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# Epidemiology and public health

Healthcare-associated infections  
in home care



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## COLOPHON

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## ABBREVIATIONS

<b>AE</b>	Adverse Event
<b>APIC</b>	Association for Professionals in Infection Control and Epidemiology
<b>CDC</b>	Centres for Disease Control and Prevention
<b>CINAHL</b>	Cumulative Index to Nursing and Allied Health Literature
<b>CRI</b>	Catheter Related Infections
<b>CSS-HGR</b>	Superior Health Council
<b>ECDC</b>	European Centre for Disease Prevention and Control
<b>ECG</b>	Electrocardiograph
<b>ESPEN</b>	European Society for Clinical Nutrition and Metabolism
<b>EU</b>	European Union
<b>GP</b>	General Practitioner
<b>HAI</b>	Healthcare Associated Infections
<b>HGR/CSS</b>	Hoge Gezondheidsraad/ Conseil Supérieur de la Santé
<b>HH</b>	Hand Hygiene
<b>HHC</b>	Home Health Care
<b>HIV</b>	Human Immunodeficiency Virus
<b>HPN</b>	Home Parental Nutrition
<b>IDSA</b>	Infectious Disease Society of America
<b>IPC</b>	Infection Prevention and Control
<b>KBF</b>	King Baudouin Foundation
<b>KCE</b>	Belgian Health Care Knowledge Centre
<b>MDRO</b>	Multidrug-Resistant Organisms
<b>MRGN</b>	Multi-Resistant Gram-Negative Bacteria
<b>MRSA</b>	Methicillin-Resistant Staphylococcus Aureus
<b>N</b>	Number
<b>NDLTD</b>	Networked Digital Library of Theses and Dissertations
<b>NICE</b>	National Institute for Health and Care Excellence
<b>NIHDI</b>	National Institute for Health and Disability Insurance
<b>OPAT</b>	Outpatient Parenteral Antimicrobial Therapy
<b>PICC</b>	Peripherally Inserted Central Venous Catheter
<b>PN</b>	Parenteral Nutrition
<b>PPE</b>	Personal Protective Equipment
<b>PPS</b>	Point Prevalence Survey
<b>RCT</b>	Randomized Clinical Trial
<b>RIZIV/INAMI</b>	National Institute for Health and Disability Insurance
<b>SOP</b>	Standard Operating Procedure
<b>TPN</b>	Total Parenteral Nutrition
<b>USA</b>	United States of America
<b>UTI</b>	Urinary Tract Infection
<b>VAP</b>	Ventilator-Associated Pneumonia
<b>WHO</b>	World Health Organisation



## FOREWORD

The Fund Dr. Daniël De Coninck invests in accessible, high-quality, humane primary health care. The Fund aims to improve quality of life and deliver better health for people in need of care.

In a context of increasingly complex care at home and the provision of more and more hospital care at home, there is a need to look in more detail at the issue of primary care related infections. Not much is known about this area.

A huge amount of attention is devoted to preventing care-related infections in hospitals and other care institutions (nosocomial infections). This is much less true when care is provided at home or in primary care, e.g. in GP surgeries, by physiotherapists etc. Nevertheless, we are facing major changes: hospital admissions are becoming shorter and the proportion of hospital care or advanced care being provided at home is increasing.

Preventing and combating infections in the context of care at home is a complex question. In this situation, the care environment exists alongside patient's own everyday environment (the place where they live, their way of life, their families and possibly their pets). In that context we must make a distinction between infections that patients bring home from hospital and infections that they acquire at home.

Although there are numerous guidelines and procedures, many of these were specifically developed for the hospital environment; so it is questionable whether they are suitable for the home situation and whether they are actually put into practice. Based on their experiences and practices at work, some health care providers or professional organisations in the field of care at home have already developed and introduced methods aimed at risk prevention. Not all of these, however, have been standardised.

How can we describe care-related infections clearly so that everyone is using the same frame of reference? What is a home care related infection and what are the risk factors in the home environment? Are health care workers sufficiently aware of the risks, and do they make use of specific methods? This publication aims to set out the current situation in regard to preventing home care related infections.

We hope this study will create opportunities to reflect on the need for standardised recommendations and introduce practices and procedures that are suited to the primary care context, particularly in the home environment.

Through this research the Fund Dr. Daniël De Coninck aims to get the prevention of care related infections in the home context firmly on the agenda, encourage further research and above all to encourage primary care workers to focus attention on this area.

Patricia Adriaens  
President of the Steering Committee of the Fund Dr. Daniël De Coninck



## VOORWOORD

Het Fonds Dr. Daniël De Coninck investeert in toegankelijke, kwaliteitsvolle en menselijke eerstelijnsgezondheidszorg. Het Fonds wil de levenskwaliteit en de gezondheid van zorgbehoevende personen verbeteren.

In de context van een steeds complexere thuiszorg en steeds vaker voorkomende ziekenhuisverzorging aan huis, is het nodig om dieper in te gaan op het thema van infecties die verband houden met de eerstelijnszorg. We weten immers nog maar weinig over dat onderwerp.

De preventie van zorginfecties krijgt enorm veel aandacht in ziekenhuizen en andere zorginstellingen (nosocomiale infecties). Dat is duidelijk minder het geval in de thuiszorg of de eerstelijnsvoorzieningen zoals in de praktijken van huisartsen, kinesitherapeuten, ... Nochtans staan we voor belangrijke veranderingen: de ziekenhuisopnames worden steeds korter en de ziekenhuisverzorging of voortgezette zorg aan huis neemt steeds verder toe.

Het voorkomen en bestrijden van infecties in de thuiszorg is een complex vraagstuk. De zorgomgeving heeft er een plaats naast de dagelijkse omgeving van de patiënten (de plek waar zij wonen, hun manier van leven, hun familie en eventueel hun huisdieren). In die context moeten we een onderscheid maken tussen infecties die de patiënten meebrengen uit het ziekenhuis en infecties die ze thuis oplopen.

Hoewel er een groot aantal richtlijnen en procedures bestaan, zijn die vaak specifiek ontwikkeld voor de ziekenhuisomgeving; de vraag is dan ook of zij aangepast zijn aan de thuissituatie en of ze echt worden toegepast. Op basis van hun werkervaring en -praktijk hebben sommige zorgverleners of beroepsorganisaties uit de thuiszorg al methoden ontwikkeld en ingevoerd die gericht zijn op risicopreventie. Maar die zijn niet altijd gestandaardiseerd.

Hoe kunnen we de zorginfecties op een eenduidige manier omschrijven, zodat iedereen hetzelfde kader gebruikt? Wat is een thuiszorginfectie en welke zijn de risicofactoren in de thuisomgeving? Zijn de gezondheidswerkers zich voldoende bewust van de risico's en hanteren zij specifieke methodes? Deze publicatie wil een stand van zaken opmaken over de preventie van thuiszorginfecties.

We hopen dat dit onderzoek de gelegenheid zal bieden om na te denken over de noodzaak van gestandaardiseerde aanbevelingen en om te komen tot praktijken en procedures die zijn aangepast aan de context van de eerstelijnszorg, vooral in de thuisomgeving.

Met dit onderzoek wenst het Fonds Dr. Daniël De Coninck de preventie van zorginfecties in de thuiscontext uitdrukkelijk te agenderen, verder onderzoek aan te moedigen en vooral de eerstelijnsverleners aan te zetten om zorgvuldig te handelen.

Patricia Adriaens  
Voorzitster van het Bestuurscomité van het Fonds Dr. Daniël De Coninck



## AVANT-PROPOS

Le Fonds Dr. Daniël De Coninck investit dans des soins de santé de première ligne accessibles, de haute qualité et humains. Il vise à améliorer la qualité de vie et la santé des personnes dépendantes.

Dans le cadre des soins à domicile de plus en plus complexes et des hospitalisations à domicile de plus en plus fréquentes, la question des infections liées aux soins de première ligne mérite d'être approfondie. En effet, nous savons peu de choses sur cette thématique.

La prévention des infections liées aux soins fait l'objet d'énormément d'attention dans les hôpitaux et autres établissements de soins (infections nosocomiales). C'est nettement moins le cas dans les soins à domicile ou les structures de soins de première ligne comme les cabinets de médecins généralistes, kinésithérapeutes... Nous sommes pourtant face à une évolution importante : la durée d'hospitalisation est de plus en plus courte et les hospitalisations ou soins prolongés à domicile sont en hausse.

La prévention et le contrôle des infections dans les soins à domicile est une question complexe. L'environnement de soins co-existe avec l'environnement quotidien du patient (le lieu où il vit, son mode de vie, sa famille et éventuellement ses animaux domestiques). Dans ce contexte, il y a lieu de distinguer les infections que les patients ramènent de l'hôpital des infections contractées à domicile.

S'il existe un grand nombre de lignes directrices et procédures, celles-ci ont souvent été développées spécifiquement pour le milieu hospitalier ; la question est dès lors de savoir si elles sont adaptées à la situation au domicile et si elles sont réellement appliquées. Sur base de leurs expériences et pratiques de travail, certains professionnels ou organisations professionnelles d'aide et de soins à domicile ont déjà développé et adopté des pratiques visant à prévenir les risques. Celles-ci ne sont toutefois pas standardisées.

Comment définir les infections liées aux soins de façon univoque pour que chacun utilise le même cadre ? Qu'est-ce qu'une infection liée aux soins à domicile et quels sont les facteurs de risque dans le contexte du domicile ? Les professionnels de la santé sont-ils bien conscients des risques et adoptent-ils des pratiques spécifiques ? Cette publication vise à faire le point sur la question de la prévention des infections liées aux soins à domicile.

Nous espérons que cette étude soit l'occasion de faire émerger la réflexion sur le besoin de recommandations standardisées et de faire évoluer vers des pratiques et procédures adaptées au contexte des soins de première ligne, particulièrement à domicile.

Par cette recherche, le Fonds Dr. Daniël De Coninck veut mettre à l'agenda la question de la prévention des infections dans le contexte du domicile, encourager la poursuite des recherches et, surtout, encourager les professionnels de première ligne à prendre des dispositions.

Patricia Adriaens  
Présidente du Comité de gestion du Fonds Dr. Daniël De Coninck



## EXECUTIVE SUMMARY

Over the last years, we observed a considerable shift from inpatient care to outpatient care, including home healthcare (HHC). Currently, the number of patients and medical conditions treated in HHC is increasing, and ‘home hospitalisation’ projects are emerging more and more in Belgium and elsewhere. However, healthcare in the home setting exposes providers to specific challenges and patients to new hazards, especially healthcare-associated infections (HAI). Unlike hospital care, data on HAI in home care is scarce, and its real burden remains unknown. The objective of this study was therefore to investigate a definition of HAI in HHC, identify their associated risk factors and develop recommendations for infection prevention and control (IPC).

To address this objective, we conducted a study which was structured in three parts. First, we carried out a desk study including a scoping literature review and in-depth interviews with individuals involved in the field of HHC. A two-rounds Delphi online survey was then performed to search for consensus among experts on the results of the previous steps. Finally, we assessed all the information collected to develop a standardized framework for IPC of HAI in HHC in Belgium.

### Main findings

- The definition for HAI in HHC agreed upon in our study is: ‘Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC’.
- This study highlighted a need for surveillance and reporting of HAI in HHC. The preferred way of reporting identified is: to start with a point prevalence survey (PPS), repeat it every 3 to 5 years, and evaluate according to its results the need for a continuous surveillance system.
- Risk factors identified on which action is required and feasible are: hand hygiene, patients’ personal hygiene, training of patients and caregivers about measures to prevent HAI in HHC and presence and management of invasive devices.
- There is a clear need for measures and guidelines to prevent and control HAI in HHC. For this, already existing national and international recognized IPC guidelines for HAI (e.g. WHO guidelines on hand hygiene) and guidelines for specific technical procedures (e.g. hospital guidelines for preventing central line-associated bloodstream infections) can be used as long as they can be adapted to the home setting when needed.
- Other areas of improvement identified are: communication between hospitals and primary healthcare workers, coordination of HHC, and training, support and supervision of homecare workers, lay caregivers and patients.

### **Recommendations**

- To use as definition for HAI in HHC: ‘Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC’.
  
- To conduct a point prevalence study to know the prevalence of HAI in HHC in Belgium, using the definition above.
  
- To have specific recommendations and guidelines regarding HAI in HHC available at national level. We recommend that the development and dissemination of these guidelines should be coordinated and done by the Superior Health Council. These guidelines should be standardised and be based on both existing national and international recognized IPC guidelines for HAI and guidelines for specific technical procedures, leaving room for adaptation to the home context.

## KORTE SAMENVATTING

De voorbije jaren hebben we een aanzienlijke verschuiving vastgesteld van intramurale naar ambulante zorg, waaronder ook thuiszorg. Het aantal patiënten en aandoeningen dat via thuiszorg wordt behandeld, neemt momenteel toe en in België en ook elders duiken steeds meer projecten van ‘thuishospitalisatie’ op. Maar gezondheidszorg in de thuisomgeving brengt specifieke uitdagingen voor de aanbieders met zich mee en ook nieuwe risico’s voor de patiënten, vooral zorginfecties. In tegenstelling met de zorg in het ziekenhuis zijn in de thuiszorg maar weinig gegevens beschikbaar over zorginfecties en de echte omvang van het probleem is nog niet bekend. Daarom wilde dit onderzoek op zoek gaan naar een definitie van zorginfecties in de thuiszorg, de bijbehorende risicofactoren identificeren en aanbevelingen opstellen voor infectiepreventie en -bestrijding.

Om dat doel te bereiken, voerden we een onderzoek uit dat bestond uit drie delen. Ten eerste deden we theoretisch onderzoek met literatuurstudie en diepte-interviews met personen die betrokken zijn bij de thuiszorg. Daarna werd een online Delphi-onderzoek in twee rondes uitgevoerd om onder deskundigen tot een consensus te komen over de resultaten van de vorige stappen. En tot slot hebben we alle ingezamelde informatie beoordeeld om een gestandaardiseerd kader voor preventie en bestrijding van zorginfecties in de thuiszorg te ontwikkelen.

### Belangrijkste bevindingen

- In ons onderzoek waren we het eens over de volgende definitie van zorginfecties in de thuiszorg: ‘Elke infectie die specifiek in verband kan worden gebracht met het verlenen van zorg (bv. een wondinfectie, een katheterinfectie) die ontstaat bij een patiënt die thuiszorg krijgt van een professionele gezondheidswerker en die zich 48 uur of langer na aanvang van de thuiszorg voordoet’.
- Dit onderzoek wees op een nood aan toezicht en melding van zorginfecties in de thuiszorg. De volgende manier van verslag uitbrengen geniet de voorkeur: beginnen met een puntprevalentieonderzoek en dat alle drie tot vijf jaar herhalen en op basis van de resultaten nagaan welke nood er is aan een systeem van permanent toezicht.
- De vastgestelde risicofactoren waarvoor actie nodig en haalbaar is: handhygiëne, de persoonlijke hygiëne van de patiënt, educatie van patiënten en zorgverleners over maatregelen om zorginfecties in de thuiszorg te voorkomen en de aanwezigheid en het hanteren van invasieve hulpmiddelen.
- Er is een duidelijke nood aan maatregelen en richtlijnen om zorginfecties in de thuiszorg te voorkomen en te bestrijden. Daarvoor kunnen al bestaande nationaal en internationaal erkende richtlijnen voor preventie en bestrijding van zorginfecties (bv. de richtlijnen van de WHO over handhygiëne) en richtlijnen voor specifieke technische procedures (bv. ziekenhuisrichtlijnen voor de preventie van

centrale katheter gerelateerde bloedbaaninfecties) worden gebruikt, zolang die kunnen worden aangepast aan de thuisomgeving waar dat nodig is.

- Andere mogelijkheden tot verbetering: communicatie tussen ziekenhuizen en eerstelijnsgezondheidswerkers, coördinatie van de thuiszorg en scholing, ondersteuning en begeleiding van thuiszorgverleners, mantelzorgers en patiënten.

## Aanbevelingen

- De volgende definitie voor zorginfectie in de thuiszorg gebruiken: 'Elke infectie die specifiek in verband kan worden gebracht met het verlenen van zorg (bv. een wondinfectie, een katheterinfectie) die ontstaat bij een patiënt die thuiszorg krijgt van een professionele gezondheidswerker en die zich 48 uur of langer na aanvang van de thuiszorg voordoet'.
- Een puntprevalentieonderzoek uitvoeren om de prevalentie van zorginfecties in de thuiszorg in België na te gaan, met gebruik van de bovenstaande definitie.
- Beschikken over specifieke aanbevelingen en richtlijnen over zorginfecties in de thuiszorg op nationaal vlak. Wij adviseren dat het opstellen en verspreiden van die richtlijnen moet worden gecoördineerd en gebeuren door de Hoge Gezondheidsraad. Die richtlijnen moeten worden gestandaardiseerd en moeten berusten op zowel bestaande nationaal en internationaal erkende richtlijnen voor preventie en bestrijding van zorginfecties en richtlijnen voor specifieke technische procedures, met ruimte voor aanpassing aan de thuisomgeving.

## RÉSUMÉ

Nous avons observé ces dernières années une évolution considérable allant des soins aux patients hospitalisés vers des soins ambulatoires, y compris les soins à domicile (SàD). Le nombre de patients et de problèmes de santé actuellement traités dans les SàD augmente et des projets d'hospitalisation à domicile émergent de plus en plus en Belgique et ailleurs. Cependant, les soins de santé à domicile exposent les prestataires de soins à des défis spécifiques et les patients à de nouveaux risques, en particulier aux infections nosocomiales (IN). Contrairement aux soins hospitaliers, les données sur les IN dans les soins à domicile sont rares et leur véritable portée reste inconnue. L'objectif de cette étude était par conséquent d'étudier une définition des IN dans les SàD, d'identifier les facteurs de risques associés et d'élaborer des recommandations en matière de prévention et de contrôle des infections (PCI).

Pour atteindre cet objectif, nous avons mené une étude structurée en trois parties. Nous avons d'abord effectué une étude documentaire, y compris une analyse documentaire de la portée de l'étude et des entretiens approfondis avec des personnes impliquées dans le secteur des SàD. Un sondage en ligne Delphi en deux phases a ensuite été réalisé dans le but de dégager un consensus entre les experts sur les résultats des étapes précédentes. Enfin, nous avons évalué toutes les informations recueillies afin d'élaborer un cadre normalisé de prévention et de contrôle des IN dans les SàD en Belgique.

