



# Single dose activated charcoal for gut decontamination: Application by medical non-professionals -a prospective study on availability and practicability

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## ABSTRACT

**Context:** Oral activated charcoal (AC) for toxin absorption should be applied as soon as possible. Extra-hospital AC-application on site by medical laypersons with pre-emptive obtained AC may save time, but may be inferior to AC-application by medical professionals.

**Objective:** 1) Availability and incidence of pre-emptive stockpiling of AC on site in the German region Bavaria 2) time saved by AC-stockpiling and application on site, 3) quality of AC-application defined by completeness of the applied AC-dose, time needed, incidence of side-effects in lay-care and in professional-care, considering confounding variables: AC-formulation/powder/tablets, recommended AC-dose, patient's age.

**Method:** telephone-interviews in cases with AC-recommendation by a Poison Information Centre (PIC). Lay-care was suggested according to risk-assessment by PIC. Ingestion sites were classified as either apt for AC-stockpiling or not apt.

**Results:** 1) availability: In Bavaria only 20%–22% of eligible cases had AC on-hand, 2) time-saving was at least 14 min. 3) Lay-care/professional-care or patient's age had no significant influence on the completeness of the applied AC-dose, which was higher with AC as powder but negatively correlated with the recommended AC-dose. No significant difference was seen with time needed for application and incidence of side-effects.

**Conclusion:** pre-emptive AC-stocking should be encouraged.

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## 1. Introduction

After ingestion of a potentially toxic substance, Single Dose Activated Charcoal (AC) is the most applied decontamination procedure [1]. It is easy to use, inexpensive and safe [2]. With increasing lag-time between toxin-ingestion and AC-application the efficacy of AC to decontaminate declines rapidly [3]. Thus, AC should be applied as soon as possible. Pre- and extra-hospital AC-application may shorten this lag time [4]. This implies AC application by non-

medical persons (=laypersons). In cases where a consulting Poison Information Centre (PIC) sees an indication for AC and estimates toxin and circumstances to allow observation by laypersons instead of treatment by medical professionals, this could additionally save medical resources. In these cases prerequisite for an optimal scenario is provident stockpiling of AC at suitable sites prone for eventual toxin ingestion such as households, nurseries, schools, psychiatric wards. Application of AC by laypersons however may be inferior to application by medical professionals. We studied the local situation in Bavaria in terms of availability of AC, timesaving, feasibility and quality of AC-application by laypersons. With the results of this study the PIC Munich, wants to stimulate health authorities and – insurances to support and propagate precautionary stockpiling of AC at suitable places. Presently there is no policy of health care authorities and insurances policy concerning AC.

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This study is not the first to address this subject; previous studies showed distinct regional differences: In Finland 42% of households had AC at home which shortened the lag-time till AC-application by 18 min compared with application in hospitals [5]. In another study in Kentucky, 10% of households had AC at home. Here, time saving there by AC-application at home was 36 min, including cases, in which AC had to be obtained from elsewhere [6].

Our study prospectively investigated cases in which the PIC recommended AC addressing three questions:

- (1) Availability of AC: In which percentage of cases AC was actually on site, where precautionary AC stockpiling would be reasonable and possible.
- (2) Time saved by AC application in different scenarios:
  - a) AC stored on site, AC applied there,
  - b) AC-application in a pharmacy,
  - c) AC-application on site, however AC had to be obtained from elsewhere,
  - d) AC-application in a medical professional environment e.g. by paramedics or in doctor's office to be compared with
  - e) AC-application in hospital or emergency-room.
- (3) In anticipation of eventual concerns of health care authorities against storage and application of AC by laypersons we studied the "quality" of the application of AC by laypersons and compared it with AC-application by professionals. Since there is no established definition for the quality of AC-application nor studies had yet addressed this subject, we investigated the "quality"
  - a) by the actually applied amount of AC (g/kg) in relation to the recommended dose (g/kg),
  - b) time needed for application
  - c) incidence of unwanted side-effects attributable to AC.

Application by medical professionals was defined as AC-application in hospitals, by paramedics or in a doctor's office; non-professional setting as application by laypersons at home, in pharmacies or other places.

