | 36 |
| 1/3/2012 | 37.67 | 22.89 | 11.50 | 44.27 | 7 | 28 |
| 1/4/2012 | 37.67 | 22.85 | 11.50 | 44.27 | 7 | 31 |
| 1/5/2012 | 37.67 | 23.26 | 11.50 | 44.27 | 13 | 40 |
| 1/6/2012 | 37.67 | 23.04 | 12.46 | 37.54 | 7 | 26 |
| 1/7/2012 | 37.67 | 24.04 | 14.21 | 45.71 | 16 | 25 |
| 1/8/2012 | 37.67 | 26.36 | 14.13 | 41.71 | 12 | 31 |
| 1/9/2012 | 37.67 | 27.96 | 12.29 | 40.29 | 13 | 24 |
| 1/10/2012 | 37.92 | 23.16 | 14.13 | 42.42 | 16 | 26 |

# BAPHE study

## GENERAL STUDY/ STATISTICAL MODEL

| | |
|---|---|
| **Cohort** | • Same characteristics of the population studied<br>• Homogeneous exposure zone |
| **Poisson Regression based On GAM** | • Pollutants<br>• Seasonality<br>• Trend<br>• Holidays<br>• Weekends and weekdays<br>• Flu period |
| **Model** | • Estimation of relative risk<br>• Surveillance of short term relation between air pollution and health |

# BAPHE results

## DESCRIPTIVE RESULTS

| Pollutants | Annual average µg/m³ 2012 | Number of exceeding days (d/year) 2012 | Max average µg/m³ | Number of exceeding days |
|---|---|---|---|---|
| | | | Lignes directives, WHO STANDARD | |
| $PM_{10}$ | 51 (151%) | 133 | 20 | Do not exceed 3 days per year |
| $PM_{2,5}$ | 30(200%) | 129 | 10 | Do not exceed 3 days per year |

# BAPHE results

## DESCRIPTIVE RESULTS

**Table 1** Characteristics of emergency hospital admission patients for diseases of respiratory and circulatory systems

| Age group | Male | Female | Total | Proportion of age group % |
|---|---|---|---|---|
| Age 0–15 | 1368 | 907 | 2275 | 21.05 |
| Age 16–64 | 3000 | 2243 | 5243 | 48.50 |
| Age 65 et + | 1638 | 1655 | 3293 | 30.45 |
| Total | 6006 | 4805 | 10,811 | 100.00 |