### Principaux résultats

- La définition des IN dans les SàD, convenue dans notre étude, est la suivante :  
« Toute infection pouvant être spécifiquement liée à la prestation de soins (p. ex. infection d'une plaie, infection liée à l'utilisation de cathéters) qui se développe chez un patient qui reçoit des SàD d'un professionnel de la santé et qui survient 48 heures ou plus après le début de ces SàD ».
- Cette étude a mis en évidence la nécessité d'une surveillance et d'un signalement des IN dans les SàD. Le mode de signalement privilégié est le suivant : commencer par une étude ponctuelle de prévalence, la répéter tous les 3 à 5 ans et, en fonction de ses résultats, évaluer la nécessité d'un système de surveillance continue.
- Les facteurs de risque identifiés pour lesquels une action est nécessaire et faisable sont les suivants : hygiène des mains, hygiène personnelle des patients, formation des patients et des soignants sur les mesures de prévention des IN dans les SàD et présence et gestion de dispositifs invasifs.
- Il est clair qu'il faut des mesures et des lignes directrices pour prévenir et contrôler les IN dans les SàD. Pour ce faire, il est possible d'utiliser les lignes directrices reconnues aux niveaux national et international en matière de prévention et de contrôle des IN (par exemple, les lignes directrices de l'OMS sur l'hygiène des mains) et les lignes directrices relatives à des procédures techniques spécifiques (par exemple, les lignes directrices des hôpitaux concernant la prévention des infections

liées aux cathéters intravasculaires centraux), à condition de les adapter au contexte du domicile si nécessaire.

- D'autres domaines à améliorer ont été identifiés : la communication entre les hôpitaux et les travailleurs des soins de santé primaires, la coordination des SàD, la formation, le soutien et la supervision des travailleurs à domicile, des soignants non professionnels et des patients.

## Recommandations

- Utiliser la définition suivante des IN dans les SàD : « Toute infection pouvant être spécifiquement liée à la prestation de soins (p. ex. infection d'une plaie, infection liée à l'utilisation de cathéters) qui se développe chez un patient qui reçoit des SàD d'un professionnel de la santé et qui survient 48 heures ou plus après le début de ces SàD ».
- Effectuer une étude ponctuelle de prévalence pour connaître la prévalence des IN dans les SàD en Belgique, en utilisant la définition ci-dessus.
- Disposer de recommandations et de lignes directrices spécifiques sur les IN dans les SàD au niveau national. Nous recommandons que l'élaboration et la diffusion de ces lignes directrices soient coordonnées et réalisées par le Conseil supérieur de la santé. Ces lignes directrices devraient être normalisées et s'appuyer tant sur les lignes directrices en matière de prévention et de contrôle des IN reconnues aux niveaux national et international que sur les lignes directrices relatives à des procédures techniques spécifiques, tout en laissant une marge d'adaptation dans le contexte du domicile.

# INTRODUCTION

## 1. Background

In our ageing society, where the prevalence of chronic diseases is increasing and leading to new, advanced and often complex medical treatment, demand for healthcare is constantly rising. Considered as the ‘most frequent adverse event (AE) in health care delivery worldwide’ (1), healthcare-associated infections (HAI) represent a significant public health threat that should never be overlooked. In high income countries, around 7% of hospitalised patients will acquire at least one HAI (1), 6% in Europe (around 7% in Belgium) (2) and a bit over 3% in the United States of America (USA) (3). The burden of HAI is huge, including not only mortality and morbidity, but also financial and socio-economical costs due to increased length of hospitalisation, additional diagnostic, treatment and rehabilitation of infected patients, and loss of productivity and of quality of life. Finally, over 20% of HAI are estimated to be preventable, which calls for a ‘zero tolerance’ attitude towards this part of the problem (4).

‘Primum non nocere’, this motto is a cornerstone of care and of one of the fundamental bioethics principle: ‘non-maleficence’. It also gave rise in Belgium to the concept of quaternary prevention, or how ‘to protect patients from medical harm’ (5). Safe care must indeed be a priority, for everyone, everywhere. Furthermore, a ‘patient-centred approach’ is now an essential driver in healthcare decisions and quality of care discussions, and invites to consider not only the patient but also his/her family and environment. In the European union (EU), having a high quality healthcare is considered as a fundamental human right and patient safety is at the centre of various legislative and policy documents. HAI and consequently infection prevention and control (IPC) measures in acute hospital settings have therefore become a priority on the political agenda of many countries, but somehow inconsistently (6).

However, the focus is still essentially on inpatients settings, but as highlighted by the World Health Organisation (WHO), no healthcare setting is exempt from the risk of HAI, with risk factors varying according to the type of setting. Over the last years, we observed a considerable shift from inpatient care, often in acute care hospitals, to outpatient care, which encompasses various community-based settings as general practices, outpatient clinics, physical therapy centres and many others specialized settings. But mostly, outpatient care involves home care. Home health care (HHC) is defined as care provided by professionals to a person in his/her own home and covers a wide range of activities, from preventive visits to end-of-life care (7). The number of patients receiving HHC services has been increasing, and is expected to continue its expansion (8,9). Indeed, while healthy, elderly patients have always received preventive routine care at home, ill patients are now increasingly transferred to their home with the hope of gaining quality of life and reducing healthcare costs. However, receiving care at home poses new challenges and exposes patients to others hazards, especially HAI, known to be influenced by the home environment, the caregivers, the socio-economic status, the type of care provided or the use of medical devices (10).

On the contrary of hospital care, where extensive research on HAI has identified risk factors and proposed measures and interventions to prevent these infections or mitigate their consequences (11-13), data on HAI in home care is scarce, and its real burden remains unknown. This can be partially explained by the difficulty to collect reliable data on this topic, the lack of surveillance system, resources and standardised definitions, and certainly because the culture of infection control has until now mainly focused on hospitals and acute care facilities (14). In Belgium, national surveillance systems of HAI in hospital settings cover bloodstream infections, multi-drug resistant organisms (MDRO) as methicillin-resistant staphylococcus aureus (MRSA) and multi-resistant Gram-negative bacteria (MRGN) and a point prevalence survey of HAI in acute hospitals and long-term care facilities repeated every three to five years (15), but no surveillance system exists for HAI in HHC. Most of the knowledge used in IPC practice in home care originates from the evidence collected in hospital care, with empirical adaptations to the home setting. Indeed, in the absence of specific recommendations for primary care, including home care, WHO recommends to use and adapt guidelines designed for acute care facilities (16). However, a few recommendations for addressing HAI in primary care settings, including home care, have been published in the recent years (17-19) and research on HAI in HHC has been attempted, but its results are not yet consolidated and not included in the basic training of health care professionals or in national guidelines (20).

Already well established in France and Spain, the concept of ‘home hospitalisation’ is rapidly making its way into the Belgian landscape of healthcare delivery. There are currently 12 pilot projects financed by the National Institute for Health and Disability Insurance (NIHDI or RIZIV/INAMI) aiming to test if the quality and safety of home care is guaranteed compared to the inpatient environment, especially for administration of parenteral antibiotics or cancer treatment including chemotherapy (21). This further supports the need for epidemiological data on HAI in HHC, for a better identification of risk factors for infection, and for the development and strengthening of IPC capacity in HHC. The use of a standardised definition is essential to generate surveillance data that can be used to better describe the epidemiology of HAI among HHC patients, to enable comparison among different settings and of course to prevent HAI in HHC and improve quality of care. This study therefore aims to fill this gap and answer these fundamental questions.

## 2. Aims and Objective

The aim of this project is to conduct a conceptual analysis of HAI in home care in order to improve the quality of HHC, and subsequently health and quality of life for all.

The related specific objectives are:

- To develop/propose a clear definition for HAI in HHC,
- To identify specific risk factors for HAI acquisition in the home care setting,
- To develop a standardised framework for prevention and control of HAI in HHC in Belgium.

## METHODS

A research protocol was first developed and approved by the King Baudouin Foundation (KBF) prior to the study and a working group including five Belgian experts was set up to follow-up the progress of the project. Two meetings were organised during the assignment, to discuss preliminary results and adjustments to the protocol when needed. The project officially started on the 15<sup>th</sup> of October 2018 and ended on the 30<sup>th</sup> of April 2019. As shown in figure 1, the work plan was structured in three parts: a desk study composed of a literature review and in-depth interviews, a Delphi analysis, and finally an assessment of all the information collected in the previous steps.

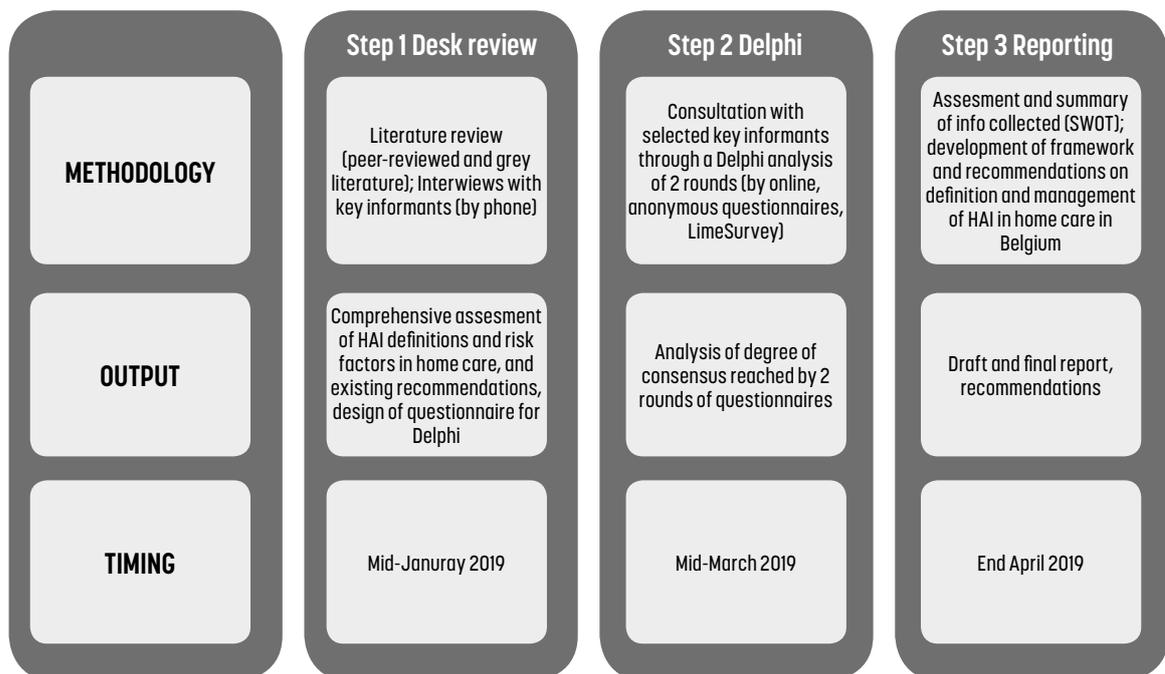


Figure 1: Work plan approach

The literature review and the healthcare professionals in-depth interviews aimed to assess what is known and what is already done in the field of IPC for HAI in HHC.

They addressed the following questions:

- How are HAI in HHC described and defined as a phenomenon and as a concept (including distinction between clinical and epidemiological case definition)?
- What are the known risk factors associated with HAI in HHC?
- Which actions and which assessments are currently performed and what are the existing recommendations and good practices in IPC in HHC?

Based on the literature review and the interviews results, Belgian experts and actors in the field of IPC or HHC were consulted on how to best define, report and address HAI and their risk factors in HHC, using the Delphi method to assess agreement and degree of consensus. The information gathered through these three activities were finally summarised to develop a conceptual framework and recommendations for the management of HAI in HHC in Belgium.

This section will go through the methodology of each of the three activities in detail: the literature review, the in-depth interviews and the Delphi analysis, before giving way to a description of the main results.

## 1. Literature review

After preliminary searches and discussion with the working group, we decided to perform a scoping literature review, whose design seemed more adapted to our research question. The aim of a scoping review is to map and summarize a wide range of evidence in order to convey the breadth and depth of a field (22). Differences with a systematic review are the possibility to formulate broader research aims, to develop and refine selection criteria along the search process and the possibility not to appraise the quality of the included studies (23–25).

### 1.1. DATA SOURCES

We searched for articles published in both peer reviewed journals and grey literature. Published, peer reviewed literature was searched in the following databases: PubMed, Embase, Science Direct, the Cumulative Index to Nursing and Allied Health Literature (CHINAHL) and Cochrane. Grey literature was investigated through Google Scholar and grey literature databases as: Open Grey ([www.opengrey.eu](http://www.opengrey.eu)), the Networked Digital Library of theses and Dissertations ([www.ndltd.org](http://www.ndltd.org)) and Grey Literature Report, ([www.greylit.org](http://www.greylit.org)). We also searched websites of national and international institutions as WHO, the Centres for Disease Control and Prevention (CDC), the European Centre for Disease Prevention and Control (ECDC), the Belgian Health care Knowledge Centre (KCE) and the Belgian Superior Health Council (CSS/HGR). Citation searching and ‘related articles’ tools were also used where available and reference of included studies were checked to identify relevant cross citations. All data used for this review came from public domain and did not require any specific permission.

### 1.2. SEARCH STRATEGY

#### 1.2.1. Search terms

The two following key concepts were used for the search, both in text words (in title, abstract or key words) and subject headings when possible: healthcare-associated infections and home care. Search terms for the first concept included ‘infection’, ‘sepsis’, ‘pneumonia’, ‘nosocomial’, ‘iatrogenic’, ‘infectious disease’ and ‘communicable disease’, while for the second concept we used ‘home care’, ‘home healthcare’, ‘home infusion’, ‘home based hospital care’, ‘hospital at home’ and ‘aftercare’. These terms and the subjects headings were used in different combinations using the Boolean operators ‘AND’ and ‘OR’ on the selected databases. The exact strings used for the literature review in each database can be found in Annex 1. They were launched in the databases on the 30<sup>th</sup> of October 2018.

### 1.2.2. Eligibility Criteria

Studies were included if:

- They were written in English, Dutch, Italian, French, German and Spanish.
- They related on patients receiving HHC services, including outpatient parenteral antimicrobial therapy (OPAT) and home parenteral nutrition (HPN).
- They were published in high income countries, as defined by the World Bank (26), as these countries supposedly share equivalent standards of care and risk factors for HAI.
- They answered to at least one of three aspects of HAI in HHC defined in our objective.
- The research design was qualitative, mixed method, or quantitative (mainly observational studies, either descriptive either analytical). Theoretical essays were also included.
- They were published from year 2000 on. This criteria was added after the titles screening in light of the amount of old literature on the topic, in order to obtain the most updated information on this constantly evolving subject.

Studies were excluded if:

- Written in another language.
- Performed in a low or middle income country, or related to a healthcare setting that was not the patient's dwelling.
- Target population focused on family members or HHC workers (occupationally acquired infections in home healthcare).
- They were unrelated articles, editorials, commentaries, case-studies.
- They were disease specific such as investigations on human immunodeficiency virus (HIV) patients, transplanted patients or patients with cystic fibrosis. This criteria was added through the process since our study aimed to focus on the general population.
- They related on nursing homes, telemedicine, oral hygiene/care, patient's satisfaction or evaluation of the performance of specific agencies. This criteria was also added along the searching process as these topics were considered irrelevant for our research question.

### 1.2.3. Data extraction and data synthesis

After removal of duplicates, the identified studies were screened for relevance.

The eligibility criteria were applied first to title and abstracts, then to full text.

Predetermined relevant characteristics of the selected studies were extracted using a data extraction form and tabulated on an excel sheet. For the purpose of the study a personalized quality assessment tool was developed. We attributed a score for each criteria based on what was more relevant to fulfil our objectives and after discussion and validation of the working group. These characteristics and their scoring are presented in Tables 1 and 2. Due to the nature of a scoping review and the heterogeneity in study designs the global synthesis was narrative and investigated each of the three aspects of our objectives: definitions, risk factors and recommendations.

Table 1: List of criteria evaluated for each included article and their scoring

Characteristics	Evaluated Criteria and their scoring
Study information	<p><b>Study type:</b>            +++ Experimental study/literature review            ++ Observational study            + Expert opinion/essay</p> <hr/> <p><b>Setting:</b>            +++ Study conducted in Belgium            ++ Study was conducted in Europe</p> <hr/> <p><b>Population:</b>            +++ All age groups            ++ Only children/elderly            + Undefined</p>
Type of infection	<p><b>In all possible infection sites as defined by ECDC</b></p> <hr/> <p>+++ HAI in HHC            ++ Presumed HAI in HHC            + Mixed source            - Undefined source</p>
Contents & Findings	<p><b>Definition of HAI in HHC:</b>            +++ Provides definition            ++ Uses accepted recognised definition (guidelines)            + Uses accepted definition (literature, peers)            - No definition provided</p> <hr/> <p><b>Risk factors of HAI in HHC:</b>            +++ Identifies risk factors            ++ Lists risk factors            + Mentions risk factors            - No risk factors provided</p> <hr/> <p><b>Recommendations for prevention and control:</b>            +++ Identifies recommendations            ++ Lists recommendations            + Mentions recommendations            - No recommendations provided</p>

Table 2: Scoring table and meaning of the assigned values

Score	Meaning
+++	Matches completely/is completely fulfilled
++	Matches partially/partly fulfilled
+	Matches incompletely but sufficiently/is only partly but sufficiently fulfilled
-	Does not match or matches insufficiently/is insufficiently fulfilled
c.b.e	cannot be evaluated

## 2. In-depth interviews

The objectives and research questions for the in-depth interviews were similar to those of the literature review and are given above in the introduction of the 'Methods' chapter. We used the purposive sampling method to select candidates for the interviews (27). In order to select relevant interviewees, we developed a guide of the potential professional profiles to target, including requested requirements and criteria (see Annex 2).

Candidates could for instance be involved in the organisation and/or management of HHC or provide HHC in Belgium or be experts in IPC. The three Belgian regions, Brussels-Capital, Flanders and Wallonia, had to be represented more or less equally in the sample. We planned to conduct a total of 30 interviews. However, this number was adapted during the study on the point in the data collection when new data no longer brought additional insights and we reached data saturation.

Identification, recruitment and interviews of candidates were done by the two Belgian researchers involved in this study. Relevant candidates were identified through their already existing network and through searching the internet. Candidates were contacted by e-mail and a time-slot to conduct the phone interview was agreed with those who reacted positively. A reminder was sent to candidates who did not reply on the e-mail after two weeks. Participants participated voluntarily and informed consent was obtained. Confidentiality was and is protected and guaranteed. Interviews were done by phone (apart from one interview that was conducted face-to-face) in the participants' native language (French or Dutch). They were audio recorded and interview notes were taken. The interview guide used to support the interviews is given in Annex 3. This guide was developed by the three researchers involved in the study and was based on the research objectives and information found in the literature review. It covered the same three topics as the literature review, exploring: (1) description and definition of home care-associated infections, (2) risk factors for HAI in HHC, and (3) prevention and control of HAI in HHC in Belgium.

The two same researchers who conducted the interviews did the data analysis. They used the deductive framework approach using the research question/objectives to group data together looking for similarities and differences. Analysis and grouping of data started immediately after conducting the first interview using the audio recordings and the interview notes. The interview guide was adapted based on the analysis results. The final framework is given in figure 2.

