Question 1:

- A country has a first minister: We assume that each country must have exactly one minister.

- We assume that a person can have 0 or more Traces depending on the amount of locations they visit

- We can imply a person's bubble via their trace as it includes a person's NHS Number and locations visited. People who were at the same location as a person at the same date will be considered part of their "bubble".

- We assume that a person can have multiple traces. One for each place they've visited.

- We assume that a Country's infection data is comprised of the sum of the data from its individual counties

- We assume that a Counties infection data is comprised of the sum of the data from its individual districts

- We assume everyone has one type of job (employed, self-employed, unemployed)

- For every country, there are multiple counties and for every county there are multiple districts, creating respective one to many relationships.

- Population statistics are accurate and are not changed. Birth/Death rates, not taken into account.

- We use total infections and population to help us calculate the new infection rate

- We derive total infections by summation of infections per day

Question 2:

Entities:

- Infection
- Person
- Trace
- Minister
- Country
- County
- District

Details(Entities with attributes):

Infection(InfectionID, InfectionRate, TotalNewInfections, InfectionsPerDay, TotalInfections)

Person(NHSNumber, Name
These are possible values that can be stored for name: [FName,MName, LName],

PostCode, AddressLine1, AddressLine2, City, Gender, DateOfBirth, Ethnicity, Nationality, ProfessionType

These are possible values that can be stored for ProfessionType: [employed, self-employed, student], mobileNumber)

Minister(MinisterID, Name
These are possible values that can be stored for name: [FName,MName, LName], Contact, MinisterStatement)

Country(CountryID, Population, NameOfCountry)

County(CountyID, CountyPopulation, NameOfCounty)

District(DistrictID,
These are possible values that can be stored for Tier: [tier-1, tier-2, tier-3], DistrictPopulation, NameOfDistrict)

Trace(TraceID, TestResult, LocationVisited, DateVisited, WorkLocation)

Relationships/Cardinalities:

Governs (Minister, Country): 1:1
Contains (Country, County, District): Country contains counties which contain districts (1:N)
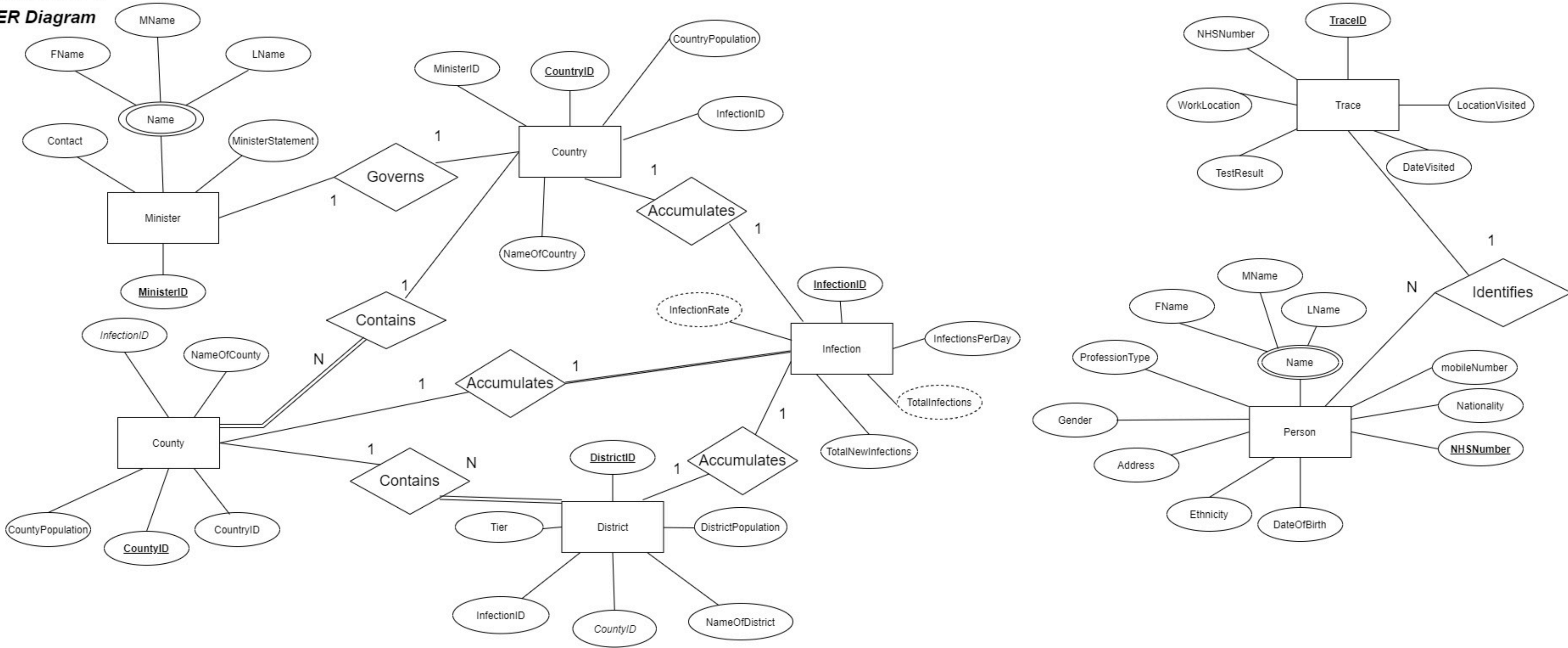Identifies(Trace, Person): 1:N
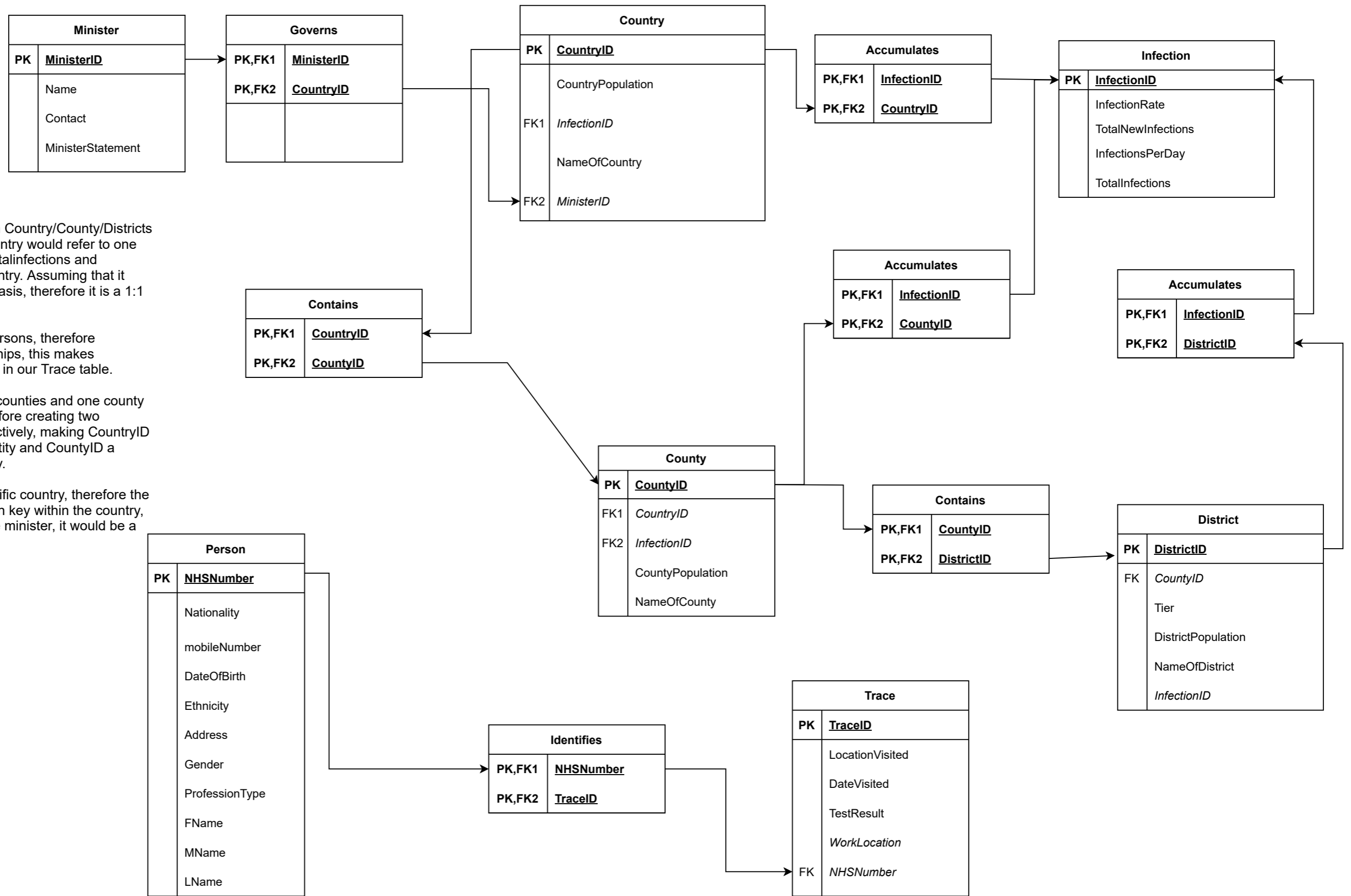Accumulates (Country, Infection): 1:1
Accumulates (County, Infection): 1:1
Accumulates (District, Infection): 1:1