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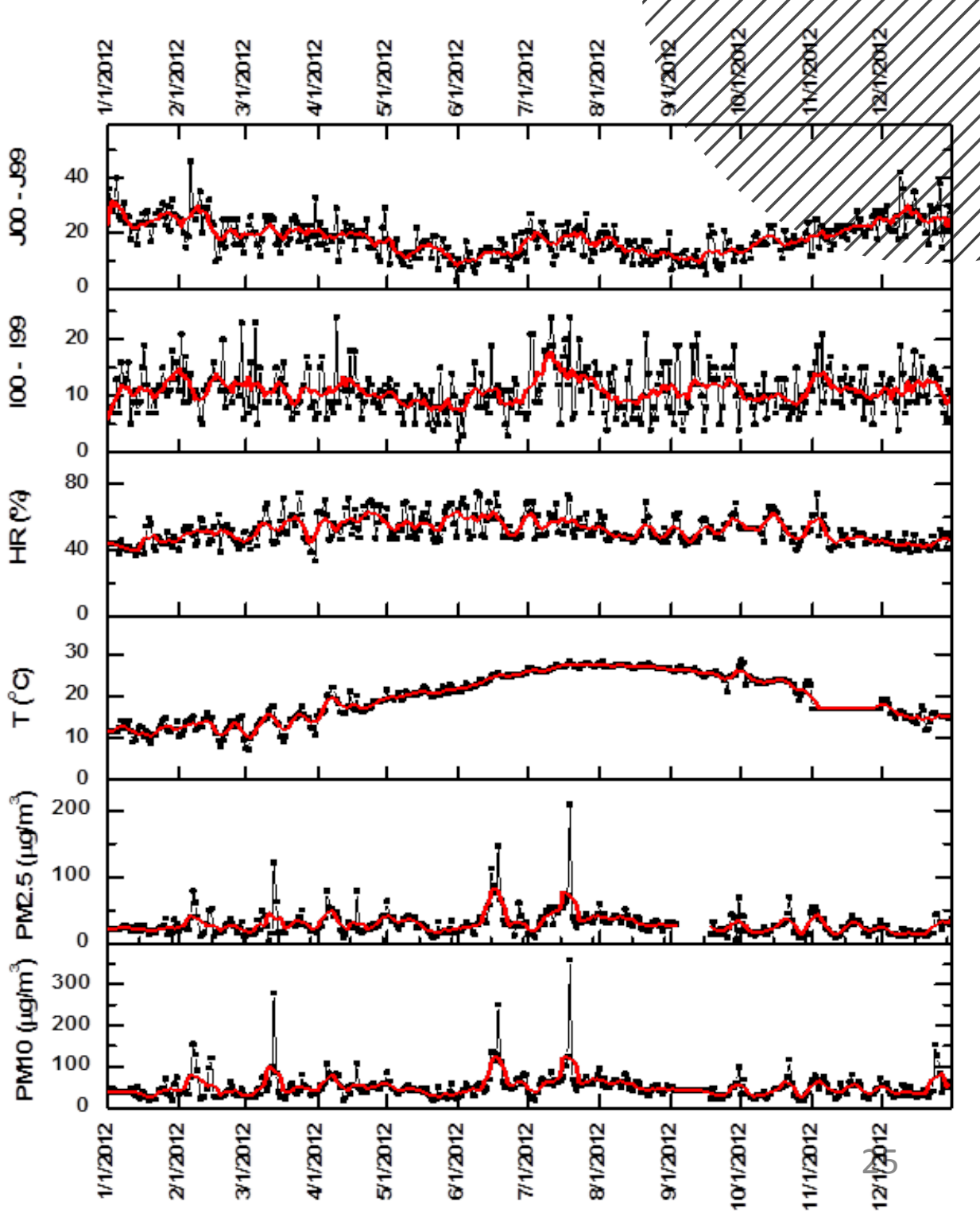
# DESCRIPTIVE RESULTS

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# BAPHE results

## ASSOCIATION RESULTS

### Association results – < 16 years

| For an increase of 10µg/m ³ | | Lag | Admissions for respiratory diseases | |
|---|---|---|---|---|
| Age | Pollutant | Lag | RR | 95% CI |
| Less than 16 years old | $PM_{2.5}$ | 0 | **1.013** | (0.985;1.042) |
| | $PM_{10}$ | 0 | **1.014** | (1.000;1.029) |

### Association results - > 65 years

| Pour une augmentation de 10µg/m | | Lag | Admissions pour causes respiratoires | | Lag | Admissions pour causes cardiovasculaires | |
|---|---|---|---|---|---|---|---|
| Age | Pollutant | Lag | RR | 95% CI | Lag | RR | 95% CI |
| Over 64 | $PM_{2.5}$ | 0 | **1.036** | (1.011;1.06) | 0 | **1.02** | (0.993;1.054) |
| | $PM_{10}$ | 0 | **1.019** | (1.006;1.032) | 0 | **1.01** | (0.989;1.022) |

### Association results – 16 < > 64 years

| For an increase of 10µg/m ³ | | Lag | Admissions for respiratory diseases | | Lag | Admissions for cardiovascular diseases | |
|---|---|---|---|---|---|---|---|
| Age | Pollutant | Lag | RR | 95% CI | Lag | RR | 95% CI |
| 16-64 | $PM_{2.5}$ | 6-7 | **1.010** | (1.001;1.019) | 0 | **1.02** | (0.993;1.037) |
| | $PM_{10}$ | 6-7 | **1.006** | (1.001;1.011) | 0 | **1.01** | (0.998;1.021) |