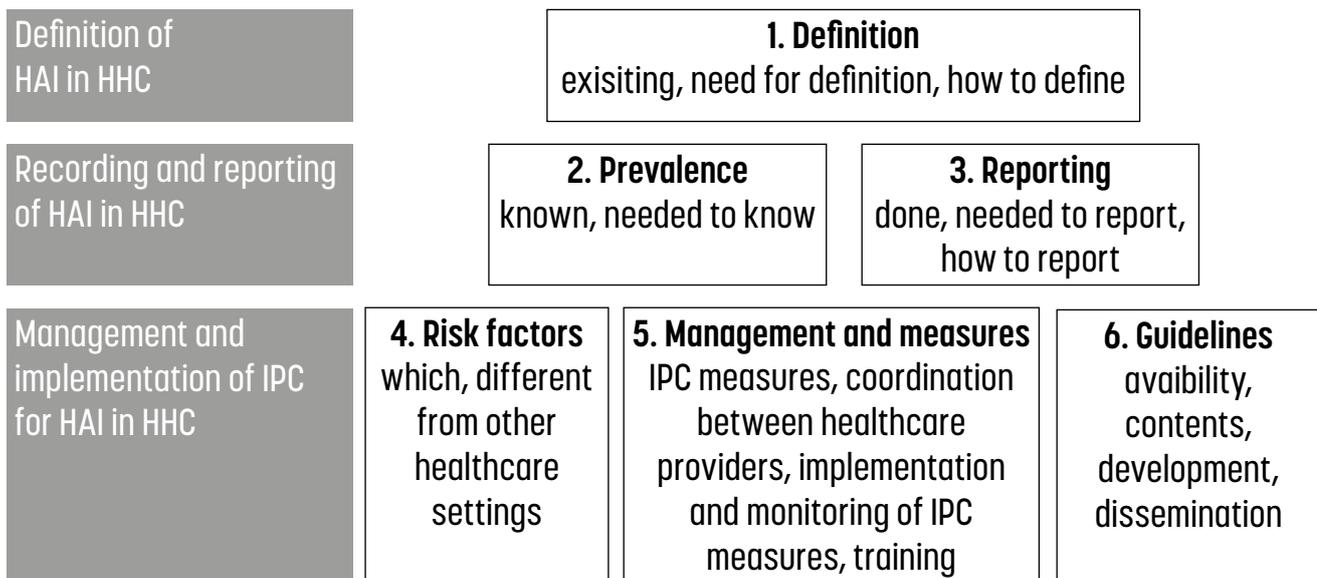


Figure 2: Framework for analysis of in-depth interviews on healthcare associated infections in home healthcare (HAI: healthcare-associated infection; HHC: home healthcare; IPC: infection prevention and control)

### 3. Delphi consultation

The two round Delphi consultation was conducted through an online survey. Participants in this Delphi consultations were experts involved in the organisation and/or management of HHC, providers of HHC in Belgium or experts in IPC. Only Belgian experts were consulted. STATA 14.2 was used to perform descriptive analysis of the Delphi data.

The results of the literature review and the in-depth interviews were used to design the questionnaire for the first round of the Delphi. This questionnaire was piloted in English with seven volunteers, including three experienced qualitative researchers, and was adapted and translated accordingly. The final version was transcribed in the online survey tool 'LimeSurvey', both in French and in Dutch. Anonymity was guaranteed throughout the process. Besides basic information on years of experience and professional activities, the questionnaire contained questions on definition, reporting and risk factors of HAI in HHC, and questions on measures and guidelines to prevent and control HAI in HHC. The questionnaire used for the first Delphi round can be found in Annex 4. For each topic, a comment could be made if desired.

To study the level of agreement among the experts a four point Likert scale was developed, being:

- 1: Strongly disagree / very low importance
- 2: Disagree / low importance
- 3: Agree / high importance
- 4: Strongly agree / very high importance

A middle, neutral option (neither agree nor disagree) was deliberately not included, in order to encourage participants to forge an opinion. However, the option 'I don't know' was provided.

For each question/statement of the survey, we calculated the percentage of respondents in each of the 4 Likert scale groups. A predetermined consensus level was set up at 80%, that is consensus was considered if the percentage of experts who agreed or strongly agreed to a statement was 80% or higher ('I don't know' answers were excluded from the calculation). Additionally, for each question/statement measures of central tendency as mean and median were calculated using the four point Likert scale. Among the statements that achieved the desired level of agreement ( $\geq 80\%$ ), the mean was used to determine the level of importance of each statement.

For the second Delphi round, we used the following criteria to design the questionnaire, that can be found in Annex 5:

- For questions where two or more contradictory statements achieved a 80% level of consensus, it was asked to choose the statement with which they agreed most.
- Statements for which a consensus level of more than 80% was reached were excluded.
- Questions on which no agreement (or disagreement) could be found where investigated again. They were either asked a second time as such, either reformulated, or accompanied by new statements based on the comments provided by the experts in the first round.

A general feedback on the results of the first round was also provided, and the level of consensus achieved for each item was displayed. By doing so, we aimed to motivate the experts to reconsider their answer in the light of the group response. The methodology applied to analyse results of the first round was equally applied to the second round.

For each round, two reminders were sent and the time limit allowed to submit a response was 2 weeks.

## RESULTS

This section will describe the results of each activity independently, before summarizing the main findings.

### 1. Literature review

Searches in peer-reviewed literature databases yielded a total of 3171 results, of which 2007 were unique publications. After screening the titles and removing papers published before year 2000, 366 underwent abstract review and of these 118 were eligible for full text review. In the full text review 6 publications were added out of the 120 papers screened from the grey literature. 47 articles were finally selected to be included in the study and evaluated according to the pre-selected criteria (Table 1). Of these, 2 articles were identified through manual search of the bibliographies.

Figure 3 describes the flow diagram of the literature search and the articles selection process.

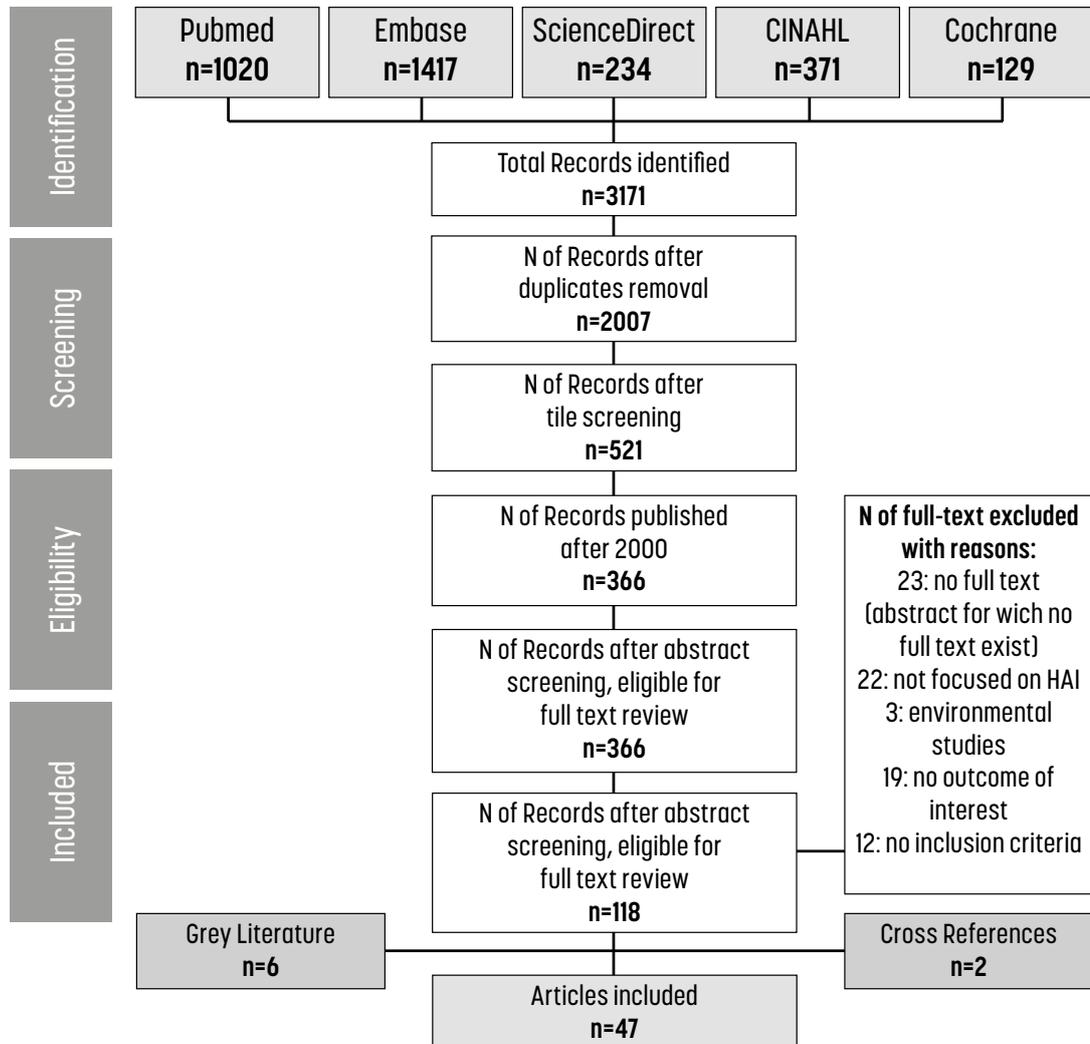


Figure 3: flow diagram of the literature search and articles selection process

### 1.1. CHARACTERISTICS OF THE INCLUDED STUDIES

47 publications, selected from the different sources, reported relevant information about our objectives and were included in the study. As described in table 3, 13 publications were articles from experts which presented the state of the art or discussed best practices or guidelines, 4 were official guidelines and 1 was a draft of definitions for a surveillance system. The remaining 29 publications were research articles, 13 retrospective observational investigations, 7 surveys, 3 literature reviews, 3 cohort studies, 2 point prevalence studies (PPS), and 1 randomized clinical trial (RCT).

Table 3: Type of publications included in the review

Type of Publication	Number (N)	
Expert essay	13	
Guidelines	4	
Draft surveillance system	1	
Research Study	Retrospective	13
	Survey	7
	Literature review	3
	Cohort	3
	PPS	2
	RCT	1
Total	47	

Of the 29 research articles, 3 specifically considered hospital at home care, while the remaining 26 reported about general home care without specifying further. None of the guidelines made this distinction, while some of the expert publications mentioned it but in a theoretical approach.

Among the included publications, 22 (47%) were from the United States of America (USA), 16 (34%) from Europe, 6 (13%) from Canada, 1 (2%) from Hong Kong, 1 (2%) from Saudi Arabia and 1 (2%) from the WHO.

Of the research articles 21/29 included patients of all ages, 5/29 adults  $\geq 18$  years, 1/29 patients  $\geq 17$  years, 1/29 patients  $\geq 16$  year, and 1 focused on children.

25 publications (53%) focused on general unspecified HAI, or on multiple types of infection together, while 20 (43%) dealt specifically with catheter related infections (CRI) and 2 (4%) with ventilator associated pneumonia (VAP).

Detailed information on each study's characteristics as well as their score can be found in Annex 7. The 4 guidelines, due to their nature, were not scored and are therefore not included in Annex 7.

### 1.2. DEFINITION OF HAI IN HHC

30 of the 47 included papers provided or described any form of definitions of HAI in HHC. Of these, 15 research studies used self-proposed definitions, either for one specific HAI (28-36) or for more than one HAI (37-42). These definitions ranged from a very simple definition such as 'patients who acquired an infection during their period at

home' (37) to a very detailed one such as provided by the 1988 CDC guideline (43) used by Patte et al.(42). The Association for Professionals in infection Control and Epidemiology (APIC) provided its own definition, that was used by 7 other papers (44–50). The APIC definition was initially drafted by Embry et al. in 2000 (51) and published in 2008 as 'Surveillance Definitions for Home Health Care and Home Hospice Infections'(52): 'A healthcare associated infection (HAI) is an infection that develops in a patient who is cared for in any setting in which healthcare is delivered (...) and is related to receiving health care (...). In ambulatory and home settings, HAI applies to any infection that is associated with a medical or surgical intervention. (...) Thus, home care and home hospice healthcare associated infections (HAI) are those infections that were neither present nor incubating at the time of initiation of care in the patient's place of residence. For those infections appearing in a patient within 48 hours of discharge from a healthcare facility, the infection(s) is reported back to the facility that discharged the patient prior to their home care services.'

Other publications (53, 54) used definitions from the Infectious disease society of America (IDSA) (55) and the European society for clinical nutrition and metabolism (ESPEN) (56).

Official institutions as WHO (12) and CDC (13) include HHC in their general guidelines for infection prevention and control of HAI while the National Institute for Health and Care Excellence (NICE) includes it in a specific guideline for primary and community care (18).

Very interestingly Miliani et al.(57) in their PPS of HAI in HHC in France adapted ECDC HAI definitions for acute care (2) to the home setting. They specify that the infection should occur during the process of care, neither present nor incubating at the time of starting home care (Day 1), for which the signs and symptoms became apparent after Day 2 and were not associated with a previous discharge from a hospital.

### **1.3. RISK FACTORS FOR HAI IN HHC**

Among the 47 included publications, 27 papers reported on risk factors for the acquisition of HAI in HHC. Of these, 15 (28–30,32,33,35,36,42,54,57–62) identified the risk factors as a result of a research study, 7 (37,53,63–67) listed risk factors reported by others while the rest (34,41,68–70) just mentioned potential and theoretical risk factors. Also, the 4 included guidelines listed (12) and mentioned (13,18,71) potential risk factors for HAI, but none of them referred specifically and exclusively to the HHC setting.

The methodology through which the risk factors were identified varied between multivariable analysis on datasets of patients in HHC who developed a HAI, literature review, environmental studies and expert opinions. As reported by Shang et al.(59) in their systematic literature review of the risk factors of HAI in HHC, the studies are limited by small sample size and other methodological flaws, which in their case did not allow for a meta-analysis.

The more consistent risk factors reported for the different type of infections can be grouped as follows:

- Non-specific infections: presence of indwelling devices, patients living alone, training of staff offering the service, urinary catheter, at least 1 vascular catheter, duration of HHC, lack of personal protective equipment by staff, lack of hospital liaison at discharge.
- Intravenous catheter related infections (CRI): patient's age, being a woman, underlying disease, receiving total parenteral nutrition (TPN), number of days in TPN, multi-lumen catheter, infusion ports, peripherally inserted central venous catheters (PICCs), socio-economic status of the patient, patients living alone, previous HAI, skin microbiome.
- Catheter related urinary tract infections (UTI): being a woman, catheter changed <4 times a week, number of nurses changing the catheter.
- Ventilator associated pneumonia (VAP): longer duration of the ventilation, hand hygiene, type of equipment used (non-critical, semi-critical, critical), oral care, equipment cleaning, patients education.

#### **1.4. MEASURES AND GUIDELINES TO PREVENT AND CONTROL HAI IN HHC**

The vast majority of the included studies (43/47), provided some kind of recommendations. A quarter of these (28,29,31,34,53,58,59,61,62,72,73) focused on IPC, while the others offered more general recommendations. One Belgian paper from the Superior Health Council (CSS-HGR) (71) provided in 2008 detailed guidelines for outpatient settings, including HHC. Various hygienic aspects of IPC are described, such as hand hygiene, personal hygiene, personal protective equipment (PPE), equipment cleaning, waste treatment etc. A very insightful prospective on the critical components of IPC in home care is presented by Morrison et al.(74), which summarises the main points highlighted by other papers.

The most important recommendations encountered in the literature highlighted the need for:

- Appropriate training for patients in HHC and eventually their informal caregivers, followed by an assessment of their ability to perform the required tasks leading to the eventual approval to treat the patient at home;
- IPC education of formal and informal caregivers as well as continuous training (74);
- Standardized definitions of HAI in HHC (41,46,47,49,50,62,75-77);
- Implementation of surveillance systems with standardized indicators to allow for benchmarking (36,40,42,45,57,63,69,74,78);
- Implementation of protocols to reduce the risk of infections in home care;
- A better communication (centralized database and information system) (74);
- A better coordination of continuum of care, as patients move from institutional to other health care sectors (74).

More specific IPC recommendations (28,29,31,34,53,58,59,61,62,72,73) reported that:

- Peripherally inserted central catheters (PICCs) should be used only for a short time in HPN and when few infusion days are needed;
- Management of Hickman catheters (and catheters in general) should be done by specialized nurses;

- Patients in long term parenteral nutrition (PN) should have single lumen tunneled catheter and limit the non-PN infusions;
- Sterile water should be used to clean the periurethral area before catheterization;
- However, it seems tap water could be used as infection risk from tap water in HHC seems low;
- Special attention must be paid to patients in PN because of their higher risk of HAI;
- A catheter should be locked with taurolidine instead of heparin.

## 2. In-depth interviews

We conducted 19 interviews between the 21st of January and the 21<sup>st</sup> of February 2019. 9 interviews were conducted in Dutch and 10 in French. 2 interviews included 2 healthcare workers meaning that in total 21 healthcare workers were interviewed. The interviews lasted between 19 and 46 minutes. About one out of three candidates that received an invitation agreed to be interviewed. Although initially a higher number of interviews was targeted, they were stopped at the point when new data from additional interviews did not bring additional information and/or insights to the research questions.

### 2.1. CHARACTERISTICS OF THE PARTICIPANTS

The interviewees included healthcare professionals (nurses, general practitioners (GP), a microbiologist and a physiotherapist) that were conducting home visits or that were involved in healthcare policy, in HHC management or in pilot projects regarding the delivery of more complex care at home (e.g. hospital at home, OPAT). One lay healthcare worker (a family member caring for a patient) was also interviewed. Among the different profiles targeted (Annex 2) two profiles, patient representatives and academic healthcare professionals, were missing. Patient representatives declined the invitation for being interviewed informing the researchers they missed the right competences and knowledge to participate in these interviews. Despite the reminders sent, none of the academic healthcare professionals reacted on the invitation. An overview of the participant's profile is given in Annex 6.

### 2.2. DEFINITION OF HAI IN HHC

#### 2.2.1. KNOWLEDGE ABOUT EXISTING DEFINITION(S)

Most of the interviewees have never heard of a specific definition of HAI in HHC and have never used a definition. However, few interviewees referred to the 'Association for Professionals in Infection Control and Epidemiology (APIC)' definition of HAI in HHC which they tried to use in the frame of a study they conducted recently on the occurrence of HAI in HHC or in view of obtaining an internationally recognised accreditation.

#### 2.2.2. WAYS TO DEFINE HAI IN HHC

Several options and opinions were formulated regarding how to define a HAI in HHC. Those that tried to use the APIC definition mentioned the challenge using this definition for epidemiological purpose (recording and reporting of HAI in HHC). Other mentioned definitions were:

- An infection linked to/caused by care provided by the healthcare worker, linked with the process of providing care, including infections transmitted from one patient to another.

- An infection occurring 2 days (or 48 hours) or later after the healthcare worker provided for the first time care at home.
- An infection occurring in a patient during period he/she receives care.
- An infection due to a bad manipulation during care.
- An infection that would have been brought by the healthcare worker to the patient, during a home care visit, e.g. by contact through materials that has not been decontaminated.

It was often mentioned that the definition of HAI in HHC should be in line with the definition for HAI occurring at the hospital. However, several interviewees also mentioned that to have a workable epidemiological definition it would be important to first define the type of care we want to cover in the definition of HAI in HHC (e.g. general hygiene care or assistance in oral drug administration versus wound care or administration of drugs via a central line) and it might be good/better to focus on infections specific to one type of care.