Question 3

ER Diagram

Minister entity attributes: Name (with FName, MName, LName), Contact, MinisterStatement, MinisterID

Country entity attributes: MinisterID, **CountryID**, CountryPopulation, InfectionID, NameOfCountry

County entity attributes: *InfectionID*, NameOfCounty, CountyPopulation, **CountyID**, CountryID

District entity attributes: **DistrictID**, Tier, DistrictPopulation, InfectionID, *CountyID*, NameOfDistrict

Infection entity attributes: **InfectionID**, InfectionRate, InfectionsPerDay, TotalInfections, TotalNewInfections

Trace entity attributes: NHSNumber, **TraceID**, WorkLocation, LocationVisited, TestResult, DateVisited

Person entity attributes: MName, FName, LName, ProfessionType, Name, Gender, Address, Ethnicity, DateOfBirth, mobileNumber, Nationality, **NHSNumber**

Relationships:
- Minister — Governs (1 : 1) — Country
- Country — Accumulates (1 : 1) — Infection
- Minister — Contains (1 : N) — County
- County — Accumulates (1 : 1) — Infection
- County — Contains (1 : N) — District
- District — Accumulates (1 : 1) — Infection
- Trace — Identifies (N : 1) — Person

Question 4:
Relational Schema

Minister

PK	MinisterID
	Name
	Contact
	MinisterStatement

Governs

PK,FK1	MinisterID
PK,FK2	CountryID

Country

PK	CountryID
	CountryPopulation
FK1	InfectionID
	NameOfCountry
FK2	MinisterID

Accumulates

PK,FK1	InfectionID
PK,FK2	CountryID

Infection

PK	InfectionID
	InfectionRate
	TotalNewInfections
	InfectionsPerDay
	TotalInfections

• InfectionID is a foreign key in Country/County/Districts entity. This is done as one country would refer to one row in Infection, holding the totalinfections and infectionrate for a specific country. Assuming that it would be updated on a daily basis, therefore it is a 1:1 relationship.

• One trace identifies many persons, therefore creating a one:many relationships, this makes the NHSNumber a foreign key in our Trace table.

• One country contains many counties and one county contains many districts. Therefore creating two one:many relationships respectively, making CountryID a foreign key in the County entity and CountyID a foreign key in the District entity.

• One minister governs a specific country, therefore the ministerID would be the foreign key within the country, due to one country having one minister, it would be a 1:1 relationship.