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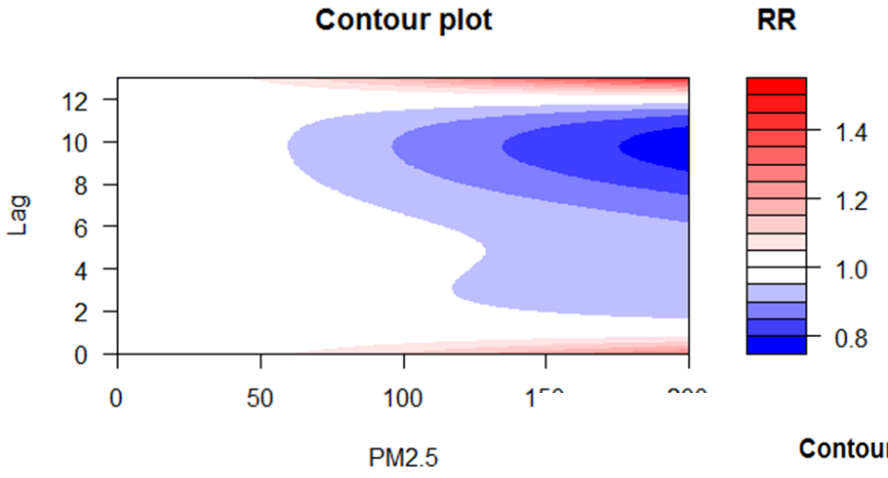
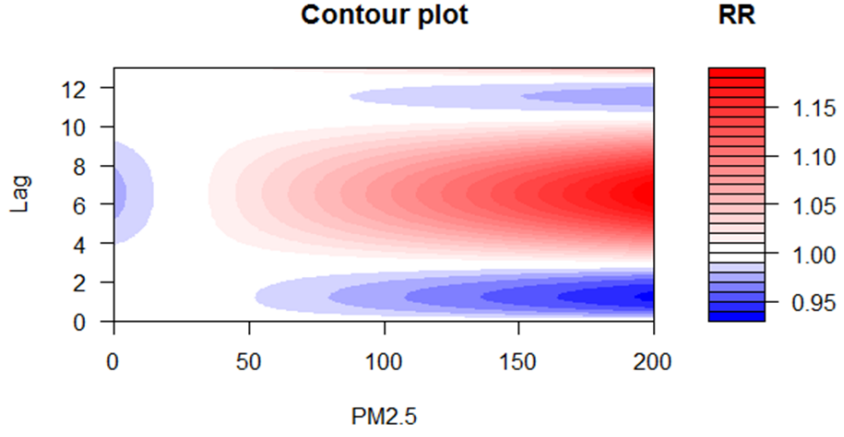
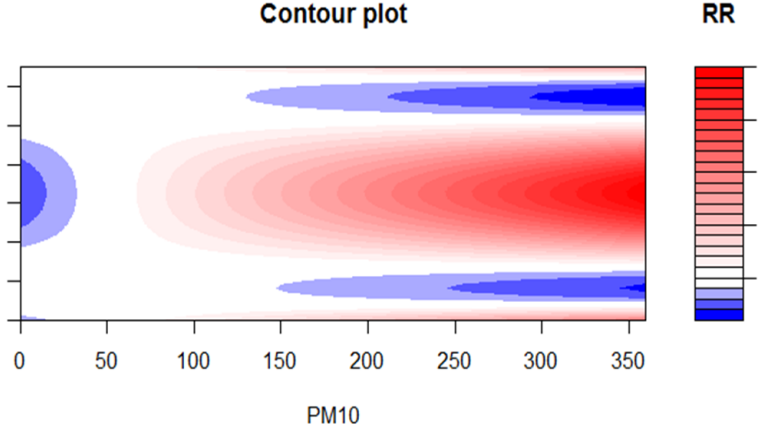
# BAPHE results