Also mentioned several times was that the diagnosis of HAI used in a definition should not only be based on signs and symptoms (clinical diagnosis) but should include microbiological elements.

## 2.3. PREVALENCE AND REPORTING OF HAI IN HHC

### 2.3.1. PREVALENCE OF HAI IN HHC

All interviewees mentioned that the prevalence of HAI in HHC in Belgium was unknown but almost all believed it was lower than in institutional healthcare. Several persons mentioned as reason the specific homecare setting where less invasive procedures are performed, less sick patients are treated, and risk for transmission of infections (e.g. MDRO) seems lower than in institutional healthcare facilities. No one stated that the prevalence of HAI in HHC is thought to be higher than in institutional healthcare.

Interviewees performing HHC visits mentioned that they did not perceived HAI in HHC as an important issue in their work as they very rarely encountered them. They all stated that if infections occurred, it was not because of the care provided but because of other factors as patient's living conditions and patient's poor therapeutic compliance. Public health managers interviewed stated that the presence of HAI in HHC might be underestimated because there was no data available on the topic, and they stressed that special attention on the occurrence of skin, wound, and UTI was needed. Someone stated<sup>1</sup>:

*'I believe this problem is not investigated enough in HHC, that healthcare workers are not aware enough of these risks.'*

### 2.3.2. NEED TO REPORT HAI IN HHC

Few interviewees mentioned they locally reported HAI in HHC as part of a pilot project on hospital at home or of the regularly organised review of adverse events in the GP practice. Most interviewees thought that it would be useful to report data related to

<sup>1</sup> In-depth interview quotes are given in a text box

HAI in HHC in a systematic and standardised way, for various reasons such as personal, agency or national interest, to assess the extent and consequences of the problem and to support the implementation of measures to prevent HAI in HHC and evaluate the impact of these measures. Someone mentioned:

*‘At present, to be able to formulate a policy and guidelines regarding HAI in HHC in Belgium more data are needed.’*

Some interviewees expressed the need for reporting on specific procedures (e.g. hand hygiene, hospital at home), others of the infections themselves. Among those indicating that infections should be reported two different approaches were mentioned: (1) reporting of those infection that could be really linked to care (e.g. wound infections, catheter associated infections); (2) reporting of all type of HAI occurring in all HHC patients. However, as someone mentioned, for several infections occurring in HHC (e.g. respiratory tract infections) the distinction between community acquired and HAI would be very difficult and might lead to misclassification as HAI.

Several interviewees mentioned that the objective should be important enough to set up a reporting system. In this context some stated that a specific reporting on HAI in HHC was not needed because the problem was not so prevalent and available resources could be better used for something else to improve patient’s health and wellbeing. Others stated that more attention to IPC and quality of care in general was needed because of fast changing evolutions in the field of HHC where more complex care are now provided (e.g. OPAT).

### 2.3.3. WAYS TO REPORT HAI IN HHC

Interviewees suggested that conducting a PPS was feasible but challenging to organise. It was mentioned that a continuous surveillance had more value and information than a PPS which gives only the situation at a specific moment in time but that the organisation of a continuous surveillance would be very hard/ unfeasible/ not possible. Some suggested to decide, based on the PPS results, if a continuous surveillance for some type of HAI would be useful and feasible.

Challenges mentioned regarding doing a PPS included logistic (who does what?; healthcare workers should not collect data; how to reach all HHC workers, e.g. self-employed nurses?) and methodologic (include all healthcare workers or a sample?; reporting all HAI or only those linked with a specific type of care?; what should be used as denominator?) issues. Regarding how to organise and conduct a PPS someone suggested the use of a kind of ‘HHC hygiene referent’ available at national or regional level.

Several interviewees mentioned that reporting of HAI in HHC should be based on diagnostic microbiological elements and not only on infections’ signs and symptoms, which seems also challenging as someone stated:

*‘Bloodstream infections can be only diagnosed in cooperation with the medical doctor who requests and prescribes the needed laboratory tests, this means that setting-up a PPS or a surveillance of HAI in HHC needs coordination between different healthcare workers.’*

However, it was also mentioned that the methodology used by the ECDC for their PPS on HAI in long-term care facilities (HALT-project) could be used for a PPS in HHC and in this PPS identification of infections is based on signs and symptoms (and if available on diagnosis) (79).

The usefulness and importance of reporting of MDRO prevalence in HHC (systematic swapping/screening of asymptomatic patients to measure e.g. multi-drug resistant *Staphylococcus aureus* (MRSA) prevalence in HHC) was also stated.

Some interviewees mentioned that reporting HAI in HHC could be done based on the data available in the electronic patient medical and nursing file. However, nurses, organisations, GPs and hospitals seem to use different patient recording systems and software which makes this approached challenging. Someone mentioned as approach to report HAI in HHC:

*‘Assess if the same kind of infections are present at the same nurse-visits tour, however it will be difficult to implement this data collection and it will be also difficult to identify and document relations/causal links between these infections.’*

#### **2.4. RISK FACTORS FOR HAI IN HHC**

Almost everyone believed risk factors for HAI at home were different than in hospitals. Risk factors mentioned as being specific for hospitals and other institutional healthcare facilities and thus not present at home are: (1) proximity with other patients (patients share same room), (2) multiplicity of healthcare workers (type and number), (3) presence of pathogens and microorganism (e.g. MDRO), (4) patient’s underneath medical condition (weaker). As protective hospital factors interviewees mentioned the control on environment and care which is quasi complete in the hospital setting. So, quality/impact of care is the same for each patient (whatever the socio-economic background or lifestyle of the patient).

When asked about specific risk factors for HAI in HHC most interviewees mentioned risk factors could be linked to three categories, being: (1) lifestyle, living environment and socio-economic status of the patient, (2) the patient’s characteristics and pathology, and (3) the care provided. Especially the factors linked with the lifestyle and socio-economic status of the patient were considered very specific for the HHC situation and often not controllable as stated by one of the interviewees:

*‘In HHC, big differences in home living-conditions/environment is a challenge. Not every home setting makes the provision of safe care possible. Sometimes it is not really justified to provide healthcare in the patient’s home setting.’*

The majority of the interviewees mentioned that risk factors related to patient's characteristics and pathology and the provided care are similar in home and institutional healthcare. As someone mentioned:

*'Hand hygiene (HH) is not a more important risk factor in HHC compared to hospital care.'*

An interviewee believed that HH practice in HHC seemed worse than in hospitals because of less peer pressure and less supervision.

For each of the three categories above, following risk factors were mentioned:

1. For lifestyle, living environment and socio-economic status of the patient:  
Patient treatment compliance, level of activity of patient, patient's empowerment towards his health, lifestyle habits (e.g. smoking), not able to buy medical supply needed for HHC (too costly), housing condition (unhealthy and unsuitable), patient's personal hygiene, cleanness of the house/home, pets, food hygiene, other caregivers involved (e.g. GP, cleaning lady).
2. For patient's characteristics and pathology:  
Underlying pathology (e.g. diabetic patient), patient's age, shift from providing acute care in the hospital to the home/ ambulatory setting, presence of invasive device(s).
3. For the care provided:  
Availability of equipment and sterile material, infections transmitted by healthcare worker, invasive procedures (e.g. catheterisation of the bladder), factors related to sterile working and HH, increasing work load/lack of time for nurses and 'traffic stress'.

Although living environment factors, including the presence of pets, were by the majority mentioned as risk factors, their impact and importance were also questioned. Someone mentioned:

*'Nurses provide some education at patient regarding home-environment factors (e.g. personal hygiene), e.g. timely change of towels. I'm not sure if these, including presence of pets, are really risk factors for HAI. Our policy regarding pets is to ask removal of pets from the room if care is provided, but this is not always possible. But this is own patient biotope, so is this a risk factor?'*

## **2.5. MEASURES AND GUIDELINES TO PREVENT AND CONTROL HAI IN HHC**

### **2.5.1. MANAGEMENT AND MEASURES TO PREVENT AND CONTROL HAI IN HHC**

#### **2.5.1.1. Need for specific measures**

Interviewees mentioned that the basic principles of IPC for HAI in hospitals and HHC were the same and were sufficient for a good quality of HHC provision, so there was no need for specific IPC recommendations for HAI in HHC. For example interviewees referred to the available HH guidelines and Spaulding guidelines regarding cleaning of material, while some interviewees even wondered if they were not 'doing too much' and questioned the evidence regarding the efficiency of all these guidelines in HHC.

However, for some recommendations adaptation to the specific HHC setting seemed needed, such as for example the management of MRSA (adapted guideline: nurse does not take bag and patient record inside patient's home, put on protective clothing in hall of house). Interviewees indeed believed there should be general, basic measures that apply to all patients (e.g. hand hygiene) plus additional/other recommendations (e.g. wearing gloves, masks, blouse) for specific patients/pathology/procedure (e.g. MDRO carrier, patient with a central line, immunosuppressed patients).

Furthermore, some people mentioned that management of and sensitization on HAI in HHC in the first line in general was neglected compared to HAI prevention and control in acute and long term healthcare facilities and that there was a need for a policy on IPC, including HAI prevention, in the first line (including GPs).

#### 2.5.1.2. Management of risk factors

Regarding management of risk factors related to lifestyle, living environment and socio-economic status of the patient, several interviewees mentioned that it was possible to limit the impact but not to control these factors (e.g. not possible to put pet in another room when there is only one room). Health education provided by the healthcare worker to the patient and (caring) relatives and empowerment of the patient are mentioned in this context. On the contrary, interviewees stated they believed it was possible to control risk factors related with the patients' pathology and provided care.

Interviewees involved in hospital at home and OPAT projects said that before starting HHC a comprehensive assessment of the home situation and setting was done and that this was one of their eligibility criteria to initiate HHC. An interviewee also mentioned that in their HHC organisation for every new patient an intake/risk assessment (checklist) was done before starting providing HHC and depending on this assessment the way to provide care was adapted (e.g. (1) if hygiene in a home setting is questionable, nurse does not take bag inside house but only the material needed for the care the patient needs, (2) if patient has a transmittable disease nurse does not take electronic patient card or mobile phone inside the house, (3) specific agreements regarding pets, (4) if logistically and clinically possible, infectious patient planned as last patient during nurse visit-tour). This risk assessment could be repeated depending of developments occurring during HHC provision.

Most interviewees mentioned they noticed in recent years an increase in the number of patient who needed more complex care (e.g. negative pressure therapy, chemotherapy, OPAT) and that were in weaker conditions (faster discharge from the hospital, longer treatment at home). One interviewee mentioned their HHC organisation therefore employed a dedicated reference nurse to provide support to other nurses.

Additional recommendations mentioned were:

- Have a dedicated 'HHC hygiene referent' at HHC organisation accessible for any kind of advice on IPC in HHC;
- Flu vaccination of all HHC providers and patients for which the vaccination is advised;
- Patient should be more autotomized/ empowered concerning his/her care and IPC (e.g. patient requiring that healthcare worker wear gloves). However, few

interviewees did not agree with this and mentioned IPC in HHC was fully and only the responsibility of the healthcare worker;

- Provide specific health education and information for patient and caring relative;
- Increase health authority's investment in HHC, as stated by the caring relative interviewed:

*'I believe more money should be invested in HHC, very expensive! and sometimes learned about other cheaper options only months after initiating care....'*

### 2.5.1.3. Communication and coordination between different healthcare providers

All interviewees mentioned challenges with communication and coordination between different healthcare workers (hospital, GP, HHC nurse) and with continuum of care as illustrated by following quote:

*'Difficult to get information from hospital even when nurse calls the hospital because difficult to get contact with treating physician.'*

Generally communication and coordination was described as being very weak or non-existent, although everyone agreed these were essential components for good patient healthcare management. Interviewees described a lack of standardization in the communication and coordination of care. The responsibility of the GP in organising and coordinating HHC in a more systematic approach was mentioned, but issues with GP's workload emerged. It happened that communication with a hospital or GP regarding a patient was good because of the individual efforts/ initiatives of the hospital, the treating physician, the GP or the HHC nurse but this was rarely based on a standard approach. An exception were the healthcare workers involved in the hospital at home and OPAT projects who mentioned a very good coordination and cooperation between hospital treating physician/team, GP and HHC nurse(s). They mentioned among others the use of dedicated standardised referral clinical notes from the hospital to the HHC workers. This kind of referral notes were often missing or incomplete for HHC nurses outside these projects, hampering good quality and efficient care provision. For example, several interviewees mentioned they were often not aware of the MRSA (and other MDRO) carrier status of the patient, and even actively trying to receive the needed information was challenging. Those interviewees working in association employing more nurses or nurses and GPs mentioned however a good internal communication and coordination of care.

Several interviewees mentioned the opportunity using electronic patient cards and e-communication for improving communication and coordination between different healthcare workers. One interviewee mentioned this e-communication already existed (if users had the needed compatible software packages). However, at present GP can have access to the electronic nursing file of the patient, but HHC nurse have no access to the GP medical patient file. Access of all involved healthcare workers to the electronic patient file would be very helpful. The use of a 'liaison book note' that stays with the patient and which is used by the different healthcare workers caring for the patient was also mentioned as a mean to improve communication and coordination of care.

#### 2.5.1.4. Implementation and monitoring of IPC measures for HAI in HHC

Interviewees at health policy level expressed their doubt on the implementation of standard/general IPC measures for HAI in HHC even if these are known by the healthcare worker. They also mentioned that compared to the situation in hospitals, these measure were more difficult to implement in HHC.

Interviewees belonging to the management staff of organisations offering HHC mentioned that IPC measures for HAI in HHC could be and were implemented provided these were realistic and feasible (e.g. daily comprehensive cleaning of bag is not realistic).

Interviewees who conducted HHC themselves mentioned the lack of time/heavy workload and the multitude of guidelines and recommendations as an important factor hampering their implementation. Some of these interviewees stressed that to be feasible to be implemented, recommendations should be tailored according to the risk level of patients: high risks (e.g. immunosuppressed, central line present with) versus low risk (routine visit to an elderly healthy patient). Someone stated:

*‘Recommendations should be individualised as far as possible in view of the heterogeneity of patients, even if certain level of standardisation is needed to enhance feasibility.’*

Several mentioned that IPC for HAI in HHC wasn't optimal due to lack of supervision and because the home healthcare worker usually works alone with no one to monitor his work. Regarding this, some interviewees mentioned that in their organisation the implementation of IPC measures was evaluated regularly by a nursing supervisor/mentor who conducted home visits together with the nurses and that indicators (e.g. use of hand alcohol, how often disposable aprons are ordered) were used to evaluate IPC implementation.

#### 2.5.1.5. Training needs

Most mentioned (more) training on IPC for HAI for healthcare workers delivering HHC (nurses and GPs) was needed, including post-graduate training, although some also mentioned that ‘continuous training’ for nurses should be encouraged but not mandatory (due to lack of time).

Regarding training needs, there was a difference between independently self-employed healthcare workers and those working as part of an organisation offering HHC or a bigger association. Interviewees belonging to an organisation mentioned that specific training on IPC for HAI in HHC was organised for their staff including refresher training. Some of these interviewees mentioned the availability at their organisation of a dedicated skill lab to deliver this training or cooperation with hospitals for training on specific procedures. Among self-employed independently working healthcare workers several mentioned they never attended a specific training and some mentioned they did not know about the existence of such training. However, several also mentioned there was no need for additional pre- or post-graduate training. They believed the present available training (e.g. available training on HH) was sufficient. Interviewees mentioned that pre-graduate IPC training on HAI offered in nursing schools in Belgium was good, although this training was mainly focussed on hospital and out-patient-

department care and not on HHC. IPC training seemed to be lacking in medical schools and GP training and should be added. Someone mentioned that HHC was really a specific specialty and should be considered as one and better recognised, with e.g. more investment in training to offer standardised HHC throughout Belgium.

## **2.5.2. IPC GUIDELINES FOR HAI IN HHC**

### **2.5.2.1. Availability of (specific) guidelines**

Few persons referred to the publication of December 2008 of the ‘Hoge Gezondheidsraad/ Conseil Supérieur de la Santé nr. 8279’ (80). However, the majority stated they never heard of specific guidelines on IPC for HAI in HHC. Nearly everybody used the available hand hygiene and other IPC guidelines (e.g. waste management, cleaning of materials) and adapted hospital protocols for more complex procedures (wound care, urinary track catheter insertion and care) to the home environment. The majority of the interviewees belonging to an organisation offering HHC stated they developed guidelines themselves. These guidelines were only available for the staff working for the organisation.

Interviewees involved in offering hospital at home care mentioned that for technical procedures they used the protocol/guidelines (standard operational procedures (SOPs)) developed and requested by the referring hospital responsible for the treatment of the patients. Interviewees mentioned SOPs for same procedures might differ depending from the referring hospital (e.g. specific equipment, use of gloves) and that this needed to be standardised.

### **2.5.2.2. Content, development and dissemination of guidelines**

As described above for measures on IPC for HAI in HHC, there seemed to be no need to develop new specific guidelines for HHC, but rather to include in those guidelines standardized general guidelines to be applied to all patients whatever their risk factors or level of care (e.g. hand hygiene, waste management) plus specific guidelines for more complex care.

Interviewees involved in the development of guidelines for their organisation mentioned that available general guidelines on IPC (e.g. WHO guidelines on HH, Spaulding classification) were developed and written in such a way they could be used in all different healthcare settings by all different type of healthcare workers. However, an assessment of the feasibility to implement basic IPC principles in HHC should be done and guidelines should leave room for adaptation to the specific HHC setting. For example, guidelines should also include recommendations on how to manage patient’s lifestyle and home environment (e.g. how to deal with pets or with poor hygiene conditions).

Different interviewees however highlighted the importance to define/consider whom to target with guidelines and recommendations. For instance, should all healthcare workers providing HHC be targeted or is there need for different guidelines for different type of healthcare workers (e.g. nurses, GPs, physiotherapist)? In this context, should lay caring relatives be also considered as home healthcare workers?

Several interviewees working for Wit-Gele Kruis (an organisation offering HHC) but employed in different independent branches stated they developed IPC policy and

guidelines for HAI in HHC covering basic procedures that should be applied for every patient and specific procedures relevant for specific pathology or type of care (e.g. how to manage a patient with MRSA). They mentioned that these guidelines were almost identical to guidelines and procedures for hospitals with some minor adaptations specific for HHC setting and context (e.g. how to manage waste in HHC, what to take inside the house and leave inside the car). It was mentioned that to develop these guidelines an IPC committee was established including experts in the field of IPC and HHC and that adaptation of existing guidelines was only performed after approval of the hospital hygienist and other experts belonging to this IPC committee. These guidelines were developed in cooperation with the WGK federation at central level and are at present accessible for all WGK provincial divisions. The WGK provincial divisions are fully independent organisations and decides themselves to use or not to use these guidelines. WGK interviewees mentioned these guidelines were available on their intranet (provincial level) which is accessible at place of care provision (home) through the electronic patient nursing file. One interviewee from a WGK provincial division mentioned that a satisfaction survey conducted among their nurses regarding the availability of guidelines and use and implementation of these guidelines scored well.