## 2. Method

In this prospective, observational study from February 22, 2013 to July 27, 2014, calls where the Munich PIC recommended AC (over all 46.002 calls in this period, serving a population of approx. 12.000.000), were followed up by telephone after 1 or 2 days with a standardized questionnaire. As a further condition, one of the investigators had to be on duty in the PIC being involved in the first call. Indications for AC were given according to the position papers of EAPCCT and AACT [7]. Treatment in a hospital or emergency room was recommended a) in all cases where the alleged toxin was at worst estimated to be able to cause symptoms necessitating professional medical assistance [8,9], b) in all cases where the toxin was ingested with abusive or self-harming intention; c) in all cases showing symptoms necessitating medical professional assistance. In cases where the alleged toxin was expected to produce only minor symptoms that were considered to be manageable with observation by medical non-professionals (laypersons), this was recommended in addition to single doses oral AC. In cases where AC was not on site, it was recommended to bring the patient to the next facility where AC is available and, if feasible, to apply AC there. In most cases this was a pharmacy. The recommended target dose of AC was 1 g/kg of bodyweight, but at least tenfold the estimated weight of the suspected toxin, the maximum being 50 g. AC doses less than 1 g/kg were advised when the estimated weight of an ingested substance with minor toxicity was smaller than 1 g. In such cases the recommendation was in accordance with

the experimental results showing a sufficient binding with tenfold weight excess of AC over the toxin [10]. Formulation of AC and mode of application were at the discretion of the caller. We only suggested suspending AC in water. No suggestion was made concerning the kind of preparation of AC or a brand-name. However, when a caller asked for advice, the fastest opportunity to obtain AC was recommended regardless of the preparation. When asked for advice how to apply AC, we suggested to mix it with water, approximately 100 ml water per 5 g AC, but no more than 500 ml. When a layperson had called we made sure that the patient was alert and had no increased risk of aspiration and recommended to give the AC-suspension by mouth. For very small children we suggested the use of a baby-bottle. Medical professionals never asked for advice how to apply AC.

Case-relevant items were registered during the first consultation. Sites where the ingestion happened or the patient's whereabouts at time of the call were categorized as sites in our opinion appropriate to store AC (e.g. household, nursery school, school, psychiatric ward, jail) or as not appropriate for AC-stockpiling (e.g. public space, recreational facilities, transport). Ingested substances and circumstances were categorized as a) minor hazardous and to be manageable with AC and observation by laypersons or b) as necessitating AC and evaluation by a physician, or c) as necessitating treatment in hospital or emergency-room. The caller's consent to participate in the study was asked for at the end of the consultation. The quantity of AC applied and time-values were retrospectively estimated by the interview partner (=caller at first encounter). Statistical analysis was performed with SPSS-software Version 23 IBM Corp. Armonk, NY 2014. For parametric values we used the Mann-Whitney-test and for non-parametric data the Chi-square-test. For the AC-application quality parameters we used multiple linear, respectively a binary logistic regression models. A  $p < 0.05$  was considered statistically significant. The study was approved by the local ethic committee.

## 3. Results

### 3.1. Availability of AC for application in non-medical setting

In all, there were 548 cases of AC recommendation. In 361 (=68.5%) cases, the PIC's advice to apply AC was followed. To evaluate the availability of AC on site and time saving by application on site by having AC on-hand, we only evaluated cases, which might have profited from pre-emptive AC-stockpiling. Thus, the evaluation was restricted to cases, which met all following conditions: a) a layperson had called, b) latency ingestion-call was <60 min, c) the alleged toxin and accompanying circumstances allowed an observation by laypersons d) the site of ingestion was considered apt for AC storage. 213 cases met all criteria – see Fig. 1. Among those, 76 received no AC. In 11 cases (=14.5%) the cause for no AC application was non-availability of AC. 137 cases received AC: 14 in hospitals, 10 in pharmacies, 113 at site of ingestion (=“on site”-group), this was the caller's home in 111 cases. Among those 113 “on site” – cases, 30 had AC already stored at site (=“onsite, AC on stock” –group), but in 83 cases AC had to be obtained from elsewhere prior to application on site (=“on site no AC” –group), in 80 cases, this was a pharmacy. As shown in Fig. 1 these 30 cases with AC on site show with an optimistic calculation 22.4% of the sites where toxin ingestions may happen and where pre-emptive AC stockpiling would be advisable, AC was actually on stock. A less optimistic calculation assumes that the 14 cases of AC applications in hospitals were due to non-availability of AC. That would mean that only 20.2% of sites where pre-emptive AC stockpiling would be advisable (i.e. mostly households), AC actually was on site (Table 1).

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