## ASSOCIATION RESULTS

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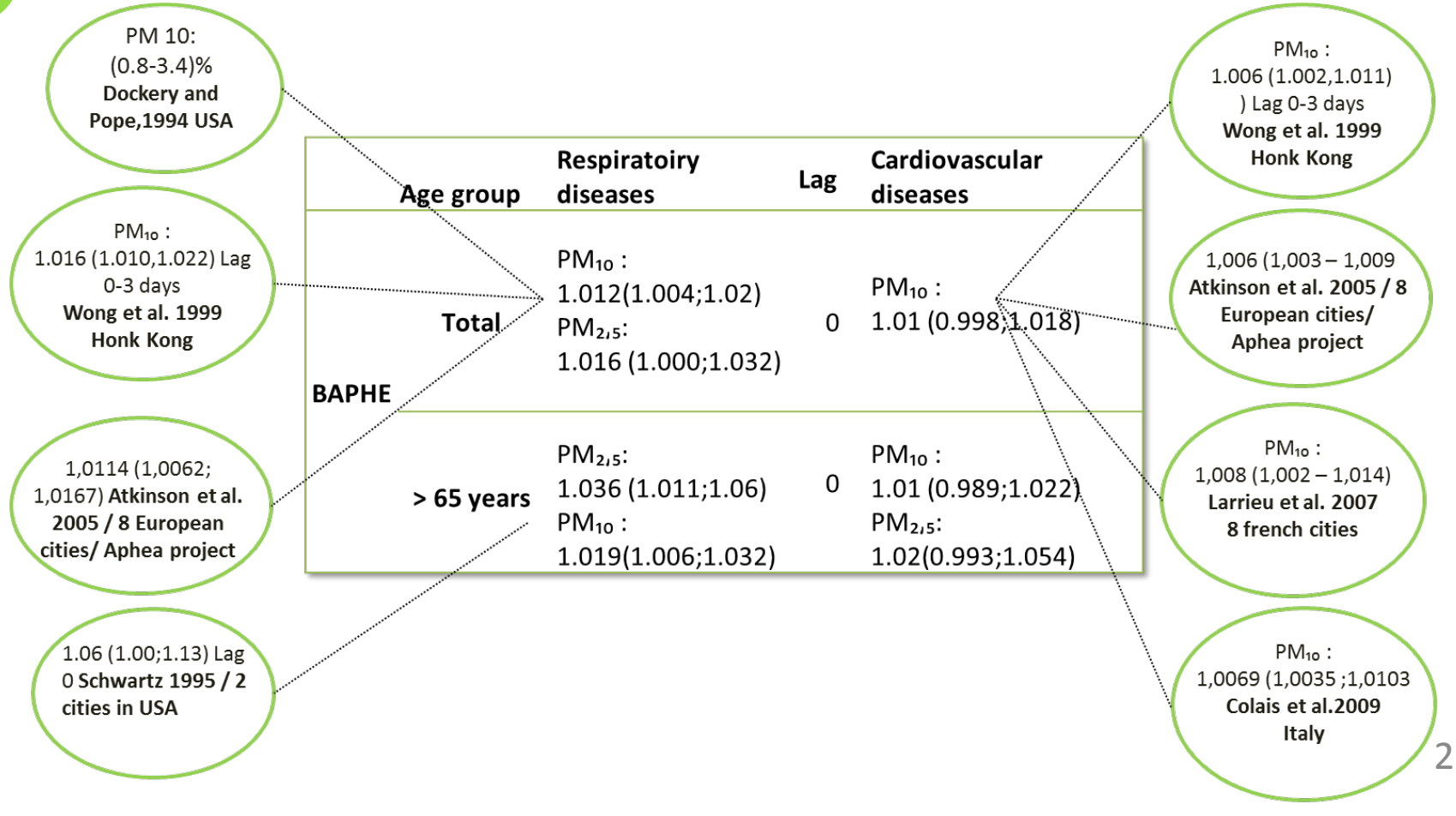
# BAPHE results