Several interviewees mentioned it would be useful if the development of policies and guidelines on IPC for HAI in HHC would be coordinated and executed at central policy level in Belgium, e.g. by HGR/CSS, in order to have ‘national guidelines on IPC for HAI in HHC in Belgium’ that are accessible and known by all nurses. This emerged as an urgent need.

### 3. Delphi consultation

The questionnaire was sent to 43 experts for the first Delphi round and 42 for the second round (one expert specified in the first round he would not be able to participate in the study), using mostly the same experts as approached for the in-depth interviews and adding few additional experts. The overall response rate approached 50% (21/43) in the first round and 55% (23/42) in the second round, and was in total slightly but not significantly higher among the Dutch speaking experts than the French speaking experts. On average, the group had respectively 14 years and 17 years of working experience in healthcare for each round, of which more than half was specifically in home healthcare. The professional activities that were mostly represented were infection prevention and control, home healthcare practice and management of an organisation offering home healthcare services and policy making.

#### 3.1. DEFINITIONS OF HAI IN HHC

##### 3.1.1. KNOWLEDGE ABOUT EXISTING DEFINITION(S)

57% of the respondents said they already knew a definition of HAI in HHC. In their comments, three persons defined it as an ‘infection contracted during the care process’, two of them referring to ‘zorg-en-gezondheid’ as their source. One person mentioned the ‘48 hours delay after initiation of care’, one other defined it as ‘transmitted by healthcare workers’. The APIC definition was mentioned once. Others talked about the definitions received during their training or used in a previous pilot study.

100% of the respondents agreed there should be a standardized definition of HAI in HHC.

### 3.1.2. WAYS TO DEFINE HAI IN HHC

Among the statements provided in the first Delphi round, two definitions reached a consensus level of more than 80 % (table 4) and were investigated further in the second round where we asked which of the two definitions they agreed most with. These definitions included both the 48 hours delay after initiating HHC, but one focused on all infections while the other focused on infections that could be specifically linked with providing care. As shown in table 4, 65% of the respondents opted for the definition including infections that can be specifically linked with providing care.

Table 4: Delphi results on definition of HAI in HHC

Definitions	1 <sup>st</sup> Delphi round % agreed and strongly agreed	2 <sup>nd</sup> Delphi round % agreed most
Any infection that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	86	35
Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	90	65

Some comments questioned the feasibility to determine the causal link between the home environment and the acquisition of an infection, and the 48 hours delay seemed a bit arbitrary in this regard. The practical feasibility of the definition chosen was also questioned. A participant also highlighted the need to define what are ‘infections specifically linked to care’, and which infections they include exactly, and one other suggested to include not only infections but also colonisations.

## 3.2. REPORTING OF HAI IN HHC

### 3.2.1. PREVALENCE AND NEED TO REPORT HAI IN HHC

Table 5 describes the main Delphi results regarding reporting of HAI in HHC. 100% of the respondents agreed in the first round reporting was needed in order to get an idea of the prevalence of the problem. 83% of them believed the prevalence of HAI in HHC was currently underestimated.

Table 5: Delphi results on the need to report HAI in HHC in Belgium

Statement	1 <sup>st</sup> Delphi round: % agreed and strongly agreed	2 <sup>nd</sup> Delphi round: % agreed most
Reporting of HAI in HHC is currently not needed since it is not a healthcare priority	11	NA
Reporting of HAI in HHC is needed for all occurring infections	45	24
Reporting of HAI in HHC is needed because at present there is no data available which makes it difficult to know its importance; it might be overestimated or underestimated	100	NA
Reporting of HAI in HHC is needed only for those infections that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) in HHC	75	76
Reporting of HAI in HHC should be based on diagnostic microbiological elements and not only on infections’ signs and symptoms	74	NA

NA: not applicable as this statement/question was not asked in the 2<sup>nd</sup> round.

### 3.2.2. WHAT AND HOW TO REPORT HAI IN HHC

What to report (all versus specific infections, MDRO included or not) was still unclear (table 6) and was investigated further in the second round, where 76% of the respondents opted to report only the infections that can be specifically linked to care rather than all occurring infections. At least as a first step one commented. Concerns about feasibility of reporting were raised.

On how to report; 90% of the respondents agreed in the first round to start with a PPS and depending on the PPS result, to set up or not a surveillance system. 81% of the respondents also agreed to repeat a PPS on a regular basis (every 3 to 5 years, see table 6). One respondent added as comment to conduct an incidence study rather than a prevalence study, over a limited but longer period of time (e.g./3 months). However, agreement was still not reached in the second round on whether to include in the PPS only infections that can be specifically linked to care (61%) or all infections (39%). A specific study on MDRO prevalence is needed both in patients and their caregivers according to 78% of the respondents in the 2<sup>nd</sup> Delphi round, but opinions were highly divided as to whether to include it in the PPS. One respondent raised a warning in wanting to combine two different studies. 74% agreed reporting should be based on diagnostic microbiological elements in addition to clinical elements. One commented that although this would be ideal, it might be difficult to obtain, and sometimes not necessary for infections with an obvious clinical diagnosis.

Table 6: Delphi results on the ways to report HAI in HHC in Belgium

There is need for....	1 <sup>st</sup> Delphi round: % agreed and strongly agreed	2 <sup>nd</sup> Delphi round: % agreed most
A study to quantify the prevalence of different HAI and obtain information on the importance of the issue	95	NA
A specific study on MRSA (and other MDRO) prevalence in HHC patients and their caregivers (including nurse, GP, etc.)	65	NA
A point prevalence survey (PPS), organized only once*, that includes all HAI occurring in HHC	57	39
A PPS organized only once* including only HAI that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) occurring in HHC	56	61
A PPS that is repeated on regular basis (e.g. every 3 to 5 years)	81	NA
A surveillance system including all HAI occurring in HHC	47	NA
A surveillance system including only HAI that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) occurring in HHC	61	NA
Start with a PPS and depending on the results of the PPS set up a surveillance system for some type of HAI	90	NA

\*the words 'organized only once' were removed from the 2<sup>nd</sup> Delphi round  
NA: not applicable as this statement/question was not asked in the 2<sup>nd</sup> round.

### 3.3. RISK FACTORS FOR HAI IN HHC

79% of respondents agreed risk factors for acquiring HAI in the home setting were different from the hospital setting, where 78% of the respondents considered the risk was higher. The consensus level defined at 80% was however not achieved. 100% of the respondents agreed there was a need for additional research on identification of

risk factors for HAI in HHC. There was also 100% agreement that the following risk factors were highly important in developing a HAI in HHC: underlying condition of the patient and presence, duration of the presence and management of invasive devices. 95% considered hand hygiene as a highly important risk factor. In the second round, we asked participants to select the five risk factors they believed were the most needed to act on and the most feasible to act on. Results are presented in table 7. The hand hygiene of healthcare providers achieved the highest score in both categories. Acting on patients' personal hygiene and training patients and caregivers about measures to prevent HAI in HHC were also both identified as factors for which an action is required and feasible. The presence of invasive devices was considered as a risk factors for which an action is required, but less feasible. On the contrary, the management of invasive devices by healthcare providers was identified as a highly feasible point of action, but not as the most needed one. The patient's age, the duration of homecare and the medical condition for which HHC was indicated achieved the lowest score for both questions.

Table 7: Delphi results on risk factors for HAI in HHC in Belgium

List of Risk Factors	1 <sup>st</sup> Delphi round % agreed and strongly agreed	2 <sup>nd</sup> Delphi round: N of respondents who selected this risk factor as 'most needed to act on'	2 <sup>nd</sup> Delphi round: N of respondents who selected this risk factor as 'most feasible to act on'
Patient's personal hygiene	100	15	15
Home hygiene	75	NA	NA
Home infrastructure (presence of sanitations, soap...)	100	11	10
Presence of pet in the home environment	63	NA	NA
Education level of the patient	74	NA	NA
Presence of caregiver(s) in the household	63	NA	NA
Socio-economic status of the patient	84	3	1
Training of patient and caregiver(s) about the measures to prevent HAI in HHC	95	16	15
Patient's age	81	0	1
Patient's gender	14	NA	NA
Underlying health condition of the patient	100	4	1
Medical condition for which HHC was indicated	95	1	1
Presence of invasive devices	100	14	6
Duration of the presence of invasive devices	100	11	10
Duration of the home care	81	0	2
Hand hygiene of healthcare provider	95	16	18
Management of invasive devices by the healthcare provider	100	11	16
Frequency of visits by healthcare provider	90	1	4
Lack of time by the healthcare provider during the visit	80	7	6
Communication between different care providers	74	NA	NA

■ risk factors which reached consensus ( $\geq 80\%$ ) in the first round  
 ■ 4 more selected risk factors as 'most needed' and 'most feasible'  
 NA: not applicable as this statement/question was not asked in the 2<sup>nd</sup> round.

### 3.4. MEASURES AND GUIDELINES TO PREVENT AND CONTROL HAI IN HHC

Nearly all the statements suggested obtained a level of agreement higher than 80% in the first round. 100% of the respondents agreed communication between hospitals, GP's and nurses should be enhanced, and that the implementation of IPC measures in HHC should be monitored. 95% of the respondents identified training of patients and caregivers as an essential component of IPC in HHC, although feasibility of patient empowerment was discussed in one comment. Equally, the need to differentiate between standardised measures applicable in all cases, and additional measures specific to some situations was acknowledged by 95% of respondents, as was the need for specific procedures for the management of invasive devices. Regarding guidelines, 100% agreed on the need for standardised IPC guidelines for home care, available and accessible to all staff involved in HHC, and leaving room to adaptation to the local context. Had still to be investigated the possibility to apply existing national and international general IPC measures and guidelines and/or specific technical procedures and guidelines from hospital care to home care. As shown in table 8, more than 90% of the respondents agreed in the second round this was possible, as long as adaptation to the home setting when needed was encouraged.

Table 8: Second round Delphi results on measures to prevent and control HAI in HHC in Belgium

Statements	2 <sup>nd</sup> Delphi round: % agreed and strongly agreed
Existing national and international accepted infection prevention and control (IPC) guidelines for HAI (e.g. WHO guidelines on hand hygiene) can be used in HHC without adaptation	32%
Existing national and international accepted IPC guidelines for HAI (e.g. WHO guidelines on hand hygiene) can be used in HHC but need to be adapted to the home setting when needed	95%
Existing national and international accepted IPC guidelines for HAI (e.g. WHO guidelines on hand hygiene) cannot be used in HHC, which requires specific guidelines	24%
Existing national and international guidelines for specific technical procedures (e.g./ hospital guidelines for preventing central line-associated bloodstream infection) can be used in HHC without adaptation	26%
Existing national and international guidelines for specific technical procedures (e.g./ hospital guidelines for preventing central line-associated bloodstream infections) can be used in HHC but need to be adapted to the home setting when needed	90%
Existing national and international guidelines for specific technical procedures (e.g./ hospital guidelines for preventing central line-associated bloodstream infections) cannot be used in HHC, which requires specific guidelines	31%

## FINDINGS AND RECOMMENDATIONS

### 1. Main findings

#### 1.1. DEFINITIONS OF HAI IN HHC

The need to establish a valid, standardized, reproducible definition for HAI in HHC is clearly evident, especially with the current increase of complex care provided at home. Having this definition would serve as a basis to measure and provide a picture of the importance of the problem, to monitor trends, and ultimately to prevent HAI and improve quality of care.

The definitions we encountered in the literature were heterogeneous and various. The APIC definition (52) was the one most used, and the definition used by Miliani et Al.(57), combining elements of the APIC definition with ECDC case definitions for HAI in acute care facilities (2) seemed not only very interesting, but also feasible as it led to a successful PPS on healthcare-associated infections and antimicrobial use in French home care settings.

Generally, definitions were not well known by the experts consulted in the in-depth interviews, except possibly for the APIC definition, while this knowledge seemed higher in the Delphi survey, although almost the same experts were consulted.

The most important elements to be considered in the definition according to the experts were: the delay of 48 hours, the occurrence of the infection during the process of receiving care, and the fact that the infection must be linked with the process of receiving care. This question of causality between the home setting and the occurrence of the infection emerged frequently. As discussed by APIC, it is important to understand that the association described using the 48h delay after initiation of home care is temporal and not causal, and that 'since the geographic location of infection acquisition is often uncertain, the infection is considered to be healthcare associated, rather than healthcare acquired'.

*'Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC'.*

The definition for HAI in HHC which obtained the higher agreement is thus the following:

#### 1.2. REPORTING OF HAI IN HHC

Equally, the need for surveillance and reporting of HAI in HHC appeared clearly from the study, especially because data on prevalence is currently unknown. The majority of the experts consulted agreed to report:

**What:**

- Those infections that can be specifically linked with care, basing if possible case definitions on clinical signs and symptoms but also on microbiological results when available;
- MDRO prevalence in HHC.

**How:**

- For those infections that can be specifically linked with care start with a PPS, and according to its results, set-up a systematic surveillance system;
- For MDRO, continue discussion on whether to do a specific study or include them in the PPS.

**When:** repeat the PPS every three to five years.

**1.3. RISK FACTORS FOR HAI IN HHC**

Various risk factors emerged from the literature search, some being very specific to a certain type of infection (e.g./ device related), other being more general. Risk factors could be grouped in three categories:

- Those related to lifestyle, living environment and socio-economic status of the patient: not easily controllable but some impact possible;
- Those related to the patient's characteristics and pathology: not easily controllable but some impact possible;
- Those related to the care provided: more easily controllable, focus for prevention and control.

- Hand Hygiene
- Patients' personal hygiene
- Training of patients and caregivers about measures to prevent HAI in HHC
- Presence and management of invasive devices

The factors for which action is definitely required and feasible are:

**1.4. MEASURES AND GUIDELINES TO PREVENT AND CONTROL HAI IN HHC**

As for definition and reporting, there is a clear need for measures and guidelines to prevent and control HAI in HHC. Many different recommendations emerged from the literature, including highly detailed recommendations for IPC of HAI, especially when related to specific procedures as catheter insertion, and others more general recommendation for IPC. Until now, it seems that healthcare providers in the field generally apply internationally recognised guidelines as WHO guidelines on hand hygiene to the home setting and adapt what they know from hospitals for technical procedures. This is however done inconsistently and in a non-standardised way, as in Belgium, guidelines differ from each referring hospital. There also seemed to be a lack of awareness about existing IPC guidelines and on the importance of prevention of HAI in the home setting.

After consultation, experts agreed to:

Use already existing national and international accepted IPC guidelines for HAI and guidelines for specific technical procedures in HHC as long as they can be adapted to the home setting when needed.

This study also highlighted crucial elements to be improved if we want to achieve a better prevention and control of HAI in HHC and ultimately a better quality of care. These include:

- The need for standard definitions and indicators, as well as reporting, as already discussed before;
- The need to enhance communication between hospitals and primary healthcare workers, as well as coordination of HHC. Ideally this should be done via electronic files/system, available and shared between all healthcare workers involved with the patient, in the respect of data protection regulations;
- The need for a better training of healthcare workers (pre and post-graduate training), of lay caregivers as caring relatives, and of the patients themselves through empowerment and health education;
- The need for the monitoring of the compliance with the implemented guidelines and for the supervision of home healthcare workers;
- The need to increase awareness and support of healthcare workers regarding HAI in HHC, eventually by having a dedicated HHC hygiene referent, available for any kind of advice asked by any healthcare worker.

## 2. Recommendations

Based on the main findings of this study we recommend the following :

1. To use as definition for HAI in HHC: 'Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC'.
2. To conduct a point prevalence study to know the prevalence of HAI in HHC in Belgium, using the definition above.
  - Indeed, data on prevalence of HAI in HHC are currently lacking at national and international level.
  - Preferably this prevalence study should be conducted as an independent study. We recommend to make funding available for this study that should be conducted at national level and we recommend having a working group established to develop a tender document, including a clear description of the necessary requirements and outputs of this study. Interesting applicants will have to reply on this study tender.
  - The protocol that will have to be developed by the applicants should also:
    - Discuss whether to include MDRO in this PPS or in a dedicated study.
    - Specify in the definition proposed which infections exactly can be included in 'infection that can be specifically linked with providing care' e.g./wound infection, infections linked with the use of devices (which devices: catheter? Electrocardiograph (ECG)?), blood sampling, small surgeries, earwax plug removal, gynaecological procedures etc.)
    - Assess whether case definitions should include clinical and/or microbiological elements.

- We suggest to refer to the ECDC protocols of HAI in acute care hospitals (2) and of HAI in European long-term care facilities (80) and to Miliami et Al.'s French PPS (57) for the three previous points.

3. Finally, to develop specific recommendations and guidelines regarding HAI in HHC available at national level. We recommend that the development and dissemination of these guidelines should be coordinated and done by the Superior Health Council (Hoge Gezondheidsraad, Conseil Supérieur de la Santé). These guidelines should be standardised and be based on both existing national and international recognized infection prevention and control (IPC) guidelines for HAI (e.g. WHO guidelines on hand hygiene) and guidelines for specific technical procedures (e.g. hospital guidelines for preventing central line-associated bloodstream infections), leaving room for adaptation to the home context. These recommendations should additionally cover:

- The need to enhance communication between hospitals and primary healthcare workers, as well as coordination of HHC;
- The need for a better training of healthcare workers (pre and post-graduate training), of lay caregivers and of the patients themselves;
- The need for the monitoring of the compliance with the implemented guidelines and for the supervision of home healthcare workers.