Contains

PK,FK1	CountryID
PK,FK2	CountyID

Accumulates

PK,FK1	InfectionID
PK,FK2	CountyID

Accumulates

PK,FK1	InfectionID
PK,FK2	DistrictID

County

PK	CountyID
FK1	CountryID
FK2	InfectionID
	CountyPopulation
	NameOfCounty

Contains

PK,FK1	CountyID
PK,FK2	DistrictID

District

PK	DistrictID
FK	CountyID
	Tier
	DistrictPopulation
	NameOfDistrict
	InfectionID

Person

PK	NHSNumber
	Nationality
	mobileNumber
	DateOfBirth
	Ethnicity
	Address
	Gender
	ProfessionType
	FName
	MName
	LName

Identifies

PK,FK1	NHSNumber
PK,FK2	TraceID

Trace

PK	TraceID
	LocationVisited
	DateVisited
	TestResult
	WorkLocation
FK	NHSNumber

Question 4: Normalisation

Tables for entities before key migration:

FK's in Italics

Infection(<u>InfectionID</u>, InfectionRate, TotalNewInfections, InfectionsPerDay, TotalInfections)

Person(<u>NHSNumber</u>, Name, PostCode, City, AddressLine1, AddressLine2, Gender, DateOfBirth, Ethnicity, Nationality, ProfessionType, mobileNumber)

Minister(<u>MinisterID</u>, Name, Contact, MinisterStatement)

Country(<u>CountryID</u>, *InfectionID, MinisterID*, Population, NameOfCountry)

County(<u>CountyID</u>, *CountryID*, *InfectionID,* CountyPopulation, NameOfCounty)

District(<u>DistrictID</u>,*CountyID*, *InfectionID,* Tier, DistrictPopulation, NameOfDistrict)

Trace(<u>TraceID</u>, *NHSNumber*, TestResult, LocationVisited, DateVisited, WorkLocation)

1NF

Infection(<u>InfectionID</u>, InfectionRate, TotalNewInfections, InfectionsPerDay, TotalInfections)

Person(<u>NHSNumber</u>, Name, Postcode, City, County, AddressLine1, AddressLine2, Gender, DateOfBirth, Ethnicity, Nationality, ProfessionType, mobileNumber)

Minister(<u>MinisterID</u>, Name, Contact, MinisterStatement)

Country(<u>CountryID</u>, *InfectionID, MinisterID*, Population, NameOfCountry)

County(<u>CountyID</u>, *CountryID*, *InfectionID,* CountyPopulation, NameOfCounty)

District(<u>DistrictID</u>, *CountyID*, *InfectionID,* Tier, DistrictPopulation, NameOfDistrict)

Trace(<u>TraceID</u>, *NHSNumber*, TestResult, LocationVisited, DateVisited, WorkLocation)

2NF

Infection(<u>InfectionID</u>, InfectionRate, TotalNewInfections, InfectionsPerDay, TotalInfections)

Person(<u>NHSNumber</u>, *AddressID*, Name, Gender, DateOfBirth, Ethnicity, Nationality, ProfessionType, mobileNumber)

Address(<u>AddressID</u>, City, Postcode, County, AddressLine1, AddressLine2)

Minister(<u>MinisterID</u>, Name, Contact, MinisterStatement)

Country(<u>CountryID</u>, *MinisterID*, Population, NameOfCountry, InfectionID)

County(<u>CountyID</u>, CountyPopulation, NameOfCounty, *CountryID*, InfectionID)

District(<u>DistrictID</u>, Tier, DistrictPopulation, NameOfDistrict, *CountyID*, InfectionID)

Trace(<u>TraceID</u>, *NHSNumber*, TestResult, LocationVisited, DateVisited, WorkLocation)

3NF

Infection(<u>InfectionID</u>, InfectionRate, TotalNewInfections, InfectionsPerDay, TotalInfections)

Person(<u>NHSNumber</u>, *AddressID*, Name, Gender, DateOfBirth, Ethnicity, Nationality, ProfessionType, mobileNumber)

Address(<u>AddressID</u>, AddressLine1, AddressLine2)

Area(<u>ID</u>, *AddressID,* Postcode, City, District)

Minister(<u>MinisterID</u>, Name, Contact, MinisterStatement)

Country(<u>CountryID</u>, *MinisterID*, *InfectionID*, Population, NameOfCountry)

County(<u>CountyID</u>, *CountryID*, *InfectionID*, CountyPopulation, NameOfCounty)

District(<u>DistrictID</u>, *CountyID*, *InfectionID*, Tier, DistrictPopulation, NameOfDistrict)

Trace(<u>TraceID</u>, *NHSNumber*, TestResult, LocationVisited, DateVisited, WorkLocation)

[Nothing else to normalise.]