## ASSOCIATION RESULTS

| Age | Pollutant | Lag | RR | 95% CI |
|---|---|---|---|---|
| Less than 16 | PM 2.5 | 2 | **1.045** | **(1.008;1.083)** |
| | PM 2.5 | 3 | **1.049** | **(1.015;1.084)** |
| | PM 10 | 2 | **1.166** | **(1.027;1.323)** |
| | PM 10 | 3 | **1.184** | **(1.055;1.328)** |
| 16-64 | PM 2.5 | 0 | 1.044 | (0.983;1.11) |
| | PM 10 | 0 | 1.023 | (0.989;1.057) |
| Over 64 | PM 2.5 | 0 | 1.02 | (0.966;1.078) |
| | PM 2.5 | 1 | 1.013 | (0.987;1.039) |
| | PM 10 | 0 | 1.03 | (0.957;1.094) |
| | PM 10 | 1 | 0.993 | (0.957;1.03) |
| Total | PM 2.5 | 0 | 1.02 | (0.966;1.078) |
| | PM 10 | 0 | 1.01 | (0.98;1.041) |

# BAPHE results

## COMPARISON OF BAPH RESULTS WITH INTERNATIONAL STUDIES



# BAPHE results

## ATTRIBUTABLE RISK

**Attributable risk calculation**

$$AR = \frac{P_e (r - 1)}{1 + P_e (r - 1)}$$ where $P_e$ = Prevalence of exposure in the population; $r$ = Relative risk of exposure

$$RA = \frac{1 \times (RR - 1)}{1 \times (RR - 1) + 1} = \frac{(RR - 1)}{RR} = FE$$

**PE: proportion of exposed subject**
**RR: Relative Risk**
**RA: Attributable Risk**
**FE: Etiological factor**

# BAPHE results

## ATTRIBUTABLE RISK

- 

For a RR of 1.2 (admissions for respiratory diseases)

RA= 0.1666 NA= RA * N= 369 cases from 2216 were hospitalized due to air pollution