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## LIST OF ANNEXES

### 1. Search terms of the literature review

#### **Pubmed**

((‘home care’[MeSH Terms] OR ‘home\$care’[ Title/Abstract] OR ‘home health\$care’[Title/Abstract] OR ‘home infusion’[MeSH Terms] OR ‘home infusion’[Title/Abstract] OR ‘after care’ [MeSH Terms] OR ‘after\$care’[ Title/Abstract] OR ‘home based hospital care’[Title/Abstract] OR ‘ hospital at home’[Title/Abstract])) AND ((‘infection\*’[Title/Abstract] OR ‘sepsis’[ MeSH Terms] OR ‘sepsis’[Title/Abstract] OR ‘pneumonia\*’[ MeSH Terms] OR ‘pneumonia\*’[Title/Abstract] OR ‘infectious disease\*’[Title/Abstract] OR ‘communicable disease\*’[Title/Abstract] OR ‘nosocomial’ [Title/Abstract] OR ‘iatrogenic’ [Title/Abstract]))

#### **Cochrane**

(‘home care’):ti,ab,kw AND infection:ti,ab,kw

#### **ScienceDirect**

(‘home care’ OR ‘home health care’ OR aftercare) AND (infection OR sepsis OR pneumonia OR ‘infectious disease’ OR nosocomial)

#### **CINAHL**

(‘home care’ OR ‘home health care’ OR aftercare OR ‘home infusion’ OR ‘home based hospital care’ OR ‘hospital at home’) AND (infection OR sepsis OR pneumonia OR ‘infectious disease’ OR nosocomial OR ‘communicable disease’ OR iatrogenic)

#### **Embase**

(‘home healthcare’:kw,ab,ti OR ‘home infusion’:kw,ab,ti OR ‘home based hospital care’:kw,ab,ti OR ‘hospital at home’:kw,ab,ti OR ‘home care’:kw,ab,ti OR ‘aftercare’:kw,ab,ti) AND (infection\*:ab,kw,ti OR sepsis:ab,kw,ti OR pneumonia\*:ab,kw,ti OR ‘infectious disease\*’:ab,kw,ti OR ‘communicable disease\*’:ab,kw,ti OR iatrogenic:ab,kw,ti OR nosocomial:ab,kw,ti)

#### **Google scholar**

allintitle: (‘home care’ OR ‘home healthcare’ OR ‘home health care’ OR aftercare OR ‘home infusion’ OR ‘home based hospital care’ OR ‘hospital at home’ OR ‘home care’) infection

## 2. Profile and criteria of candidates for the in-depth interviews of the HAI in HHC study

Function/ job title	Additional requirement/ criteria
1. <b>Nurse</b> conducting HHC visits	Working as employee for an organisation specialised in HHC (e.g. Wit-Gele Kruis)
2. <b>Nurse</b> conducting HHC visits	Working as self-employed nurse not as part of a bigger organisation specialised in HHC
3. <b>Physiotherapist</b> conducting HHC visits	
4. Person providing family care (familiale zorg) to sick persons at home? Or aide ménagère?	Person should be working as employee for an organisation providing family care to sick persons at home
5. <b>General practitioner</b> conducting HHC visits	
6. <b>Patients</b> representative	Member of a recognised Belgian patient platform
7. Healthcare professional involved in a <b>home hospitalisation pilot projects</b>	And conducting HHC visits as part of this project This might be a medical doctor, nurse or other healthcare professional
8. <b>Member of the management</b> of an organisation organising nurse HHC who is responsible for organisation and guiding the medical aspects of this care	Should be someone with a basic medical training (nurse, medical doctor, master in public health,...)
9. <b>Academic healthcare professional</b> involved in infection prevention and control	Preferably with experiences regarding infection prevention and control in HHC and/or primary healthcare
10. <b>Public health manager</b> part of a Belgian organisation (e.g. Hoge Gezondheidsraad) supporting the national/regional health policies and involved in infection prevention and control	Preferably with experiences regarding infection prevention and control in HHC and/or primary healthcare
11. <b>Microbiologist</b> involved in infection prevention and control or <b>infection control physician</b>	

## 3. HAI in HHC in-depth interview guide

### 1. General background

(Information on sex, place and function/job are available with the interviewer and should not be asked separately but mentioned in the minutes of the interview)

- How are you involved in advising on and/or organising and/or conducting HHC/ infection prevention?
  - And since how long/ since when?

### 2. How would you describe/define an home care-associated infections?

- Do you use in your work already a definition for HAI in HCC and if so what is the definition used?
  - Where is this definition coming from?
  - Who/ which organisation/institution developed this definition? (APIC, ECDC,...)
- What clinical definition would you use? What epidemiological definition would you use?
- What about the fact that the HAI could be originated from a visit of the patient to an healthcare setting outside his/her home (e.g. during visit at general practitioner, during visit at specialist consultation (outpatient department) in hospital)?
  - How to consider this in the definition?

- How to report HAI in HHC?
  - Need for reporting at national level in a standardised way?
  - PPS, surveillance?
  - What to use as denominator (number patients, number device days, device insertions...)?

### **3. What about specific risk factors for HAIs acquisition in the home care setting?**

- Would you consider these risk factors different than in other settings (e.g. hospital, general practitioner practice)?
  - If so, can you explain this a bit more?
  - What are according to you the biggest differences in risk factor(s) comparing HHC and hospital care?
- What are according to you the most challenging risk factors in HHC?
- What about risk factors in the context of different kind/level of HHC - heterogeneous patient population (e.g. elderly person that needs assistants to get washed and dressed versus patient who is on IV antibiotic treatment through a peripheral catheter)?
- What about different risk factors depending of different home environment (pets, socio-economic background, home hygiene, education level patient and care-givers etc.). 'Home is designed for living and not for healthcare services'
- How to consider/manage these risk factors?
  - Only focus on those with HHC patients with increased/high risks?
  - HHC patients very heterogeneous...one-size-fits-all approach not possible in management of risk factors and infection prevention.
- What is according to you the risk to develop an HAI in HHC? Higher than in healthcare facility (acute/long-term health facility)?

### **4. What about prevention and control of home care-associated infections in Belgium?**

- How to prevent and control HAI in HHC?
- What is needed to prevent and control HAI in HCC? (training, communication between different healthcare settings - continuum of care, recording and reporting, definitions and priorities at national level).
- Do you know about guidelines on how to prevent and control HAI in HCC?
  - Who developed these guidelines? Where are these guidelines coming from?
  - Are these guidelines used/implemented in HHC in Belgium? If so, where? By whom?
  - Do you have comments on these guidelines? If so, what kind?
  - Are these guidelines according to you useful for the HHC setting or should there be changes in these guidelines? If so, what kind of changes?
- How would you deal with specific HHC HAI risk factors?
- How would you deal with different kind/level of care provided in HHC (e.g. elderly person that needs assistants to get washed and dressed versus patient who is on IV antibiotic treatment through a peripheral catheter).
- What about different risk factors depending of different home environment (pets, socio-economic background, home hygiene, etc.)? How to manage this?
- Do you know about guidelines and interventions already implemented in Belgium by healthcare workers providing HHC to prevent and control HAI?
  - If so, what by whom and what are the experiences (outcome) with the implementation of these guidelines and interventions?

## 4. Delphi questionnaire: first round

### Introduction

*Dear participant,*

*Thank you for taking part in the 'Healthcare-Associated Infections (HAI) in Home Healthcare (HHC)' Delphi survey. The survey is part of a broader project which aims to: formulate a definition of HAI in HHC, identify their specific risk factors, and develop a standardized framework for prevention and control of HAI in HHC in Belgium.*

*We have so far performed a literature review and conducted several in-depth interviews, which were used to design this two-steps Delphi survey. Its aim is to reach a consensus between experts on the main results.*

*In this first round, you will be asked to provide some information about your background and profession, and to answer questions related to five main areas:*

- 1. Definitions of HAI in HHC;*
- 2. Reporting of HAI in HHC;*
- 3. Risk factors for HAI in HHC;*
- 4. Measures and guidelines to prevent and control HAI in HHC.*

*In total the survey should take between 25 and 35 minutes. We are eager to learn about your opinions and thank you for your collaboration and your time!*

*Please click 'Next' at the bottom of the screen to proceed.*

*This project has been initiated and funded by the King Baudouin Foundation and is being carried out by Sciensano, the Belgian Federal Public Health Institute.*

### 2 LOGOS

*Participation in this survey is voluntary and completely anonymous.*

## Participant's information

In this section, we would like to have more information about your background, relevant to Healthcare-Associated Infections (HAI) in Home Healthcare (HHC).

### 1. How many years of working experience do you have in healthcare?

### 2. Please indicate how much you are involved in the following professional activities:

- ▶ Providing home healthcare
- ▶ Involved in policy making
- ▶ Involved in the management of an organization offering home healthcare services
- ▶ Academic healthcare professional
- ▶ Involved in a hospital at home (eg/OPAT) project
- ▶ Involved in infection prevention and control
- ▶ Public Health management

Scale: never-often

**3. If you have experience in home healthcare, please indicate how many years of working experience you have in this field (if no experience, indicate 0)**

## Definitions of HAIs in HHC

In this section, we aim to investigate if there is information, need for and agreement on definition of Healthcare-Associated Infections (HAI) in Home Healthcare (HHC).

**4. Do you know a definition of HAI in HHC?**

Yes

No

IF Yes: Could you write the definitions you know, or cite the source who defines it?

.....

IF No: Go to question 5 directly

**5. Do you agree there should be a standardized definition of HAI in HHC?**

Yes

No

IF Yes: Go to question 6 directly

IF No: Could you please motivate your answer?

.....

**6. Given the following definitions of HAI in HHC, which we encountered during our literature review and in-depth interviews, could you please say how much you agree with each of them?**

Nr.	List of Definitions	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
6.1	Any infection that develops in a patient who is cared for at home	○	○	○	○	○
6.2	Any infection that develops in a patient who is cared for at home, and is related to receiving healthcare	○	○	○	○	○
6.3	Any infection that is associated with a medical or surgical intervention and that was neither present nor incubating at the time of initiation of care in the patient's home	○	○	○	○	○
6.4	Any infection that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	○	○	○	○	○
6.5	Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker	○	○	○	○	○
6.6	Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	○	○	○	○	○

If you would like to suggest another definition of HAI in HHC in Belgium, please do so here (optional):

.....

## Reporting of HAIs in HHC

In this section, we would like to know your views on the importance of Healthcare-Associated Infections (HAI) in Home Healthcare (HHC), whether this problem requires a reporting and if so, by which method.

### 7. How much do you agree with the following statements regarding the prevalence of HAI in HHC in Belgium?

Nr.	Prevalence of HAI in HHC in Belgium is...	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
7.1	Most probably low	<input type="radio"/>				
7.2	Not known, but lower than in hospitals and in nursing homes	<input type="radio"/>				
7.3	Not known, and doesn't need to be measured because at present HAI in HHC is not a priority healthcare issue	<input type="radio"/>				
7.4	Not known, but needs to be measured (at least once) to know the situation regarding HAI in HHC	<input type="radio"/>				
7.5	Underestimated and minimalized because data is lacking	<input type="radio"/>				
7.6	Most probably high	<input type="radio"/>				

If you have another opinion regarding the prevalence of HAI in HHC in Belgium, please state it here (optional):

.....

### 8. How much do you agree with the following statements regarding the need to report HAI in HHC in Belgium?

Nr.	Statement	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
8.1	Reporting of HAI in HHC is currently not needed since it is not a healthcare priority	<input type="radio"/>				
8.2	Reporting of HAI in HHC is needed for all occurring infections	<input type="radio"/>				
8.3	Reporting of HAI in HHC is needed because at present there is no data available which makes it difficult to know its importance; it might be overestimated or underestimated	<input type="radio"/>				
8.4	Reporting of HAI in HHC is needed only for those infections that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) in HHC	<input type="radio"/>				
8.5	Reporting of HAI in HHC should be based on diagnostic microbiological elements and not only on infections' signs and symptoms	<input type="radio"/>				

If you have another opinion regarding the need to report HAI in HHC in Belgium, please state it here (optional):

.....

### 9. How much do you agree with the following statements regarding ways to report HAI in HHC in Belgium?

Point Prevalence Survey (PPS): study done on a given population which measures the prevalence (proportion of cases) of a defined problem at a specific point in time.

Surveillance system: continuous, systematic data collection and analysis.

Nr.	There is need for....	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
9.1	A study to quantify the prevalence of different HAI and obtain information on the importance of the issue	<input type="radio"/>				
9.2	A specific study on MRSA (and other MDRO) prevalence in HHC patients and their caregivers (including nurse, GP, etc.)	<input type="radio"/>				
9.3	A point prevalence survey (PPS), organized only once, that includes all HAI occurring in HHC	<input type="radio"/>				
9.4	A PPS organized only once including only HAI that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) occurring in HHC	<input type="radio"/>				
9.5	A PPS that is repeated on regular basis (e.g. every 3 to 5 years)	<input type="radio"/>				
9.6	A surveillance system including all HAI occurring in HHC	<input type="radio"/>				
9.7	A surveillance system including only HAI that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) occurring in HHC	<input type="radio"/>				
9.8	Start with a PPS and depending on the results of the PPS set up a surveillance system for some type of HAI	<input type="radio"/>				

If you would like to suggest another way to report HAI in HHC in Belgium, please do so here (optional):

### Risk Factors for HAIs in HHC

In this section, we seek to identify the specific risk factors that contribute to the acquisition of Healthcare-associated infections (HAI) in the home setting, as compared to the hospital setting.

### 10. How much do you agree with the following statements regarding risk factors for HAI in HHC?

Nr.	Statement	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
10.1	Risk factors for HAIs in home care are different than those in hospital care	<input type="radio"/>				
10.2	The risk for HAIs is higher in hospital care than in home care	<input type="radio"/>				
10.3	There is a need for additional research on identification of the risk factors for HAIs in HHC	<input type="radio"/>				

**11. Given the following risk factors, could you please report what you think is their importance in developing a HAI in HHC?**

Nr.	List of Risk Factors	Very low	Low	Inter-mediate	High	Very high	I don't know
Risk factors linked with patient's lifestyle and socio-economic status							
11.1	Patient's personal hygiene	<input type="radio"/>					
11.2	Home hygiene	<input type="radio"/>					
11.3	Home infrastructure (presence of sanitations, soap...)	<input type="radio"/>					
11.4	Presence of pet in the home environment	<input type="radio"/>					
11.5	Education level of the patient	<input type="radio"/>					
11.6	Presence of caregiver(s) in the household	<input type="radio"/>					
11.7	Socio-economic status of the patient	<input type="radio"/>					
11.8	Training of patient and caregiver(s) about the measures to prevent HAI in HHC	<input type="radio"/>					
Risk factors linked with patient's characteristics and pathology							
11.9	Patient's age	<input type="radio"/>					
11.11	Patient's gender	<input type="radio"/>					
11.11	Underlying health condition of the patient	<input type="radio"/>					
11.12	Medical condition for which HHC was indicated	<input type="radio"/>					
11.13	Presence of invasive devices	<input type="radio"/>					
11.14	Duration of the presence of invasive devices	<input type="radio"/>					
11.15	Duration of the home care	<input type="radio"/>					
Risk factors linked to care							
11.16	Hand hygiene of healthcare provider	<input type="radio"/>					
11.17	Management of invasive devices by the healthcare provider	<input type="radio"/>					
11.18	Frequency of visits by healthcare provider	<input type="radio"/>					
11.19	Lack of time by the healthcare provider during the visit	<input type="radio"/>					
11.20	Communication between different care providers	<input type="radio"/>					

If you would like to suggest other risk factors of HAI in HHC, please do so here (optional):

.....

## Measures and guidelines to prevent and control HAIs in HHC

In this section, we seek to investigate which measures would be most appropriate to prevent and control Healthcare-Associated Infections (HAI), as well as the need for specific guidelines in the home setting, as compared to the hospital setting.

### 12. How much do you agree with the following statements regarding measures to prevent and control HAI in HHC in Belgium?

By measures, we mean plans or actions taken to achieve a particular purpose (protect patients, visitors and staff from acquiring an infection such as appropriate environment hygiene or waste management).

Nr.		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I don't know
12.1	Infection prevention and control (IPC) measures of hospital care should be applied to home care	<input type="radio"/>					
12.2	IPC measures in HHC should not be as strict as in hospital care	<input type="radio"/>					
12.3	IPC measures in HHC should be based on the health condition of the patients receiving care and the type of care provided	<input type="radio"/>					
12.4	There is a need for specific procedures for the management of invasive devices in HHC	<input type="radio"/>					
12.5	If needed, procedures for the management of invasive devices in hospital can be applied to HHC	<input type="radio"/>					
12.6	The implementation of IPC measures is a shared responsibility between the healthcare providers, the family caregivers and the patients themselves	<input type="radio"/>					
12.7	Training for patients and caregivers is essential in the implementation of IPC measures.	<input type="radio"/>					
12.8	Monitoring of the implementation of IPC measures in HHC is needed	<input type="radio"/>					
12.9	Better communication between hospitals, GPs and HHC nurses is needed	<input type="radio"/>					
12.10	Patient empowerment is needed and key for good IPC in HHC	<input type="radio"/>					
12.12	There should be more pre-service training on IPC of HAI in HHC in medical and nursing schools in Belgium	<input type="radio"/>					
12.12	There should be more post-graduate training possibilities on IPC of HAI in HHC for healthcare workers providing HHC in Belgium	<input type="radio"/>					
12.13	In IPC management in HHC it is important to differentiate between standardized measures that apply to all patients and additional measures that apply to specific patients and care (e.g. immunocompromised patients, sterile wound infection)	<input type="radio"/>					

If you would like to suggest other measures to prevent and control HAI in HHC in Belgium, please do so here (optional):

.....

**13. How much do you agree with the following statements regarding availability and need for guidelines to prevent and control HAI in HHC in Belgium?**

By guidelines, we mean formalized documentation recommending how something should be done such as guideline for prevention of catheter-associated urinary tract infections.

Nr.	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I don't know
13.1	There are no specific guidelines to prevent and control HAI in HHC for Belgium	<input type="radio"/>					
13.2	Existing guidelines for hospital setting can be adapted and used in the home care setting	<input type="radio"/>					
13.3	There is a need for standardized IPC guidelines for HHC but these must leave room and possibilities for adaptation to the local home and HHC context	<input type="radio"/>					
13.4	There is a need for standardized general guidelines that apply to all patients receiving HHC	<input type="radio"/>					
13.5	There is a need for standardized specific guidelines that apply to patients receiving more complex HHC	<input type="radio"/>					
13.6	It would be an added value if national standardized guidelines on IPC of HAI in HHC would be available and accessible to all the staff involved in delivering HHC	<input type="radio"/>					
13.7	IPC guidelines related to specific technical procedures provided in HHC (e.g. hospital at home, outpatient parenteral antibiotic therapy) should be standardized nationally and not differ according to the referring hospital	<input type="radio"/>					
13.8	There is an urgent need for IPC guidelines specific for HHC	<input type="radio"/>					

If you have another opinion regarding the need and availability of guidelines to prevent and control HAI in HHC in Belgium, please state it here (optional):

.....

## 5. Delphi questionnaire: second round

### Introduction

*Dear participant,*

*Thank you for taking part in this second round of the Delphi Survey on ‘Healthcare-Associated Infections (HAI) in Home Healthcare (HHC)’. As you know, the survey is part of a broader project which aims to: formulate a definition of HAI in HHC, identify their specific risk factors, and develop a standardized framework for prevention and control of HAI in HHC in Belgium.*

*We have so far performed a literature review, conducted several in-depth interviews and completed the first Delphi round, whose results were used to design this second round.*

*The Delphi method aims to reach a consensus between experts on relevant topics.*

*In this second round, you will find preliminary results of the first round, and will be asked to provide some more information on topics for which there was still ambiguity. We also added a few questions to investigate further some topics or to add input from the comments received during the first round. The four main areas investigated are:*

- 1. Definition of HAI in HHC;*
- 2. Reporting of HAI in HHC;*
- 3. Risk factors for HAI in HHC;*
- 4. Measures and guidelines to prevent and control HAI in HHC.*

*In total the survey should take no more than 15 minutes. We are eager to learn about your opinions and thank you for your collaboration and your time!*

*Please click ‘Next’ at the bottom of the screen to proceed.*

*This project has been initiated and funded by the King Baudouin Foundation and is being carried out by Sciensano, the Belgian Federal Public Health Institute.*

### 2 LOGOS

*Participation in this survey is voluntary and completely anonymous.*

## Participant’s information

In this section, we would like to have more information about your background, relevant to Healthcare-Associated Infections (HAI) in Home Healthcare (HHC).

**Q1. How many years of working experience do you have in healthcare?**

**Q2. If you have experience in home healthcare, please indicate how many years of working experience you have in this field (if no experience, indicate 0)**

**Q3. Please indicate how much you are involved in the following professional activities:**

Nr.		never	rarely	sometimes	often
3.1	Providing home healthcare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2	Involved in policy making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3	Involved in the management of an organization offering home healthcare services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.4	Academic healthcare professional	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.5	Involved in a hospital at home (eg/OPAT) project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.6	Involved in infection prevention and control (IPC)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.7	Public Health management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Definitions of HAIs in HHC

In the first Delphi round, all respondents agreed there should be a standardized definition of Healthcare-Associated Infections (HAI) in Home Healthcare (HHC).

**Q4. Among the suggestions made, two statements obtained a level of agreement of more than 85%. Could you please select the statement you most agree with?**

Nr.	Definitions	Agree most	Results round 1: % agreed and strongly agreed
4.1	Any infection that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	<input type="radio"/>	86
4.2	Any infection that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) that develops in a patient who receives HHC from a professional healthcare worker and that occurs 48 hours or later after initiating this HHC	<input type="radio"/>	90

If you have a comment, please state it here (optional):

.....

## Reporting of HAIs in HHC

In the first Delphi round, all respondents agreed reporting was needed in order to get an idea of the prevalence of the problem. More than 80% of them believed it was currently underestimated.

**Q5. Among the suggestions made regarding the need to report HAI in HHC in Belgium, two statements did not reach a high level of agreement. Could you please select the statement you most agree with?**

Nr.	Statement	Agree Most	Results round 1: % agreed and strongly agreed
5.1	Reporting of HAI in HHC is needed for all occurring infections	<input type="radio"/>	45
5.2	Reporting of HAI in HHC is needed only for those infections that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) in HHC	<input type="radio"/>	75

If you have a comment, please state it here (optional):

.....

In the first Delphi round, 90% of the respondents agreed to start with a point prevalence survey (PPS) and depending on the PPS result, set up a surveillance system. More than 80% of the respondents also agreed to repeat a PPS on a regular basis (every 3 to 5 years).

**Q6. Among the suggestions made regarding the ways to report HAI in HHC in Belgium, two statements did not reach a high level of agreement. Could you please select the statement you most agree with?**

*Point Prevalence Survey (PPS): study done on a given population which measures the prevalence (proportion of cases) of a defined problem at a specific point in time.*

*Surveillance system: continuous, systematic data collection and analysis.*

Nr.	There is need for....	Agree most	Results round 1: % agreed and strongly agreed
6.1	A point prevalence survey (PPS) that includes all HAI occurring in HHC	<input type="radio"/>	57
6.2	A PPS including only HAI that can be specifically linked with providing care (e.g. wound infection, infection linked with the use of catheters) occurring in HHC	<input type="radio"/>	56

**Q7. Among the suggestions made regarding the ways to report HAI in HHC in Belgium, some statements did not reach a high level of agreement and needed to be investigated further. We therefore added or rephrased some questions for more clarification. Could you please say how much you agree with each of the following statements?**

Nr.		Strongly disagree	Disagree	Agree	Strongly agree	Results round 1: % agreed and strongly agreed
7.1	Reporting of HAI in HHC should be based on diagnostic microbiological elements and not only on infections' signs and symptoms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	74
7.2	There is need for a specific study on MRSA (and other MDRO) prevalence in HHC patients and their caregivers (including nurse, GP, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	65
7.3	Prevalence of MRSA (and other MDRO) in HHC patients and their caregivers should be included in the PPS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
7.4	Prevalence of MRSA (and other MDRO) in HHC patients only (and not the caregivers) should be included in the PPS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*

\* 'NA': not applicable, as this question was not asked in the first round

If you have a comment, please state it here (optional):

.....

## Risk Factors for HAIs in HHC

In the first Delphi round, all respondents agreed there was a need for additional research on identification of risk factors for HAIs in HHC.

**Q8. For the following risk factors for HAI in HHC, a level of agreement higher than 80% of the respondents was reached. Could you please select the five risk factors you believe are most needed to act on and the five risk factors you believe are most feasible to act on?**

Nr.	List of Risk Factors	Action most needed	Action most feasible	Results round 1: % agreed and strongly agreed
8.1	Patient's personal hygiene	<input type="radio"/>	<input type="radio"/>	100
8.2	Home infrastructure (presence of sanitations, soap...)	<input type="radio"/>	<input type="radio"/>	100
8.3	Socio-economic status of the patient	<input type="radio"/>	<input type="radio"/>	84
8.4	Training of patient and caregiver(s) about the measures to prevent HAI in HHC	<input type="radio"/>	<input type="radio"/>	95
8.5	Patient's age	<input type="radio"/>	<input type="radio"/>	81
8.6	Underlying health condition of the patient	<input type="radio"/>	<input type="radio"/>	100
8.7	Medical condition for which HHC was indicated	<input type="radio"/>	<input type="radio"/>	95
8.8	Presence of invasive devices	<input type="radio"/>	<input type="radio"/>	100
8.9	Duration of the presence of invasive devices	<input type="radio"/>	<input type="radio"/>	100
8.10	Duration of the home care	<input type="radio"/>	<input type="radio"/>	81
8.11	Hand hygiene of healthcare providers	<input type="radio"/>	<input type="radio"/>	95
8.12	Management of invasive devices by healthcare providers	<input type="radio"/>	<input type="radio"/>	100
8.13	Frequency of visits by healthcare providers	<input type="radio"/>	<input type="radio"/>	90
8.14	Lack of time by the healthcare providers during the visit	<input type="radio"/>	<input type="radio"/>	80

If you have a comment, please state it here (optional):

.....

## Measures and guidelines to prevent and control HAIs in HHC

In the first Delphi round, nearly all the statements regarding measures and guidelines to prevent and control HAI in HHC in Belgium obtained a level of agreement higher than 80%.

*By measures, we mean plans or actions taken to achieve a particular purpose (protect patients, visitors and staff from acquiring an infection such as appropriate environment hygiene or waste management).*

*By guidelines, we mean formalized documentation recommending how something should be done such as guideline for prevention of catheter-associated urinary tract infections.*

**Q9. Among the suggestions regarding measures and guidelines to prevent and control HAI in HHC in Belgium, some statements did not reach a high level of agreement and needed to be investigated further. We therefore added or rephrased some questions for more clarification. Could you please say how much you agree with each of the following statements?**

Nr.	Statements	Strongly disagree	Disagree	Agree	Strongly agree	Results round 1: % agreed and strongly agreed
9.1	Existing national and international accepted infection prevention and control (IPC) guidelines for HAI (e.g. WHO guidelines on hand hygiene) can be used in HHC without adaptation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
9.2	Existing national and international accepted IPC guidelines for HAI (e.g. WHO guidelines on hand hygiene) can be used in HHC but need to be adapted to the home setting when needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
9.3	Existing national and international accepted IPC guidelines for HAI (e.g. WHO guidelines on hand hygiene) cannot be used in HHC, which requires specific guidelines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
9.4	Existing national and international guidelines for specific technical procedures (eg/ hospital guidelines for preventing central line-associated bloodstream infection) can be used in HHC without adaptation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
9.5	Existing national and international guidelines for specific technical procedures (eg/ hospital guidelines for preventing central line-associated bloodstream infections) can be used in HHC but need to be adapted to the home setting when needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*
9.6	Existing national and international guidelines for specific technical procedures (eg/ hospital guidelines for preventing central line-associated bloodstream infections) cannot be used in HHC, which requires specific guidelines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	NA*

\* 'NA': not applicable, as this question was not asked in the first round

**If you have a comment, please state it here (optional):**

.....

## 6. Participant's characteristics of HAI in HHC in-depth interviews

Profession/ degree	Gender	Year of HHC experience in present position	Position (relevant for this interview)	Language
1. Medical doctor	F	8	Public health manager at policy level (regional)	FR
2. Nurse	F	14	Public health manager at policy level (regional) - involved in infection prevention	NL
3. Nurse	F	10	Researcher in the field of healthcare associated infections at a federal institute	NL
4. Nurse	M	6	Coordinator for an organisation of HHC provided by nurses - involved in HAH - also still conduct patient home visits	FR
5. Nurse	F	8	Responsible for HAH for an organisation that provides HHC conducted by nurses - also still conduct patient home visits	FR
6. Nurse	M	4	Responsible of team of nurses for an organisation that provides HHC conducted by nurses	FR
7. Nurse	F	-	Staff member at an organisation that provides HHC conducted by nurses - responsible for IPC in HHC - regional level	NL
8. Nurse	F	6	Staff member at an organisation that provides HHC conducted by nurses - responsible for IPC in HHC - provincial level	NL
9. Nurse	M	4.5	Staff member at an organisation that provides HHC conducted by nurses - responsible for IPC in HHC - provincial level	NL
10. Microbiologist	M	-	Coordinating OPAT	NL
11. Microbiologist	F	-	Involved in IPC in hospital + Management group for antibiotic therapy	FR
12. Nurse	F	-	Coordinating OPAT	NL
13. Nurse	F		Coordinates a hospital at home project + provides HHC as a nurse	FR
14. Medical doctor	F	8	GP (in an association with other GPs) conducting home visits + previous experience in academics	FR
15. Medical doctor	F	7	GP (in an association with other GPs) conducting home visits	FR
16. Medical doctor	M	12	GP (in an association with other GPs) conducting home visits	NL
17. Physiotherapist	F	2	Self-employed independently working physiotherapist conducting home visits	FR
18. Midwife	F	3	Self-employed independently working midwife conducting routine pre- and post-partum care at home	NL
19. Nurse	F	5	Self-employed independently working HHC nurse conducting home visits	NL
20. Nurse	F	12	Nurse (working for an association of GPs) conducting home visits	NL
21. Lay healthcare worker	M	-	Family member caring for a patient	FR

D: Dutch; F: female; FR: French; GP: general practitioner; HAH: hospital at home; HAI: healthcare associated infections; HHC: home healthcare; M: male; OPAT: outpatient parenteral antimicrobial therapy

## 7. Data extraction from the scoping review on HAI in HHC

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
1	Al Wakeel, 2018	Comment	Retrospective analysis	Saudi Arabia	>16 years	Complications and outcomes in PD in home	Peritonitis ESI
		Score	++	+	+++		+++
2	Barr, 2013	Comment	Expert overview	UK	no info	To outline good practice recommendations and highlight OPAT management of infections	device related
		Score	+	++	-		+++
3	Bech, 2016	Comment	Observational cohort	Denmark	all age groups	To investigate whether environment risk factors influence the time of 1st CRBSI	CRBSI
		Score	++	++	+++		+++
4	Blais, 2013	Comment	Retrospective cohort study	Canada	all age groups	To document the incidence rate and types of adverse events (AEs) among HC clients and identify factors contributing to these AE	Infection/ sepsis
		Score	++	+	+++		++
5	Buchman, 2013	Comment	Retrospective chart review	USA	all age groups	To determine CRBSI risk factors in HPN	CRBSI
		Score	++	+	+++		+++
6	Chenoweth, 2007	Comment	Retrospective cohort study	USA	all age groups	To identify demographic characteristics of patients, risk factors and outcomes associated with the development of VAP in home care	VAP
		Score	++	+	+++		+++
7	Cheung, 2008	Comment	RCT	Hong-Kong	>18 years	To compare the risk of acquiring UTIs through the conventional practice of using 0.05% chlorhexidine gluconate (CHG) versus sterile water for periurethral cleansing before insertion of a urinary catheter	UTI
		Score	+++	+	+++		+++

List of annexes

Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
no info	Assisted peritoneal dialysis was comparable with self care peritoneal dialysis	Implementation of protocols can reduce the risks of infections and other dialysis-related complications	
-	+++	++	
no info	- indwelling intravascular access devices	- HAI rates are lower than in hospital	To record OPAT adverse outcomes for quality assurance purposes
+++	++	++	
CRBSI was defined as no other obvious infection sites and a positive blood culture both peripherally and from the catheter	- PICC increased risk when compared with Hickman catheter	- Hickman catheter had increased risk if managed by a nurse	- Revision of the current allocation guidelines - PICCs should be used only for short-term HPN therapy and when few infusion days per week are needed - Management of the Hickman catheters by home care nurses should be further specialized
+++	+++	++++	
Patients who acquired an infection during their period of home care	- Acquiring an infection/sepsis was associated with the presence of an AE - Consider unpaid caregivers when planning strategies to improve HC safely	- Homes are not designed healthcare and are not regulated environments	The study investigates AE in general without being able to distinguish the acquisition of infections
-	+	+++	
Clinical symptoms consistent with systemic infection while infusing PN; fatigue; weight loss; the absence or presence of blood leucocytosis, together with positive blood cultures obtained via the CVC and peripherally and from the catheter tip (when the catheter required removal); and the absence of other potential sources of infection	- Being adult compare to being child - Lipid infusion (in adults) - Blood drawing from the CVC - Frequency of infusions (children) - Catheter type (infusion ports>tunnelled catheter) - Number of lumens (1<2<3) - Non-PN catheter use	Patients in long-term PN should have single-lumen, tunnelled catheter which is used exclusively for PN infusion. Blood samples should not be obtained from the PB catheters, and number of non-PN infusions should be limited. Consider decreasing the lipid emulsion infusion, at least in adults.	Good paper, with a sample size of 125 adults and 18 children.
+++	+++	+++	
Infection in patients who received home mechanical ventilation and were followed up by respiratory therapists	- Longer duration of the ventilation	Interventions may be directed at the education and support of caregivers and focused toward those patients requiring longer daily periods of ventilation.	- Clinical diagnosis of VAP - Patients with longer VAP might also have more severe underlying conditions (not checked for severity)
++	+++	+++	
no info	no info	Using sterile water to clean the periurethral area before catheterization among home care patients will not increase the risk for urinary tract infections	- Small sample size: 74 samples from 20 subjects - Further research with bigger sample size is needed
-	-	+++	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
8	Cornillon, 2017	Comment	Prospective survey	France	all age groups	To report on the systematic use of PICC for outpatient care after an allogeneic HSCT	CRBSI
		Score	++	++	+++		+++
9	Cox., 2017	Comment	Retrospective cohort study	USA	all age groups	To determine whether older adults were able to successfully administer home IV antimicrobials without intensive support from home care agencies	device related
		Score	++	+	+++		+++
10	Doran, 2014	Comment	Delphi survey	Canada	all age groups	To assess which client events should be considered reportable and preventable in home care	different HAI
		Score	+	+	+++		+++
11	Doran, 2013	Comment	Retrospective cohort study	Canada	all age groups	To investigate a significant safety dimension of HC, the occurrence of adverse events and their related outcomes	different HAI
		Score	++	+	+++		+++

## List of annexes

Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
The presence of the same organism grow from at least 1 percutaneous blood culture and from a culture of the catheter tip, or that 2 blood samples be drawn (one from a catheter hub and the other from a peripheral vein) that, when cultured, meet CRBSI criteria for quantitative blood cultures or differential time to positivity	no info	The systematic use of the PICC in a population of outpatients returning home after an allogeneic HSCT seems feasible and safe, regarding the low rate of complication	- In the study only 2/37 patients developed CRBSI - There was no comparison group, only a cohort observed over time
++	-	++	
no info	Only 3/231 BSI occurred and no specific risks was identified. The numbers are low because patients were not in PN and not immunosuppressed.	The assessment of the patient's and the caregiver's abilities to perform home infusion is crucial to the success of any home infusion program	The IV infusion was performed by the patients or the caregiver, while the dressing was changed by a nurse
-	+++	+++	
A new infection related to an IV, PICC, central catheter site or related blood stream	no info	90% of experts agreed that HAI should be reportable; meaning making the event known to a higher authority	
+++	-	+++	
Surgical wound infection: infection present on any ED visit or hospital admission within 30 days of a hospital discharge with open surgery but without infection recorded Ventilator-associated pneumonia: pneumonia present on any ED visit or hospital admission within 30 days of RAI-HC assessment among clients who had ventilator documented but didn't have pneumonia recorded at the time of assessment Catheter-associated UTI: UTI present on any ED visit or hospital admission within 30 days of RAI-HC assessment among clients who had indwelling urinary catheter documented but didn't have UTI recorded at the time of assessment Peripheral IV infection: bacteremia or localized skin infection present on any ED visit or hospital admission within 60 days of RAI-HC assessment among clients who had peripheral IV infusion documented at the time of assessment Central line IV infection: Bacteremia or localized skin infection present on any ED visit or hospital admission within 60 days of RAI-HC assessment among clients who had central IV infusion documented at the time of assessment	no info	no info	The paper analysed adverse events in general and in a small paragraph the infections. Vey good definitions though.
+++	-	-	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
12	Embry, 2000	Comment	Draft definitions for surveillance	USA	NA	Draft definitions for surveillance	different HAI
		Score	++++	+	-		+++
13	Friedman, 2000	Comment	Expert essay	USA	NA	Overview of infections control in home care	no info
		Score	+	+	-		-
14	Gallone, 2016	Comment	Survey	Italy	all age groups	To assess HAI prevalence	different HAI
		Score	++	++	+++		+++
15	Gorski, 2004	Comment	Survey	USA	all age groups	To investigate the outcomes of central venous access devices (CVAD) in homecare	CVAD
		Score	++	+	+++		+++
16	Von Baum, 2010	Comment	Environmental study	Germany	all age groups	To assess whether tap water from the domestic environment of neutropenic patients poses a risk for infections from the waterborne pathogens	different waterborne infections
		Score	+++	++	+++		+++

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Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
Home health-associated infections refer to infections that develop in patients who are receiving home health care and that were neither present nor incubating at the time the patient began receiving home health care (generally, 48-72 hours after admission but may vary based on the incubation time of the infecting pathogen). For specific definitions refer to the full text	NA	NA	Very good and detailed definitions are provided in the full text
+++	-	-	
no info, refers to some old CDC guideline (1988)	Nurse's bag Devices (noncritical, semicritical, critical)	It is imperative that home care organizations begin to collect data on HAI in an organized fashion and share their results through meetings and publications	Very discursive paper on the low issue of HAI, best practices and recommendations. Nice read, just a little bit outdated.
		++	
no info	bed sores, urinary catheter, gastrostomy, tracheostomy, vascular ulcers, diabetic ulcers, mechanical ventilation, ureterostomy, vascular catheter, and ileostomy	Need for a new framework of health system to strictly monitor the phenomenon of HAI in all settings (hospital, nursing home, long-term care facilities, and home care) through an integrated approach, because patients often move from one assistance setting to another, and microorganisms come next after patients	The paper shortly states that uses a methodology from CDC 2016 National and State Healthcare associated infections
-	++	+++	
CVAD infection if following criteria are met in >48 from admission or after insertion of CVAD: • Must have a CVAD present and the finding (by blood culture) of bacteremia OR • CVAD present and two of the following: - Temperature 2° F or °1C over the patient's baseline or chills - Significant local pain and redness associated with the central catheter or exit site - Hypotension ( 90 mm Hg systolic) - MD suspects central line infection is present and initiates therapy (changes/ removes line or starts antibiotics) - WBC count 10,000 OR • Pus, cellulitis, or significant pain present at exit site of central catheter	Multi-lumen catheter, Receiving TPN, Neutropenia, Immunosuppressive drugs, Prior history of CVAD infection, Poor nutrition, Impaired skin integrity, Technique failure, Showering and getting dressing wet	To reduce complications rate: - Identify patients at higher risk of HAI - Involve staff in data collection - Monitor and educate patients - Develop preventive protocols for patients at risk	
+	+++	+++	
no info	no info	Although the risk of infection from household water-borne pathogens appears low, preventive measures may be considered on an individual basis in patients with long-term immunosuppression as well as in patients with long-term central-vascular catheterization	The study focuses more on the presence of certain bacteria in the water and their potential risk to the patients, while finds only 8 infected patients.
-	-	+	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
17	Gorski, 2010	Comment	Expert essay	USA	NA	Review of the etiology, identification, and best practices related to central vascular access devices (CVAD)	CVAD
		Score	+	+	-		+++
18	McGoldrick, 2010	Comment	Expert essay	USA	NA	Evidenced- based guidelines and recommendations on methods for managing respiratory equipment used by patients in the home setting and surveillance activities to prevent respiratory infections	Respiratory HAI
		Score	+	+	-		+++
19	Horcajada, 2007	Comment	Retrospective analysis	Spain	all age groups	To review the experience of home care service from 1995 to 2002 using prospectively recorded data	CRBSI
		Score	++	++	+++		+++
20	Shang, 2014	Comment	Systematic review	USA	all age groups	To critically review and synthesize published evidence on infection prevalence and risk factors among adult patients who received HHC services and to evaluate the methodologic quality of these studies	different HAI
		Score	+++	+	+++		+++
21	Schildmeijer, 2018	Comment	Retrospective record review	Sweden	>18 years	To explore the origin, incidence, types and preventability of the AEs that occur in patients receiving home healthcare	different HAI
		Score	++	++	+++		+++