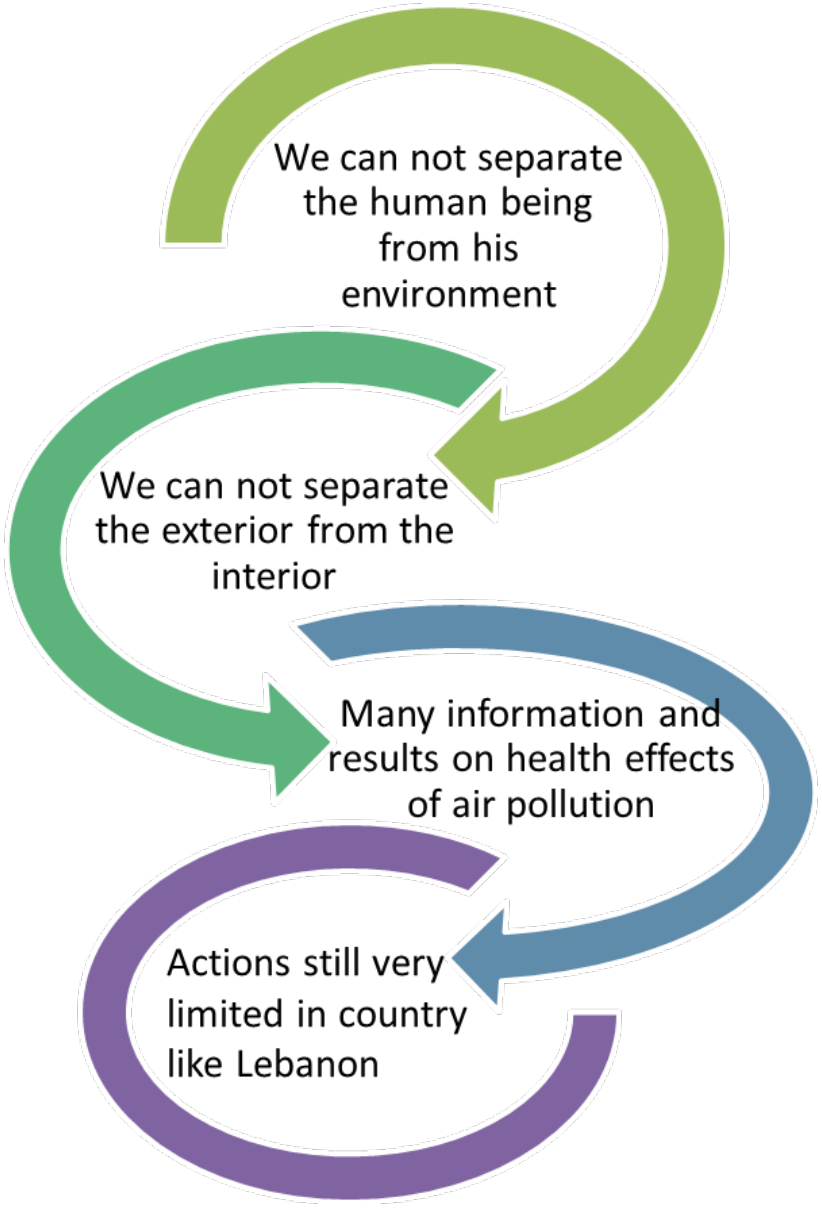
**369 cases could be avoided**

For a RR of 1.184 (admissions for skin allergic diseases)

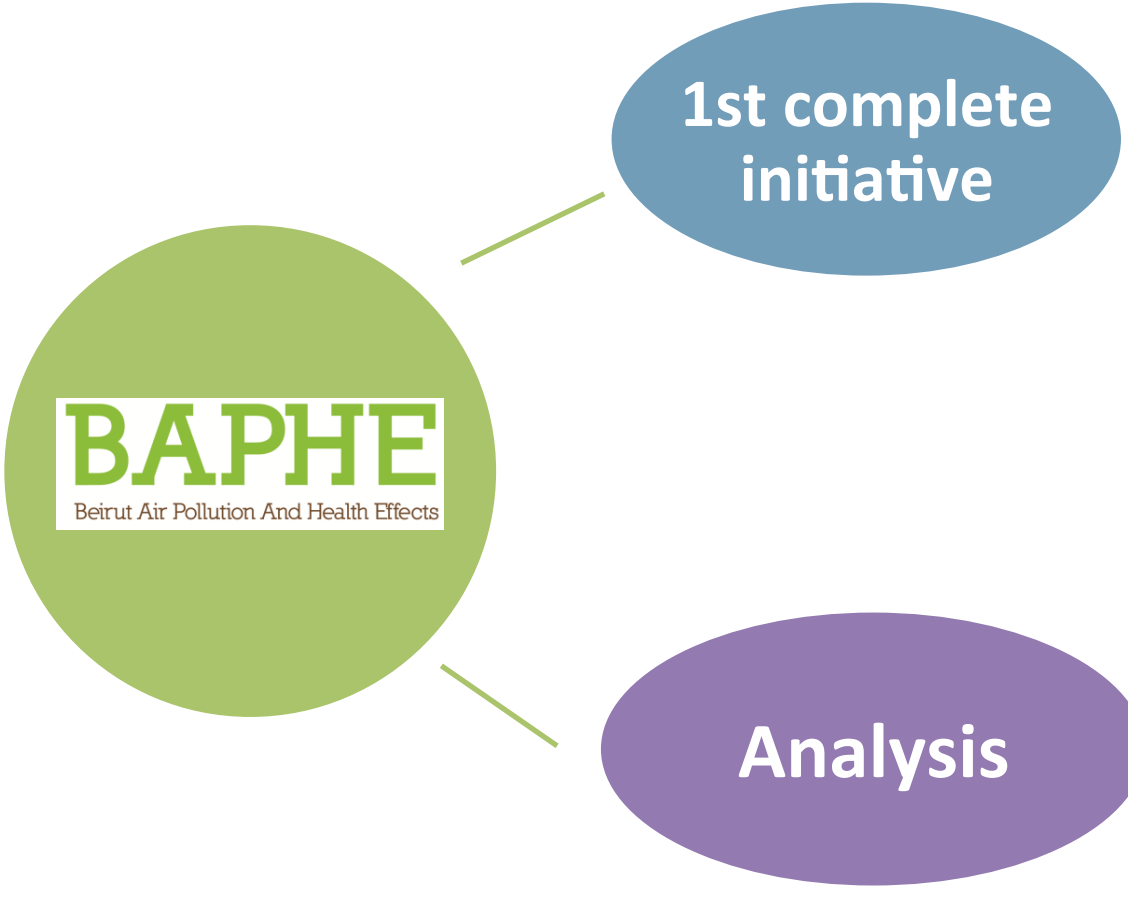
RA= 0.3394 NA= RA * N= 40 cases from 100 hospitalized due to air pollutiom

**40 cases could be avoided**

# Conclusion


We can not separate the human being from his environment
We can not separate the exterior from the interior
Many information and results on health effects of air pollution
Actions still very limited in country like Lebanon

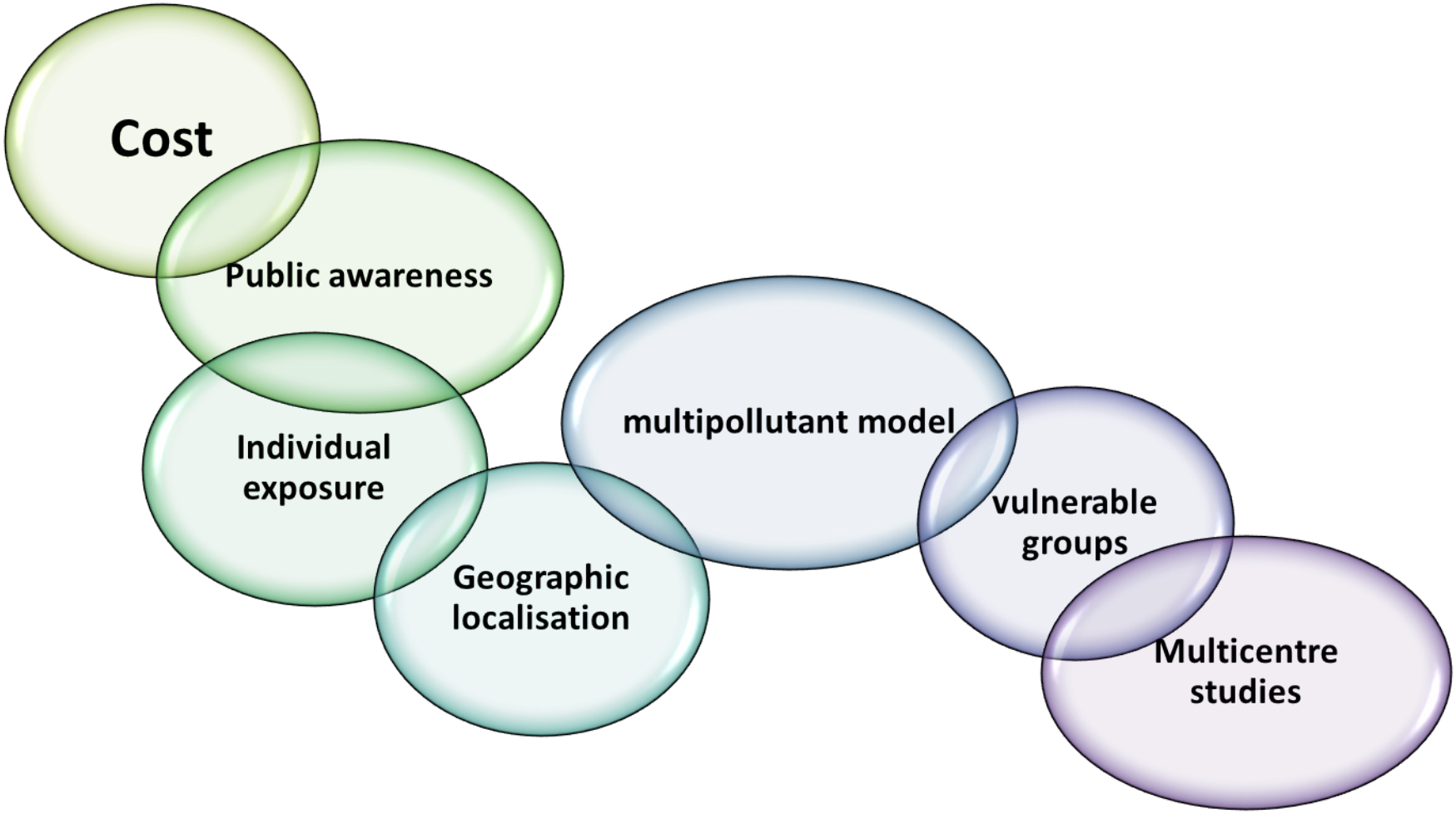
# Conclusion




- Continuous measurement for 3 years
- Creation of a new database
- Standardized methodology

- Concentrations > standards of WHO
- Significant association
- Proof for decision maker

# Conclusion

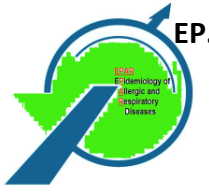

Cost
Public awareness
Individual exposure
Geographic localisation
multipollutant model
vulnerable groups
Multicentre studies

Even if the effects of pollutants are often invisible or hardly detectable

yet they are real....

# Research partners







BAPHE
Beirut Air Pollution And Health Effects

# References

**Mrad Nakhlé M**, Farah W, Ziade N, Abboud M, Gérard J, Zaarour R, Saliba N, Dabar G, Abdel Massih T, Zoghbi A, Coussa Koniski M L, Annesi-Maesano I. Analyse de la qualité des données issues des hôpitaux de Beyrouth Municipe pour mesurer les effets à court terme de la pollution atmosphérique. Rev Epidemiol Sante Publique (2013) Doi : 10.1016/j.respe.2013.09.001

Farah W, **Mrad Nakhlé M**, Abboud M, Annesi-MaesanoI, Germanos G, Zaarour R, Saliba N, GérardJ. Time series analysis of daily air pollution in Eastern Mediterranean city Beirut, Lebanon. Environmental Monitoring and Assessment EMAS, Volume 186, Issue 12 (2014), p8203-8213. DOI: 10.1007/s10661-014-3998-9.