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Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
no info	Potential source of infection: - Infusate - Skin - Microbial contamination at the catheter hub or needleless connector	Nurses must: - know the infection transmissions - apply infection prevention interventions (hand hygiene, aseptic techniques, and infusion administration) - educate patients on risks and signs of infection - investigate any occurrence of infection to prevent it from happening again.	I think the definition they most probably use the APIC definition, even though not clearly stated
-	++	+++	
no info	Risk/Protective factors: - Hand hygiene - Respiratory equipment (noncritical, semicritical, critical) - Oral care - Equipment cleaning - Patients education	Implement evidence-based practices, by organization's staff, patients and caregivers. Combine use hand hygiene, barrier precautions, and meticulous cleaning and disinfection with an EPA registered products.	
-	++		
Sepsis of the catheter	Self-administration of the parenteral treatment	Patients that self-administer the treatments should be selected and trained appropriately, insisting on the hygiene measures and on how to handle the venous catheter.	The paper does not focus on our research question but identifies one risk for the CRBSI
-	+++	+++	
no info	IV catheter: - patients characteristic or medical history (younger age, underlying disease, bone marrow transplant, receiving TPN treatment, infusion therapy outside home, HPN < 5 years, family member with HPN) - catheter related factors (multilumen catheter, central venous access salvage) - patient's social or economic factors (being part time student, recipient of social welfare) Catheter related UTI: being a woman, catheter change interval < 4 weeks, number of nurses change catheters Ventilator associated pneumonia: daily duration of ventilation Non-specific infections: indwelling devices, service offered by agency which offers paid sick leave to the staff	- Identify HHC patients who are at high risk for infection - Give special attention to L47 patients receiving PN because they experience the higher rates of infections - 1-size-fits-all approach is not appropriate in infection control for HHC settings - Assess home environment during 1st home visit - Tailored education for the patient and caregivers - Facilitate efficient and effective communication between the different actors in the transition between home care, hospitals and long term facilities.	-The identified risk factors are limited by small sample size and other methodological flaws (no meta-analysis was possible) - There is a substantial variability in term of defining and measuring infections across the studies - There are different healthcare systems across countries but the risk factors and control measures remain similar for all
-	+++	+++	
Definition was given for AE: The AE occurred during the index admission, that is, within 90 days after admission in home healthcare, regardless of caregiver. I think the HAI in HHC was defined as the HAI in hospital but there is no clear definition.	no info	The study found that 64% of HAI were preventable, meaning that they could have been prevented if adequate measures and/ or actions had been taken during the patient's contact with healthcare. This definition is based on the terminology in the Swedish Patient Safety Act.	
+	-	+	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
22	Keller, 2018	Comment	Expert overview	USA	NA	Needs and requirements for reporting CLABSIs in home infusion therapy	CLABSI
		Score	+	+			+++
23	Manangan, 2002	Comment	Expert overview	USA	NA	Feasibility of National surveillance of HAIs in home care setting	NA
		Score	+	+			
24	Masotti, 2010	Comment	Scoping review	Canada	all age groups	To map the extent and range of existing research on the AE of home care. Six topics: definitions, rates, causes, consequences, interventions and policy	CLABSI CAUTI Ventilator associated infections Wound infections (also others)
		Score	+++	+	+++		
25	McGoldrick, 2007	Comment	Expert essay	USA	NA	To discuss Guideline's recommendations implementation on the management of MDRO in home setting	NA
		Score	+	+	-		
26	Miliani, 2015	Comment	Point prevalence study	France	all age groups	To describe the major characteristics of HAIs and antibiotic consumption in HBHC and to identify risk factors associated with HBHC-associated infections	different HAI
		Score	+++	++	+++		+++

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Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
Mentions the APIC definition as the reference, but argues that a denominator definition is missing and therefore the measurement is not possible for benchmarking	no info	Reports that the 21st Century Cures Act in the US will expand Medicare coverage for home infusion therapy services by 2021 and that this act will likely lead to increased pressure for home infusion therapy CLABSI surveillance	No great evidence on the topic but good argumentations for the need of a standardized surveillance system in home care
+	-	+	
Agrees with APIC definitions draft (Embry 2000)	no info	Lists the challenges in having the surveillance system and its usefulness in understanding the epidemiology of HAI in HHC and provide mean for M&E of interventions	Interesting paper, even though a little bit outdated, the issues remain the same
+	-	+	
Definition of AE: events or occurrences which become apparent during the delivery of home care services, and which have a negative impact on patient care, patient outcomes, family or support care and resources utilization	Patient-level characteristics: increased age and co-morbidities, gender, depression, cognitive impairments, functional status/limitations, patient compliance and living alone or no caregiver Organization and system-level characteristics: communication, coordination, collaboration, team experience, training or knowledge, team workload, medication errors, unrecognized polypharmacy, drug label instructions, and inadequate patient monitoring/assessment	- Have more research for home care AE - The rates are most probably underestimated, considered higher - Policies that aim at preventing or reducing the impact of adverse events will need to target multilevel changes	The scope of this review is broader than ours, and therefore their outcomes are more. Pay attention when citing and summarising their findings
++	+++	+++	
no info	no info	- Administrative measures (ICP, annual review) - staff education and training - Surveillance system (M&E) - Prevention and control (hand hygiene, SOPs, contact precautions, equipment and supplies, environment)	The lady is an expert in home care and has written different articles on the topic. Very often they are a little bit repetitive
-	-	++	
HBHC-associated infections were those occurring in a patient during the process of care, neither present nor incubating at the time of starting home care (Day 1), for which the signs and symptoms became apparent after Day 2 and were not associated with a previous discharge from an HCF. (HAI defined using ECDC's case defintion)	- Urinary catheter - At least one vascular catheter - A McCabe score 1 or 2	- Start understanding the epidemiology of HAIs in HHC - Programme surveillance initiatives - Train ICP and general HC staff - Raise awareness - Empower patients	- Good paper - First study to provide estimates of HAIs in HHC in EU - Of the total HAIs detected, 1/3 were associated to HHC
+++	+++	+++	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
27	Morrison, 2004	Comment	Expert essay	Canada	NA	To develop a model upon which the resources required to support an effective, integrated infection prevention and control program across the health care continuum could be based	NA
		Score	+	+	-		
28	Moreau, 2002	Comment	Observational study	USA	all age groups	To document the complications associated with CVC use in a home care	CVC
		Score	++	+	+++		
29	Patte, 2005	Comment	Point prevalence study	France	all age groups	To estimate the prevalence of HAIs in the home care setting, to determine potential risk factors for infection, and to increase staff awareness of HAIs	different HAI
		Score	+++	++	+++		
30	Poff, 2014	Comment	Expert essay	USA	NA	To share how one agency built a meaningful IC program.	different HAI
		Score	+	+			
		Score	+	+		+++	

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Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
no info	no info	<p>Critical infection prevention and control in home care:</p> <ul style="list-style-type: none"> <li>- Coordination of care as patients move from institutional to other health care sectors.</li> <li>- Communication: including a centralized database and information system.</li> <li>- Systematic surveillance of infectious diseases using surveillance standards. (Need to develop data collection and program evaluation tools.)</li> <li>- Community consultation.</li> <li>- Outbreak management.</li> <li>- Infection prevention and control education of formal and informal (i.e., family members) caregivers, including development of resource material. Orientation and continuing education of staff.</li> <li>- Marketing of basic infection prevention and control measures e.g., handwashing.</li> </ul>	Expert advice before regarding the restructuring of infection prevention services in Canada
-	-	++	
Catheter infection was defined as an infectious event involving the intravenous catheter documented through laboratory findings (e.g., positive blood and catheter cultures). It can be either a local site infection or a systemic primary BSI.	Identified as more common characteristic but there is no statistical test, so we cannot consider the results as strong evidence	Management of catheter complications through early identification, education, prevention, and timely treatment can result in cost containment in hospital and outpatient settings	The paper focuses on more complications, not only infections
+++			
Uses CDC definitions for nosocomial infections (1988)	Multivariable analysis: -Advanced age -HHC >30 days - Low Karnofsky index - Urinary catheter - Skin wound	The authors consider the study as a source of insights that serve as a basis for improving surveillance and prevention	Study conducted only in Paris
++	+++		
Mentions that used APIC accepted definitions	no info	<ul style="list-style-type: none"> <li>- HHC IC program should focus on the patients or services that are of greatest risk for home care</li> <li>- Track infections that are a direct result of care or services provided by home care and/or identify those that could be decreased by interventions under the control of home care staff</li> <li>- track those infections that occur 3 days after hospital discharge and thereby not erroneously identifying them as HAIs</li> <li>- HHC is in need of standardized tracking and benchmarking</li> </ul>	Structures need standardized IC plan in order to be accredited
++	-	++	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
31	Popp, 2006	Comment	Qualitative observational study	Germany	all age groups	To assess the implementation of the IC guidelines in home care	different HAI
		Score	++	++	+++		+++
32	Rinke, 2013	Comment	Telephone survey	USA	children	To investigate HHC agency CLABSI definitions and prevention policies and compare them to the Joint Commission National Patient Safety Goal, the CDC CLABSI prevention recommendations, and a best-practice central line care bundle for inpatients	CLABSI
		Score	++	+	++		+++
33	Szeinbach, 2014	Comment	Retrospective chart review	USA	>18 years	To describe catheter complications and outcomes in patients who received HPN therapy	CLABSI
		Score	++	+	++		+++
34	Saqui, 2007	Comment	Prospective cohort study	Canada	all age groups	To determine the rate and types of bloodstream infections in a Canadian HPN program	CVC
		Score	+++	+	+++		+++
35	Schantz, 2001	Comment	Expert essay	USA	NA	Reports the experience of a big HHC agency in IPC programs and its collaboration with CDC and APIC	CVC, CAUTI
		Score	+	+			
36	Shang, 2018	Comment	Expert essay	USA	NA	Reports the state of art on the agenda for infection prevention and control in HHC	different HAI
		Score	+	+			+++

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Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
no info	Qualified infection control staff is lacking, infection control protocols are lacking or are not adapted, the cooperation with family doctors often is problematic, there are deficits in hand hygiene and great deficits with clothing hygiene and waste disposal.	Suggest improvements for some care tasks, e.g., handling of urinary catheters, infusions and prescription of tracheostomy tubes.	Is an assessment done in the German context which might be similar to the Belgian one
-			
APIC definition	The article does not identify or report risk factors but mentions that in children they are different than in adults	Standardization of an ambulatory CLABSI definition and continued oversight of home health care agency consistency with national recommendations is needed	Interestingly, the paper mentions that some surveyed agencies reported limits in their ability in complying with best IC standards due to insurance companies which limit their policies.
++	+	+++	
CLABSIs were defined as an infection that was documented in the patient charts as a catheter-related infection based on clinical evidence and quantitative blood culture data when appropriate. Secondary BSI attributed to a secondary source were excluded	- Number of days of HPN (for all complications, including CLABSIs)	- Additional research is needed - A heuristic model for risk assessment including educational workshops should be considered to help caregivers and clinicians identify patients that may be more susceptible to catheter complications	
+++	+++	+++	
From CDC: (1) laboratory-confirmed BSI: bacterial or fungal organisms isolated from blood culture, when no apparent infection was occurring at another site; and one of fever (>38 degrees Celsius), chills, or purulent discharge at CVC site; (2) clinical sepsis due to CVC; fever or chills and no or negative blood culture and no apparent infections were occurring at another site; and (3) catheter-related infection, purulent discharge, or erythema (>18 mm) at CVC site or along CVC tunnel site, and no or negative blood culture.	no info	no info	
++	-	-	
Look at full text for details	no info	Development of an IC surveillance system to test definitions, establish infection baselines, and develop tools for home health agencies in order to improve patient outcomes	Private agency who developed definitions before APIC, and collaborated with them in the surveillance draft.
+++	-	+++	
no info, refers to APIC definitions	no info	- Previous estimates of infections in HHC are likely to underestimate the problem - increasing HHC services will require better understanding of the topic - Guidelines are based on experts opinion and less research - Need for better understanding of AMR in HHC	It is an updated state of the art, and has some nice references
-	-		

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
37	Sienkiewics, 2008	Comment	Prospective cohort study	USA	>18 years	To describe the development of a UTI benchmarking project by the Home Care Association of New Jersey for New Jersey's home care agencies.	CAUTI
		Score	+++	+	++		+++
38	Spires, 2018	Comment	Retrospective study	USA	>18 years	To understand the burden of mechanical complications and CLABSI in the outpatients setting and to elucidate their impact on the healthcare system	CLABSI
		Score	++	+	++		+++
39	Dibb, 2017	Comment	Expert essay	UK	NA	Overview of complication in catheterized patients in HPN	CRBSI
		Score	+	++			+++
40	Donaghy, 2014	Comment	Survey on home nurses	France	NA	To identify key areas of concern in home care nursing practice with a view to improving patient safety and infection control practices	different HAI
		Score	++	++			
41	Rhinehart, 2001	Comment	Expert essay	USA	NA	Overview of the state of art at the time and advocacy for surveillance and IPC specific to home care	different HAI
		Score	+	+			+++

## List of annexes

Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
use definition APIC	urinary catheterization	<ul style="list-style-type: none"> <li>- Use standard definitions</li> <li>- Share information between agencies</li> <li>- Breaking old habits is difficult but possible with evidence to support the change in practice</li> <li>- Research for appropriate use of antibiotics for UTIs</li> </ul>	
++	++	+++	
CLABSI defined utilizing the National Healthcare Safety Network (NHSN) definition of CLABSI as described in January 2014 protocols with a modified timeframe shifting the date of the event to be on or after day 3 of discharge to identify events in the outpatient setting	<ul style="list-style-type: none"> <li>- female patients</li> <li>- patients with a CVC with &gt;1 lumen</li> <li>- patients receiving TPN</li> </ul>	<ul style="list-style-type: none"> <li>- emphasize the need for improved formal surveillance mechanisms in outpatients with CVCs</li> <li>- Further study and formal surveillance of patients in the outpatient setting would help elucidate modifiable risk factors for CACs and CLABSIs</li> </ul>	
+++	+++	+++	
Mentions definitions from CDC, IDSA and ESPEN	<ul style="list-style-type: none"> <li>- Catheter related venous thrombosis</li> <li>- having had a CRBSI increases the risk of getting another CRBSI</li> </ul>	<ul style="list-style-type: none"> <li>- The clinical diagnosis (with symptoms) can lead to overestimation of infection and overuse of antibiotics</li> <li>- develop robust catheter care protocols, supported by specialist nurses</li> <li>- training of multidisciplinary teams</li> <li>- proactively search for and treat CRBSI</li> </ul>	
++	++	++	
no info	<ul style="list-style-type: none"> <li>- Compliance with legal requirements for clinical waste management</li> <li>- Availability of personal protective equipment</li> <li>- lack of hospital liaison when the patients are discharged</li> </ul>	<ul style="list-style-type: none"> <li>Act on the areas of main concern for IPC to improve quality and safety of home care nursing: <ul style="list-style-type: none"> <li>- Access to continued professional development</li> <li>- Cost and quality of single use materials</li> <li>- Management of clinical waste</li> <li>- Limited prescribing rights</li> <li>- Poor communication between hospital and home care nurses</li> </ul> </li> </ul>	The article does not involve patients directly but identifies the risk by assessing the procedures followed by the nurses
Proposes definitions, see full text. Written before the APIC definitions <sup>7</sup>	<ul style="list-style-type: none"> <li>- age</li> <li>- chronic illness</li> <li>- immunosuppression</li> </ul>	<ul style="list-style-type: none"> <li>- need for studies to understand the risk factors</li> <li>- to see if the empiric approach is effective</li> <li>- hospital based IPC professionals must support and guide the home care colleagues to develop evidence-based approach</li> </ul>	Assumptions on risk factors, and says that the interventions on the nurse's bag are not needed
+++	+	+++	

Study information							Type of HAI
Nr	First Author, year		Study type	Setting	Population	Aims	
42	Dressen, 2013	Comment	Systematic review	Belgium	>=17 years	To provide an overview of CRI rates, causative pathogens and associated risk factors	CRI
		Score	+++	+++	++		+++
43	Santrapia, 2016	Comment	Retrospective observational study	Italy	>18 years	To evaluate: 1) CVC infection rate and the type of infectious agent determining CRBSI in a patients in HPN 2) predictive risk factor of CVC infection and effectiveness antibiotic therapy	CVC
		Score	++	++	++		

List of annexes

Contents - Findings			Other
Definitions of HAI in HHC	Risk factors of HAI in HHC	Recommendations for prevention and control	Notes
no info, refers to CRI generic guidelines which apply to all settings	Device related: - number of lumens - type of vein cannulated - infusion ports more than tunnelled external catheters - PICCs more than other centrally placed venous access devices - locking with heparine as with normal saline with ethanol - locking with taurolidine is protective -Education related: - training of patients Follow-up factors: - being close to a HPN centre - higher number of dependants - if family member takes care Patient related: - underlying disease Time related: - more than 7 days HPN	- Use standard definitions - training of patients - use tunnelled external catheters - lock with taurolidine instead of heparin - standardise the definitions - register the infections properly	Low quality of evidence
-	+++	+++	
ESPEN and IDSA guidelines: CRBSI is defined as isolation of the same microorganism from semi-quantitative or quantitative cultures of both blood drawn from the catheter lumen and the blood peripherally drawn of the patient with clinical symptoms of a bloodstream infection and no other apparent source of infection.	- Previous catheterization - presence of an enterocutaneous stoma	no info	
++	+++	-	



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