Farah W, **Mrad Nakhlé M**, Abboud M, Annesi-MaesanoI, Germanos G, Zaarour R, Saliba N, Shehadeh Alen, Saliba Aoun N, Gérard J .Analysis of the continuous measurements of PM10 and PM2.5 concentrations in order to quantify the short-term health effects of air pollution in Beirut, Lebanon. (in press- Environmental Engineering and Management Journal).

**Myriam Mrad Nakhlé**, Wehbeh Farah, Nelly Ziade, Maher Abboud, Dominique Salameh, Isabella Annesi-Maesano. Short-term relationships between emergency hospital admissions for respiratory and cardiovascular diseases and fine particulate air pollution in Beirut, Lebanon. Environmental Monitoring and Assessment EMAS, Volume 187, Issue 4 (2015), (2015) 187:196 DOI 10.1007/s10661-015-4409-6

**Mrad Nakhlé M**, Farah W, Ziade N, Abboud M, Coussa Koniski M L, Annesi-Maesano I. Beirut Air Pollution and Health Effects - BAPHE study protocol and objectives. Multidisciplinary Respiratory Medicine (2015), DOI 10.1186/s40248-015-0016-1

# THANK YOU

## Model used for the analysis

$$Log(Hospital\ Admission) = a_0 + a_1 .s(Time,5) + a_2 .P(PM_{2.5},4) + a_3 .T + a_4 .HR + a_5 .DO$$

A natural cubic spline with a degree of freedom of 5 was applied to the "Time" variable.

A polynomial of 4th degree was applied to the $PM_{2.5}$ variable

$$RR = e^{\beta(C2-C1)} \qquad \beta = 0.0035$$

$$RR = e^{0.0035*100}$$

$$RR = 1.419$$

$$RR = P(M \setminus E^{+}) / P(M \setminus E^{-})$$

PA pas d'abesence d'exposition

$$RR = P(M \setminus E_2^{\uparrow}) / P(M \setminus E_1^{\uparrow})$$